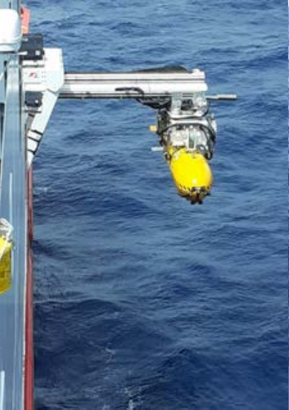
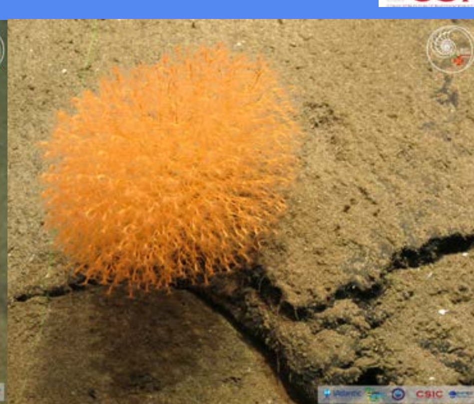


Expedition report iMirabilis2 survey

31st July 2021-30th August 2021

Research Vessel Sarmiento de Gamboa (UTM-CSIC)

Covadonga Orejas, Veerle Huvenne, Andrew K Sweetman, Beatriz Vinha, Joan Carles Abella, Pablo Andrade, Andreia Afonso, Juan Antelo, Richard Austin-Berry, Lino Baltasar, Nadito Barbosa, Kelsey Archer Barnhill, Alejandro Barreiro, Renato Bettencourt, Santiago Blanco, Alex Buigues, Antonio Calado, Iván Casal, Jerónimo de la Torre, Herculano Dinis, Iván Domínguez, Manuel Domínguez, José Ignacio Domínguez, Susan Evans, Danielle de Jonge, Stewart Fairbain, José Ignacio Fernández, Manuel Ferradans, Jacob González-Solís, Andrea Gori, Vikki Gunn, Miguel Hernández, Josep Llobet, Krazimir Medkov, Miguel Menéndez, Roger Mocholi, Ángela Mosquera-Giménez, Iván Mouzo, Eoin O'hobain, Román Palacios, Irene Pérez, Calixto Ponte, Tomás Prego, Jacek Raddatz, Bruno Ramos, J Murray Roberts, Pablo Rodríguez, Daniel Roper, Xoel Salgueiro, Mario Sánchez, Erik Simon-Lledó, Alycia Smith, Miguel Souto, Pedro Vélez-Belchí



iMirabilis2 Leg 1
Expedition Report


www.emepc.pt

Dedicatoria
La expedición iMirabilis2 está dedicada a la memoria de Enrique Orejas Valcárcel, que falleció en Julio de 2020, cuando estábamos en plena preparación de la campaña. Él siempre apoyó con interés y curiosidad el trabajo y los retos que afrontó su hija, especialmente las expediciones oceanográficas. Hubiera estado contento y orgulloso siguiendo esta expedición, como siempre hizo con las anteriores. En esta ocasión él ha estado más presente que en ninguna otra, porque en cada actividad que planificamos pude sentir sus manos y su aliento.
¡Va por ti, papá!

Dedication
The iMirabilis2 expedition is dedicated to the memory of Enrique Orejas Valcárcel, who passed away in July 2020, when we were preparing the expedition. He always supported with interest and curiosity the work and challenges his daughter took, specially the expeditions at Sea. He would be happy and proud following this expedition, as he always did with previous ones. In this occasion he was probably more present than in any other, as in any action planned I have been feeling his hands, and his inspiration.
¡Va por ti, papá!

Expedition report iMirabilis2 survey. Leg 1

31 st July 2021 - 30th August 2021

Research Vessel Sarmiento de Gamboa
(UTM-CSIC)

Chief Scientist: Covadonga Orejas Saco del Valle (Instituto Español de Oceanografía)
Co-chief scientists: Veerle AI Huvenne (National Oceanographic Centre), Andrew K Sweetman (Heriot Watt University)

Recommended citation: Covadonga Orejas, Veerle AI Huvenne, Andrew K Sweetman, Beatriz Vinha, Joan Carles Abella, Pablo Andrade, Andreia Afonso, Juan Antelo, Richard Austin-Berry, Lino Baltasar, Nadito Barbosa, Kelsey Archer Barnhill, Alejandro Barreiro, Renato Bettencourt, Santiago Blanco, Alejandro Buigues, Antonio Calado, Iván Casal, Jerónimo de la Torre, Herculano Dinis, Iván Domínguez, Manuel Domínguez, José Ignacio Domínguez, Susan Evans, Danielle de Jonge, Stewart Fairbain, José Ignacio Fernández, Manuel Ferradans, Jacob González-Solís, Andrea Gori, Vikki Gunn, Miguel Hernández, Josep Llobet, Krazimir Medkov, Miguel Menéndez, Roger Mocholi, Ángela Mosquera, Iván Mouzo, Eoin O'hobain, Román Palacios, Irene Pérez, Calixto Ponte, Tomás Prego, Jacek Raddatz, Bruno Ramos, J Murray Roberts, Pablo Rodríguez, Daniel Roper, Xoel Salgueiro, Mario Sánchez, Erik Simon-Lledó, Alycia Smith, Miguel Souto, Pedro Vélez-Belchí (2022) Expedition report iMirabilis2 survey Leg 1. iAtlantic Project H2020. 337 pp

Contents iMirabilis2 Leg 1 expedition report

1 Executive summary / Resumen ejecutivo (C. Orejas)

English

The iMirabilis2 expedition was conducted from the 23rd to the 30th of July 2021 (Leg 0, Vigo-Las Palmas de Gran Canaria) and from the 31st of July to the 30th of August 2021 (Leg 1, Las Palmas de Gran Canaria- Las Palmas de Gran Canaria). This report includes the activities conducted in Leg 1, as well as two specific activities conducted during Leg 0 and which were part of the iAtlantic project: capacity building in sea bird ecology, and ROV training and outreach.

The expedition iMirabilis2 Leg 1 targeted the study area 6 of the iAtlantic project, which included the Cabo Verde Archipelago. The expedition focused on two main areas: the abysal plains (ca 4,000m depth) off Brava, in the southwestern part of the Archipelago and the bathyal zone off Brava and Fogo (ca. 2500 to 1,400m), specifically the Seamount Cadamosto and the south-west slopes of the Islands of Fogo and Brava. The deep-sea realm of Cabo Verde is fairly unknown and this expedition was the first one focusing on the biology and ecology of the deep-sea benthic ecosystems off Cabo Verde. Previous deep-sea expeditions conducted by the research Institute GEOMAR (Kiel, Germany) were more focused on the geology and vulcanology of the area (with some benthic studies associated) as well as in the pelagic realm.

The main aim of iMirabilis2 was to gain knowledge on the deep-sea benthic ecosystems of the area with a multidisciplinary approach. The objectives of the cruise covered the characterization and mapping of the deep-sea epi-megabenthic communities, the investigation of the functional ecology of the fauna inhabiting the sediments of the abysal plains *in situ* as well *ex situ*, the study of the trophic web of the epi-megabenthic communities of the bathyal areas, the analysis of the environmental DNA (eDNA), paleoceanographic studies on foraminiferans as well as on scleractinian corals, and the oceanographic characterization of the area.

The activities conducted on the abysal plains focused on the deployment of three different types of lander equipment: a respirometer lander, a baited camera and a baited trap, as well as on the Autosub6000 AUV missions, including the eDNA sampling; whereas in the bathyal environment of Cadamosto Seamount as well as the slopes of Fogo and Brava, ROV dives wer conducted, as well as some plankton nets. In both areas CTD-Rosette cast were conducted as well as Multicorer and/or box corer sampling. Multibeam bathymetry data were also acquired around Brava and Fogo as well as in the abysal plains, and a subottom profiler survey was conducted to look for suitable places to perform Multicorer deployments to obtain sediment cores for experimental work on board.

The unique characteristics of this expedition with a wide range of equipment with specific requirements in terms of deployment time, forced us to follow a irregular routine, as can be seen in the main station list included in this report. A total of ca. 400 hours of operations have been conducted including: ca. 50 hours multibeam survey and ca. 5 hours subbottom profiler, 7 Autosub6000 missions (2 of them with results), 12 ROV dives (2 of them aborted), 22 CTD-Rosette casts, 9 Multicorer, 8 Box corer, 5 plankton nets, 8 baited camera, 5 respirometer and 3 baited trap deployments during the Leg 1 of iMirabilis2.

In the following pages the activites conducted on board as well as the preliminary results of iMirabilis2 are presented.

Spanish

La expedición iMirabilis2 tuvo lugar del 23 al 30 de julio de 2021 (Leg 0, Vigo-Las Palmas de Gran Canaria) y del 31 de julio al 30 de Agosto de 2021 (Leg 1, Las Palmas de Gran Canaria- Las Palmas de Gran Canaria). Este informe incluye las actividades realizadas en el Leg 1 y dos actividades concretas realizadas en el Leg 0 que formaban parte del Proyecto iAtlantic: las actividades de capacitación en ecología de aves marinas y en el trabajo con ROvs y las de divulgación para jóvenes investigadores y gran público.

La expedicion iMirabilis2 Leg 1 se centró en la zona de estudio 6 del proyecto iAtlantic, la cual engloba el archipiélago de Cabo Verde. La expedición se centró en dos áreas principales: las llanuras abisales (ca. 4,000 me de profundidad) en zonas de mar abierto cercanas a la isla de Brava, y en zonas localizadas en el suroeste del archipiélago cubriendo la zona batial (ca 2500 hasta los 1400 m) cercana a Brava y Fogo, en concreto la montaña submarina de Cadamosto y los taludes de Brava y Fogo. El mar profundo de Cabo Verde ha sido poco estudiado, iMirabilis2 es la primera expedición que se ha centrado en el estudio de la biología y ecología de la megafauna epibentónica del mar profundo de Cabo Verde. Expediciones previas realizadas por el instituto de investigación GEOMAR (Kiel, Alemania) se centraron en el estudio de la geología y vulcanología (con estudios de bentos asociados), así como en el medio pelágico.

La expedición iMirabilis2 tuvo como objetivo principal ampliar el conocimiento de los ecosistemas bentónicos profundos con un enfoque multidiciplinar, dado que los objetivos específicos de la expedición cubrían la caracterización y cartografiado de las comunidades megabentónicas profundas, la investigación de la ecología funcional de las comunidades bentónicas de los fondos sedimentarios tanto in situ como ex situ, el estudio de la red trófica de las comunidades megabentónicas del batial, el análisis del ADN ambiental, estudios paeloceanográficos con foraminíferos y escleractinias y la caracterización oceanográfica de la zona.

Las actividades realizadas en las llanuras abisales se centraron en el fondeo de tres tipos diferentes de “landers”: respirómetro, cámara con cebo, trampa con cebo, así como las misiones con el AUV Autosub6000 que llevaba incorporado el muestreador de eDNA RoCSI; mientras que en las zonas batiales de la montaña submarina de Cadamosto y los taludes de Brava y Fogo se realizaron las inmersiones de ROV, así como muestreos de plankton. En ambas áreas se realizaron muestreos con el CTD-Rosette, Multicorer y/o box corer. Se realizó también batimetría multihaz en torno a la isla de Brava y Fogo así como en las llanuras abisales, y se llevó a cabo un línea con el “subbottom profiler” con el fin de localizar zonas adecuadas para realizar muestreos con el multicorer para la obtención de cores de sedimento para la realización de experimentos a bordo.

Las característcias únicas de esta expedición con equipos que tenían requerimientos específicos en cuanto al tiempo de fondeo, nos obligaron a planificar las actividades día a día sin una rutina definida para toda la expedición, como puede verse en la lista de estaciones incluida en este informe. En el Leg 1 de iMirabilis2 se realizó un total de aproximadamente 400 horas de operaciones, incluyendo:˜ 50 horas de cartografiado con multihaz,˜ 5 horas de subbottom profiler, 7 misiones con el Autosub6000 (2 de ellas con resultados, el resto bien abortadas bien sin resultados por diversos fallos técnicos), 12 inmersiones de ROV (2 de ellas abortadas), 22 estaciones de CTD-Rosette, 9 Multicorer, 8 Box corer, 5 redes de plankton, 8 cámara lander con cebo, 5 lander respirómetro y 3 lander trampa con cebo.

En las páginas siguientes se presenta el trabajo realizado a bordo de la expedición iMirabilis2 así como los resultados preliminares de la misma.

2 Introduction and main aims of iMirabilis2 (C. Orejas & scientific party)

Named after the long-lived *Welwitschia mirabilis* plant of western Africa, the iMirabilis2 expedition was planned as one of the flagship "Demonstrator Capacity Building expeditions" of the iAtlantic project. The expedition took place on the Spanish Research Vessel *Sarmiento de Gamboa* (SdG) (http://www.utm.csic.es/sarmiento_car.asp) from the 31st of July to the 30th of August 2021. The expedition track and start and end port and dates are displayed in figure 2.1 and table 2.1.

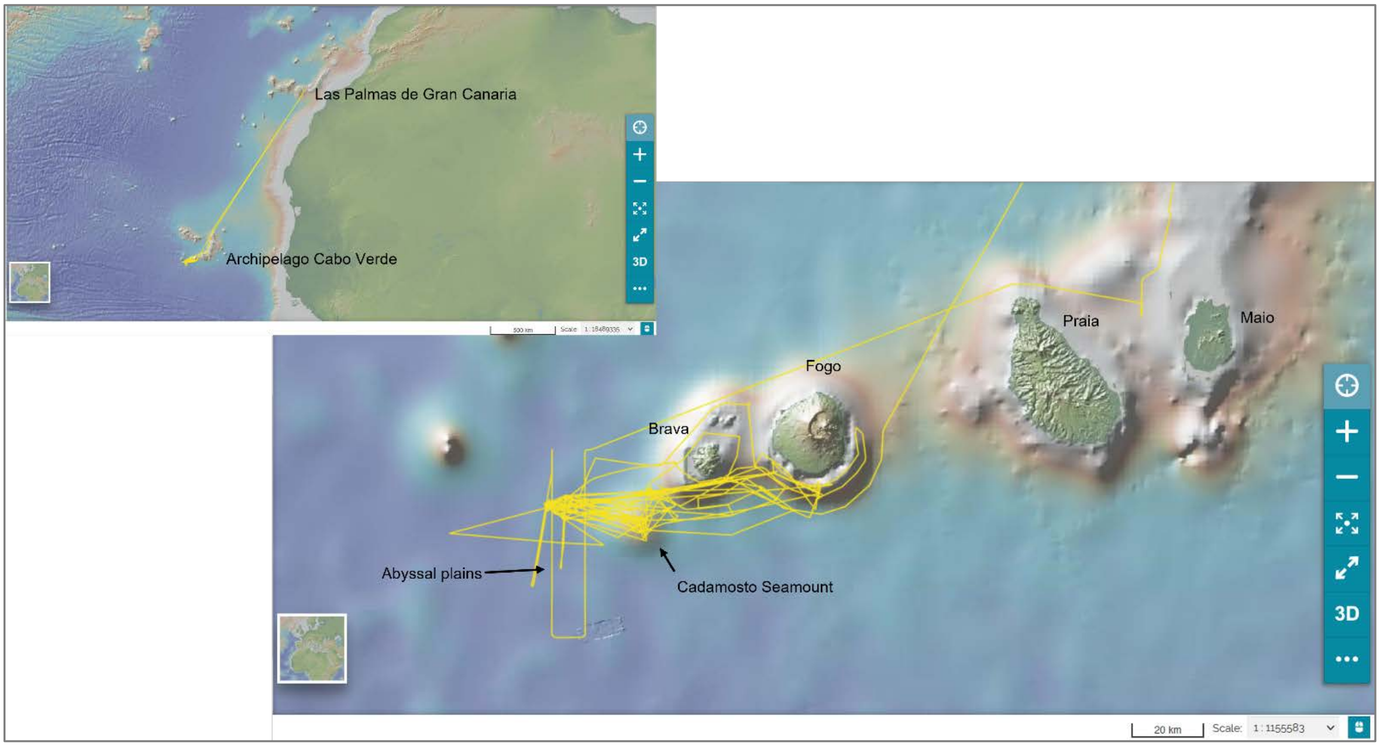


Figure 2.1 iMirabilis2 Leg 1 Expedition track. Above: overview of the navigation from Las Palmas to the Archipelago of Cabo Verde. Below: detail of the vessel track during the iMirabilis2 expedition. Map with the detail of the sampling events in the area is included at the end of the document (section 10.1).

Table 2.1 Main dates iMirabilis2 Leg 0 and Leg 1

Harbour/Working area	Departure	Arrival	Stay in harbour
Vigo harbour	23/07/2021		16-23/07/2021
Transit Vigo-Las Palmas / EMPEC work (Leg 0)	23/07/2021	29/07/2021	
Las Palmas harbour		30/07/2021	31/07/2021
Las Palmas-Las Palmas (Leg 1)	31/07/2021	30/08/2021	
Transit Las Palmas-Vigo	31/08/2021	04/09/2021	
Vigo harbour	04/09/2021		

The expedition was originally planned to cover the areas 6 (Cabo Verde) and 9 (Walvis Ridge and S African margin) of iAtlantic, unfortunately the covid 19 situation obligated to cancel the expedition last year and the new schedule did not allowed to travel to Namibia and South Africa, therefore, only area 6 has been covered during iMirabilis2. The ship travelled from Vigo to Las Palmas de Gran Canaria (Spain) where the expedition started. After completing the Leg 0 (working in areas between Vigo and Las

Palmas), the Sarmiento de Gamboa (Fig. 2.2) moved to Cabo Verde where the Leg 1 took place, and after working in Cabo Verde waters, the ship moved back to Las Palmas where the expedition finished. Demobilization of large equipment and gear took place in Vigo.
iMirabilis2 was an international multidisciplinary expedition with activities contributing to many tasks across iAtlantic's workpackages. At sea activities included the study of both the water column (e.g. measuring oceanographic parameters, water and plankton sampling) and the seafloor. iMirabilis2 mobilised state-of-the-art seabed survey equipment including the Autonomous Underwater Vehicle (AUV) Autosub6000 (https://noc.ac.uk/facilities/marine-autonomous-robotic-systems/autosubs) and the Remotely Operated Vehicle (ROV) Luso (EMEPC, https://www.emepc.pt/rov-luso?lang=en). This advanced technology allowed iAtlantic to explore benthic ecosystems in great detail producing high-resolution photographic results.

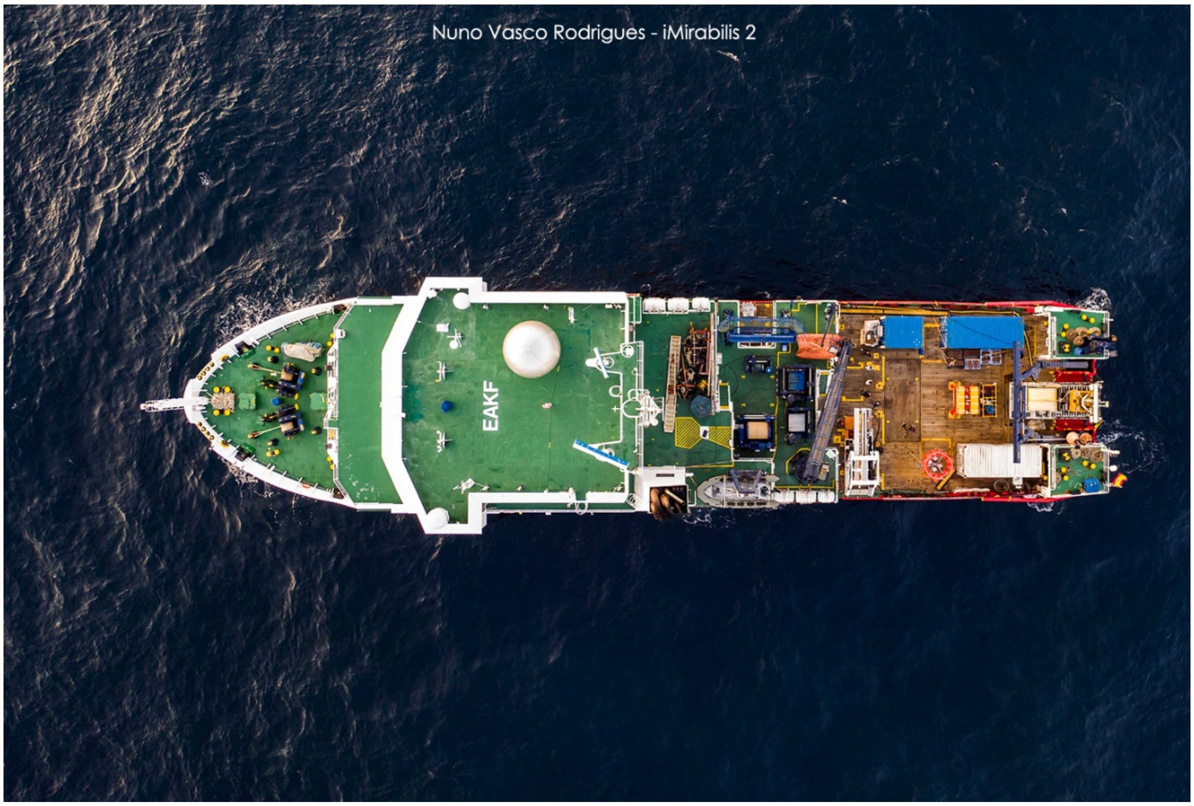


Figure 2.2 The research vessel Sarmiento de Gamboa (Image: Nuno Rodrigues)

The results of these surveys will be used to produce habitat maps off Cabo Verde from which scarce information is currently available. Moreover, the ROV Luso has allowed the collection of selected specimens for taxonomic purposes and for dating. Furthermore, new technologies have been tested during iMirabilis2 including the eDNA sampler 'RoCSI', recently developed by researchers from the National Oceanography Centre (NOC, UK). Seabed landers have also being deployed during iMirabilis2 to obtain *in situ* information on environmental parameters and demersal deep-sea fish fauna. *Ex situ* experimental work was conducted on the ship, including short-term incubations of sediment cores, collected by multicore.
Beyond the pure research activities, iMirabilis2 included detailed training and capacity building components, for instance, researchers from Cabo Verde joined the expedition during the transit from Vigo to Las Palmas (Leg0) to be trained in seabird identification and seabird census techniques.

Furthermore, outreach activities were conducted during the Leg 0 and 1 as an expedition member (K.A. Barnhill) was fully dedicated to these activities.

Expedition aims

In the following paragraphs the expedition aims are presented in relation to the iAtlantic WPs from which work has been directly related to the expedition. In addition, during the processing of samples and data from the expedition, further results may be generated which will contribute to other WP aims. The information contained here complemented the document generated before the expedition: “iMirabilis2_Science Plan” (doi 10.5281/zenodo.5793010).

WP1

Activities conducted during iMirabilis2 responded to the different aims of WP1:
Objetive 1. Characterize the environmental conditions and determine the water mass distribution in the areas of the Cabo Verde archipelago sampled.
Objective 2: Determine drivers and explain spatio/temporal patterns of physical change and variability in ecosystem-relevant parameters.
Tasks:
Task 1.1 - Carry out a set of hydrographic station using a CTD with fluorometer and oxygen sensors.
Task 1.2 - Acquisition of VADCP measurements between the CTD stations.
Task 1.5 - Conduct genomic analyses. iMirabilis2 will gather VME indicator species with wide Atlantic distribution for gene flow estimation in WP1.

WP2

Activities conducted during iMirabilis2 responded to the different aims of WP2:
Objective 1: Evaluate and expand current knowledge on ecosystem distribution and the physical environment across the Atlantic.
Objective 2: Describe the 3D structure of key ecosystems at regional and local scale.
Objective 3: Identify the main environmental drivers behind ecosystem spatial patterns.
Objective 4: Identify and apply the optimal technological developments that enable the above activities.
Tasks:
Task 2.1 - Bathymetry data collection and analysis. Habitat mapping at regional and local scale habitat maps.
Tasks 2.2 and Task 2.3 - Habitat mapping work at multiple scales, in particular also the local scale (areas of 1-10km2, sub-metre pixel sizes).
Task 2.4.1 - Demonstration of the RoCSI eDNA sampler.
Task 2.4.2 - Machine Learning techniques for automated analysis of large photographic datasets.
Task 2.5 - Analysis of spatial patterns in ecosystem drivers.

WP3

Activities conducted during iMirabilis2 responded to the different aims of WP3:
Objective 1: Quantify the single and cumulative effects of oceanographic variability (and where relevant any anthropogenic pressures) on key ecosystem compartments.
Objective 2: Test the nature of ecosystem changes for gradual shifts, generic and system-specific thresholds Palaeoceanography including studies based on foraminifera. UCL and IEO team.
Tasks:
Task 3.1 - Create an inventory of inter-annual to multidecadal data.
Task 3.3 - Analyse and report on drivers of ecosystem change and tipping points over centennial to millennial timescales. Contribute with specimens collection and sediment samples.

WP4

Activities conducted during iMirabilis2 responded to the different aims of WP4:
Objective 1: Gain knowledge on the baseline functioning of deep-sea pelagic and benthic ecosystems.
Objective 2: Assess the effects of different environmental stressors on deep-sea pelagic and benthic ecosystem functioning and integrity.
Objective 4: Identify tipping points for deep-sea ecosystems in the Atlantic Ocean.

Tasks:

Task 4.2 - Compare natural spatial gradients in deep pelagic and benthic ecosystem functioning.
Task 4.3 - Conduct ex situ single and multiple stressor experiments on hard-bottom VME species.
Task 4.4 - Conduct ex situ single and multiple stressor experiments on soft-sediment ecosystems.

WP5

Activities conducted during iMirabilis2 responded to the different aims of WP5:
Objective 1: Compile spatial and temporal information to produce a series of outputs illustrating the current and future projected changes in status of Atlantic ecosystems throughout the Atlantic.
Objective 2: Apply site prioritisation techniques to identify zones where different management regimes can be applied.
Objective 3: Generate planning scenarios to inform marine spatial planning and sustainable development in the Atlantic. Task 5.2 Development of iAtlantic advanced web-based GIS-tools.

Tasks:

Task 5.1 Compilation of regions of interest maps from existing data sources.
Task 5.2 Development of iAtlantic advanced web-based GIS-tools.
Task 5.3 Regional prioritisation and scenario development.
Task 5.4 Evaluation of sustainable management planning scenarios.

WP6

Activities conducted during iMirabilis2 responded to the different aims of WP6:
Objective 1: Achieve high levels of awareness of iAtlantic activities and results across a wide variety of audiences, from the public high-level policy for a.
Objective 3: Build and enhance capacity in the relevant scientific, technological and policy-oriented skills and enable transfer of knowledge throughout the Atlantic.

Tasks:

Task 6.3 Outreach and dissemination.
Task 6.5 Capacity building. Several training activities were conducted on board in collaboration with several teams.

3 Expedition participants, teams on board and institutions (C. Orejas)

In the following tables the participants of the expedition are listed. The first table (Table 3.1) covers the scientific party whereas the second one (Table 3.2) relates to the crew.

Table 3.1 Scientific party of the Leg 1 of iMirabilis2 Las Palmas-Las Palmas (31.07-30.08.2021)

	Expertise	Name	Email	Institution
1	Benthos ecologist Cruise leader	Covadonga Orejas	cova.orejas@ieo.es	IEO
2	Ecologist Co-cruise leader	Andrew Sweetman	a.sweetman@hw.ac.uk	HWU
3	Habitat mapping	Veerle Huvenne	vaih@noc.ac.uk	NOC

	Co-cruise leader			
4	UTM technicians – IT	Roger Mocholi	rmocholi@utm.csic.es	UTM-CSIC
5	UTM technicians -CTD	Iván Mouzo	imouzo@utm.csic.es	UTM-CSIC
6	UTM technicians – MB	Pablo Rodriguez	pablo@utm.csic.es	UTM-CSIC
7	UTM technicians – Grabs	Iván Casal	icasal@utm.csic.es	UTM-CSIC
8	UTM technicians - Grabs	Mario Sánchez	msanchez@utm.csic.es	UTM-CSIC
9	ROV Luso technicians-Team Responsible	António Calado	apgcalado@emepc-portugal.org	EMEPC
10	ROV Luso technicians	Andreia Afonso	aafonso@emepc-portugal.org	EMEPC
11	ROV Luso technicians	Miguel Souto	msouto@emepc-portugal.org	EMEPC
12	ROV Luso technicians	Bruno Ramos	bramos@emepc-portugal.org	EMEPC
13	ROV Luso technicians	Renato Bettencourt	renato.pm.bettencourt@uac.pt	IMAR
14	Autosub6000	Daniel Roper	daniel.roper@noc.ac.uk	NOC
15	Autosub6000	Richard Austin Berry	richard.austin-berry@noc.ac.uk	NOC
16	Autosub6000	Eoin O'Hobain	eoin.o.hobain@noc.ac.uk	NOC
17	Autosub6000	Stewart Fairbairn	Stewart.fairbairn@noc.ac.uk	NOC
18	Landers	Danielle de Jonge	dsd3@hw.ac.uk	HWU
19	Landers	Alycia Smith	ajs2000@hw.ac.uk	HWU
20	Benthic biology/ROV	Murray Roberts	murray.roberts@ed.ac.uk	UEDIN
21	Benthic biology/ROV	Andrea Gori	gori@ub.edu	UB
22	Benthic biology/ROV	Beatriz Vinha **	beatrizvinha95@gmail.com	U Salento/IEO/NOC
23	Habitat mapping/benthic biology	Erik Lledó	erimon@noc.ac.uk	NOC
24	eDNA sampling	Susan Evans	susan.evans@noc.ac.uk	NOC
25	Outreach/Capacity building/benthic biology/ROV	Kelsey Archer Barnhill **	kelsey.barnhill@ed.ac.uk	UEDIN
26	Oceanography	Angela Mosquera	angela.mosquera@ieo.es	IEO
27	Seabird ecology trainer	Herculano de Andrade Dinis *	projectovito.director@gmail.com	Projeto Vitó
28	Seabird ecology trainee	Nadito Jesus Pina Barbosa *	naditojesuspinabarbosa@gmail.com	Projeto Vitó
29	Seabird ecology trainee	Joan Carles Abella *	otusco@gmail.com	Independent researcher

* These researches were involved in the Leg 0 of iMirabilis2 as trainees and trainer

** These researches were involved in the Leg 0 and 1 of iMirabilis2 as trainees and trainer

Table 3.2 Crew of the Research Vessel Sarmiento de Gamboa of the Leg o and 1 of iMirabilis2 Las Palmas-Las Palmas (31.07-30.08.2021)

	Family name	Surname	Charge
1	Menéndez Pardiñas	Miguel	Capitán
2	Ponte Bermúdez	Calixto	Jefe Máq.
3	Andrade Pereira	Pablo	1º Oficial
4	Llobet Peinador	Josep	1º of. Máq.
5	Blanco Bao	Santiago	2º Oficial
6	Antelo Martínez	Juan	1º Cocinero
7	Domínguez Bouzada	José Ignacio	Contramaestre
8	Fernández de Lera	José Ignacio	E.T.O.
9	Nedkov Makaveeva	Krazimir	Ayt. De cocina
10	Domínguez Pouso	Iván	Marinero
11	Domínguez Varo	Manuel	Marinero
12	Baltasar Torres	José Lino	Marinero
13	De La Torre Cantero	Manuel Jerónimo	Marinero
14	Barreiro Pereira	Alejandro	Engrasador
15	Palacios Vacas	Román M.	Engrasador

16	Prego Castro	Manuel Tomás	Engrasador
17	Ferradáns Blanco	Manuel	Alumno Puente
18	Buigues Diego	Alejandro	Alumno Puente
19	Salgueiro McCormack	Xoel	Alumno Puente

4 Narrative of the cruise (C. Orejas, V. Huvenne)

The iMirabilis2 Leg 1 expedition started for the science party on the 20th of July. Although the work at sea started the 30th of July, before this, 10 days of quarantine in a hotel in Las Palmas contributed to generate a bond for our team of scientists and technicians, waiting for our real "get together" on board. In the meantime we met "personally" two times for the event of the quarantine: the PCR and serologic tests to assure we start the expedition as a "bubble group" of scientists, technicians and crew, free of covid 19, but as illustrated in Fig. 4.1 we also met virtually sometimes, one of them even playing a quiz organised by Veerle! Before Leg 1, Leg 0, which took place from 23rd to 30th July 2021, included some important contributions to iAtlantic: e.g. the capacity building training for seabird ecologists and ROV trainees.

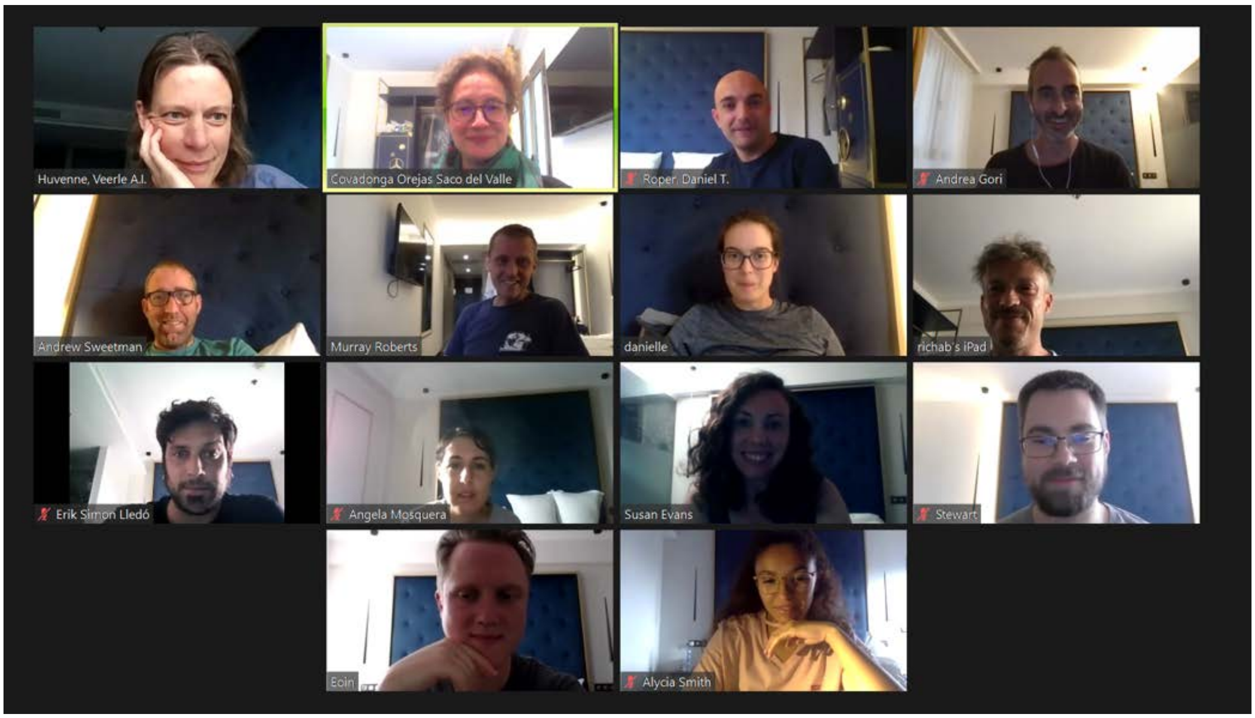


Figure 4.1 one of the online meetings from part of the iMirabilis2 scientific team during the quarantine in Las Palmas.

The **31st of July** we got on board the Spanish Research Vessel (RV) Sarmiento de Gamboa (CSIC). At 15:00 we set sail from Las Palmas harbour to start our path to the Cabo Verde Archipelago (Fig.2.1). The start of the expedition was tough as the Sea was brave and "Sarmiento" was moving quite a lot, this was the first hard test for our team, especially for those with less seagoing experience. However, almost everyone passed well the experience! The atmosphere on board was from the beginning fantastic, the connection scientists-technicians-crew was from the very start of the expedition very good and, a very important thing on vessels: the food prepared by our cook, Juan, and his assistant, Krazi, excellent. All this made a fantastic basis for the start of the expedition! The first day was dedicated mostly to setting up the labs, distributing our materials and tools in drawers and cupboards, organising stuff, allocating spaces for the different teams and in general to organise ourselves. The first day several presentations

were offered by the crew, specifically Pablo, the first officer and Alex, one of the three bridge cadets, in order to show the basic rules for the life and work on board. Safety training was also conducted. We had four days of transit to Cabo Verde and in order to take the maximum profit of this time, we, the scientific team, also programmed a series of talks so that everyone could present the work to be conducted on board as well as some basic background of our research area: the deep sea off Cabo Verde. This day we also organised our general routine for the expedition. From one side a daily briefing on the bridge for the officers, other crew members, chief scientists and team responsible at 09:00 to discuss the meteorological conditions and operations to conduct; from the other side a short daily meeting between scientists and technicians at 13:30, just before lunch to comment on the work conducted, the work to be conducted and any aspects and highlights as well as domestic issues people would like to comment and discuss.
The **1st of August** we had our first briefing on the bridge, where the responsible from UTM (Pablo), the responsible of each large equipment: Dan-AUV, Antonio-ROV and Andrew-Landers, as well as the expedition leader: Cova, and co-leaders: Veerle and Andrew, met. In this very first meeting the work and operations planned were discussed with the captain, Miguel, as well as the officers, Pablo and Santi, and the boatswain, Nacho. Frequently Alex, Xoel and Manu, the three "Bridge cadets" were also present in those meetings. During the meeting also the formal protocols to follow in the meetings were set out ("toolbox talk" and "minutes"). During this second day of transit to Cabo Verde, several activities were conducted on board, as for instance the preparation of the aquaria by Murray, Kelsey and Andrea in the thermoregulated room, aiming to conduct some feeding experiments with the cold-water corals we aimed to collect in the deep sea off Cabo Verde. Laboratories were already organised and equipped. Beside all this organisation, aside meetings taking place, in this day chief scientist Cova and co-chief Veerle met the ROV team: Antonio, Andreia, Bruno, Renato and Miguel, to start to discuss the main areas selected for the dives and comment on the preparation of potential dive tracks to be selected based on the available high-definition bathymetry supplied by our colleague Thor Hansteen from GEOMAR. The 1st of August we opened the series of talks we called "Aventuras Atlánticas" (following Murray's suggestion!), the first two were offered by Murray (iAtlantic coordinator) presenting the overarching framework of the project and by Cova who presented the aims and scope of the expedition.
The 2nd of August the transit to the Archipelago of Cabo Verde kept going. In our daily briefing on the bridge, we (scientists and technicians) discussed with the bridge personnel and deck crew this time the manoeuvre to be conducted with the Autosub6000 in detail. After discussing it on the bridge, the crew and scientists went to the deck to discuss all previously discussed aspects while looking at the gear and the situation on deck (Fig. 4.2). This day we continued with the talks within "Aventuras Atlánticas". In this occasion Andrew, Alycia and Danielle (the "lander team") explained the work to be conducted with the landers as well as the incubation of the multicores on board. Further Veerle, Erik and Susan (the "Autosub6000 team") explained the work to be conducted with the Autosub6000.

Figure 4.2 Crew, technicians and scientists discussing on deck the manoeuvres with the Autosub 6000. (Image: Veerle Huvenne)

The 3rd of August, Autosub6000 and lander manoeuvres were further discussed on the bridge and on deck during the briefing at 09:00 and again at 16:00. Andrew and his team prepared the incubators (Fig. 4.3) and all needed materials and equipment to conduct the incubations of sediments as we expected to arrive at our first waypoint at ca 23:00. This day, Veerle, Bea, Andrea and Cova (who were part of the "ROV-team") also discussed the settings to use in the OFOP software in order to do the video annotations live when the ROV dives are taking place. Once arrived on the first sampling station, the sub-bottom profiler was switched on in order to find areas with muddy sediments, suitable for coring for the experiments to be conducted by Andrew and his team. After ca 45 minutes a potentially suitable area was detected and on the **4th of August** the day started with a CTD cast and four multicorer (MUC) deployments, with the manoeuvre conducted by Iván C and Mario with help of the deck crew.
All of the cores were successfully conducted in the area, supplying the needed material for the "climate change experiments" (see sections 6.7 and 7.8) to be conducted on board by Andrew, Danielle and Alycia. The sampling event finished at ca 07:30 and we continued steaming to our main research area: Cadamosto seamount (see Fig. 2.1) and close-by Abyssal Plain (see Fig. 2.1). The transit lasted for ca. 12 hours and at 18:30 the first Multibeam (MB) survey started, with the area already decided by Veerle and Cova and the survey planned by Veerle. The MB gear was operated by Pablo and Veerle and watches were organised with the scientific party; this survey was fundamental to decide the areas where to conduct the Autosub6000 missions.

The MB survey continued through the night and the **5th of August** and after finishing the MB survey a CTD-cast was done in the area. The CTD deployments were conducted by Iván M (always with the help of the crew) and the station planning by Angela, with a previous plan carefully prepared on land by Pedro Vélez (Physical Oceanographer who was not on board but deeply involved in the iMirabilis2 planning) and Angela. After the daily briefing on the bridge, a test with a barrel was conducted in order to practice the manoeuvre to be performed with the Autosub6000. After the test the first lander deployments took place: lander respirometer (LR) and baited camera lander (LC).

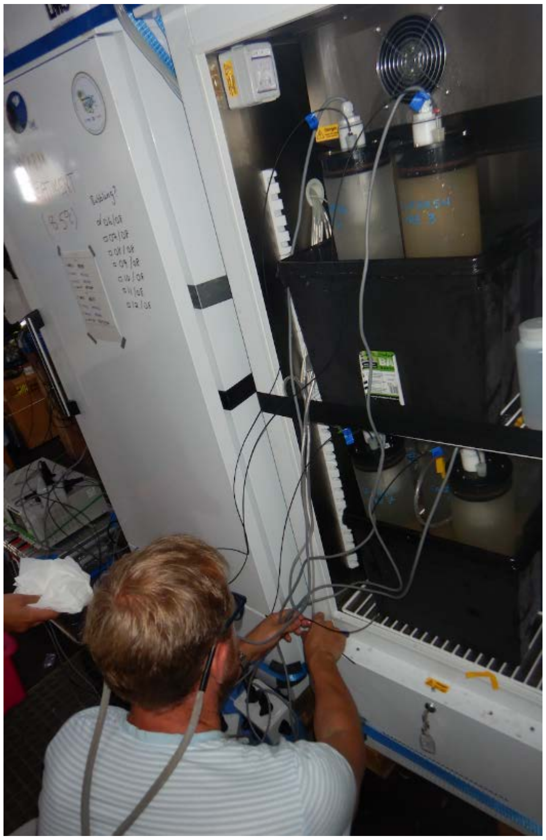


Figure 4.3 Andrew preparing the ex situ experiment with the sediment cores already placed in the incubators. (Image: Danielle de Jonge).

The first one went smooth, the second one was recovered as the weight was not enough and the system did not sink. After adding the needed extra weight, the LC was deployed and "Sarmiento" steamed to the Cadamosto Seamount area. iMirabilis2 was a continuous moving forth and back between the abyssal plain, working at depths of > 4000 m (mostly to deploy the landers and also planned -even if not really successful- to perform the Autosub6000 missions) and the Cadamosto Seamount, at depths of 2500-1500 m (mostly to conduct the ROV dives); in both areas, the so called "Lander area" and the "Seamount", CTD-casts, as well as MUC, Box Corer (BC) and MB survey were conducted. The **6th of August** at 04:30 the vessel was at the first waypoint selected to conduct the first ROV dive on Cadamosto Seamount. The ROV team went to the bridge and observed for a long time the Sea. The wave height and direction, the currents, the wind, and the effect of all these on the behaviour of the vessel. Miguel, Pablo or Santi, depending on the time when the ROV dives were planned, helped Antonio and his team to position the vessel in the most suitable orientation to conduct the ROV dives. This, sometimes long time was by no means "a waste of time", I learned how this detailed observation over the time allowed to properly decide when to perform a dive and how. Once the Luso team decided to dive, the missions were successful! For this first dive, the weather conditions (too much NE wind) did not allow to work at the Seamount therefore we decided to move to the Island of Fogo looking for the protection of the shadow of the Island. The ROV went down for meters and meters… > 2000 indeed, and everyone in the ROV container as well as in the lab was excited about the discoveries to do…this was an "exploration expedition" and therefore new seascapes, never seen by human eyes, were discovered! Renato and I were especially excited about the second when the ROV reached the seafloor….which mysteries will be there waiting for us….This first dive in the unknown depths of Fogo revealed a fantastic seascape, with pillow lavas and impressive volcanic rocks, with high diversity of gorgonians although with low densities. *Metallogorgia* sp. and gorgonians belonging to the family Plexauridae seemed to be the most dominant in the area, as well as other gorgonian species and abundant holothurians among other benthic organisms. In this dive, as well as in all the others conducted along the expedition, water samples, as well as sediment cores were taken whenever the terrain allowed. This was possible thanks to the many gadgets that the Luso ROV has, which allowed not only the collection of specimens thanks to the hydraulic manipulator, but also of water samples, sediments, and rocks (Fig. 4.4). At the end of the day the first deployment of the baited trap (LB) took place on the abyssal plain, therefore after steaming from Fogo to that area.

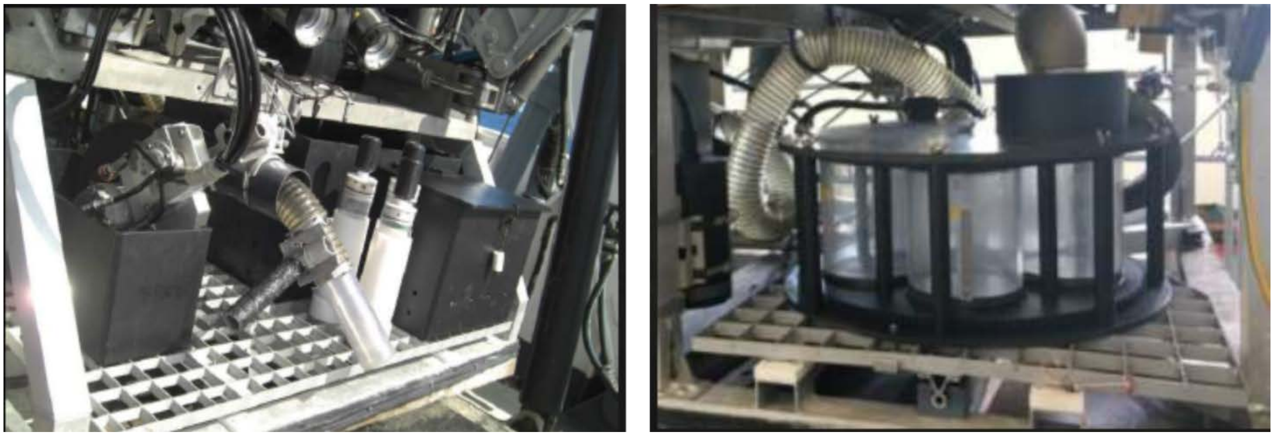


Figure 4.4 Some of the sampling elements from the Luso. Left: different sampling boxes, push cores and the suctionhose. Right: carousel to collect plankton samples with 5 independent chambers attached to suction hose. (Image: Antonio Calado).

The **7th of August** started with the successful recovery of the LC, and after this a deep CTD was conducted. In the briefing meeting on the bridge the Autosub6000 manoeuvre and mission were discussed, with the subsequent Autousb 6000 deployment which unfortunately was aborted due to problems with the software. After recovering the Autosub6000 we moved to the Cadamosto Seamount to conduct the second ROV dive. Although the dive started, unfortunately it was necessary to cancel it due to the loss of signal from the 4K Camera. Once the ROV was on board we conducted part of the planned CTD-casts in Cadamosto, this took place already on the **8th of August**. After this CTD, our vessel "Sarmiento" steamed back to the so-called "lander area" in order to collect the LR and to deploy the second LC. As the Autosub6000 and ROV experimented technical problems this day, it was impossible to conduct any mission with any of the two pieces of equipment, therefore we carried on with Box Corer deployments in Cadamosto covering three different depths to contribute to the sampling proposed by the Paleoceanographers onshore. These deployments were somehow risky as the available bathymetry did not allow to know the type of substrate in the area. Two of the three deployments were successful. At the end of the day an Autosub6000 mission was planned but unfortunately the gear was not working properly (after one of the on-deck checks, the propeller did not work properly), therefore no deployment took place. Instead, we did a deep CTD in the "lander area", which finished the **9th of August** and after moving to Cadamosto we conducted an ROV dive at the southern part of the seamount, fully successful. The southern side of the seamount displays a diverse benthic community, showing different patterns at the different depth ranges. Samples were also collected for the trophic net analyses that Bea will conduct in the framework of her PhD Thesis. During the ROV dives there was always a great expectation and scientist and technicians were watching the path followed by Luso in the ROV container or in the main lab (Fig. 4.5); Kelsey and Murray were helping Bea a lot with the OFOP annotations when she was giving the directions for the dives inside the ROV container. This role was played mostly by Cova Andrea or Veerle due to their large experience in working with underwater video material. For Bea this was her first time at sea as well as doing ROV work, therefore it was also important to train her in this task as this will be an important part of the material she will analyse for her PhD. The dive finished the **10th of August**, and the work of this day continued with a CTD on the Cadamosto summit, followed by the deployment of the LC at the lander site. After this deployment, "Sarmiento" headed to the area where the Autosub6000 missions were planned. A new Autosub mission started. We also had a birthday onboard (the first!): Miguel Souto from ROV team, for this Veerle, Bea and myself planned some surprises, and Juan and Krazi also prepare a surprise cake. After an apparently successful deployment, the AUV started to move in an erratic way and it was decided to abort the mission. After recovering the Autosub6000 again on board, we headed to a waypoint located on the abyssal plain in order to conduct a MUC at a deep station. The MUC was successful and indeed it was the deepest MUC deployment ever undertaken with the gear from the UTM (4395 me depth!); after finishing the MUC deployment and recovery, a deep CTD was conducted, finishing this CTD cast on the **11th of August**.

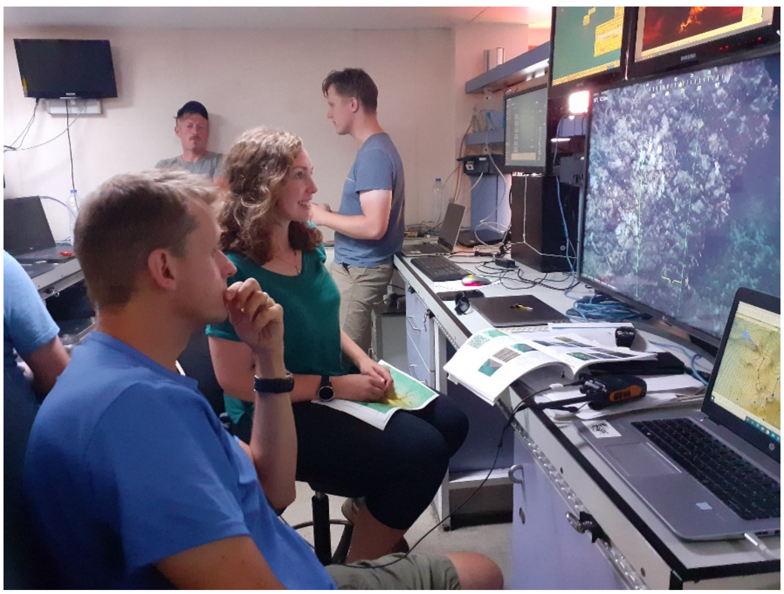


Figure 4.5 Susan and Murray following an ROV dive from the main lab (Image: Cova Orejas)

With that, we accomplished our first full working week of iMirabilis2, with the following summary of successful operations at the abyssal plain, Cadamosto Seamount and off Fogo: Multibeam survey at the abyssal plain, 6 CTDs, 4 MUC for Andrew's experiments and 1 in the abyssal plain, 3 Box Corers, 3 Baited camera lander deployments, 2 Respirometer deployments and 1 baited trap deployment as well as 2 ROV dives. During all these days, beside her participation in the OFOP annotations and helping with other activities, Kelsey was tirelessly writing blog posts on the different activities conducted to disseminate our expedition via the iMirabilis2 web page, as well as the social networks. Other iMirabilis2 members were also participating in the blogs of the expedition as well as by presenting their activities in short video clips (see https://www.iatlantic.eu/our-work/expeditions/imirabilis/). After the CTD conducted at the abyssal plain finishing the 11th of August, the third LC was picked up; it is worth to mention the success of the landers deployed until this date, as all of them were recovered without problems and all of them yielded interesting results. It was remarkable to see the difference in the scavenger fauna attracted by the LC baited with mackerel and with squids baits (see section 7.8); in the case of the LR, from the 4 chambers installed in the gear, two were collecting sediment and background respiration, and one was conducting experiments. Considering the number of deployments planned, it is promising that robust results will be obtained, also the LB provided interesting results which complement the ones obtained by the LC. After the recovery of the landers, the weather conditions did not allow to perform an ROV dive to be performed at Cadamosto, therefore we headed again to Fogo where we accomplished another great ROV dive in a very diverse area regarding the benthic fauna, where the sampling to re-construct the trophic net of the deep-sea benthos of the southern part of the Cabo Verde Archipelago was very successful. The dive finished already the **12th of August**. After finishing the dive, we moved to the initial position of the ROV dive, as this was very close to a new area planned for an Autosub6000. Due to the issues displayed by the Autosub6000, on this occasion we decided to plan a mission at slightly shallower depths (ca. 2700 m) aiming to detect as early as possible any potential problems with the gear. In this occasion the Autosub6000 conducted a partially successful mission (this was confirmed the following day) as it followed partially the programmed track and the RoCSI worked properly. RoCSI is one of the most important pieces of equipment on board. It is an eDNA sampler designed by National Oceanography Centre (among them Susan!), which aims to collect eDNA samples continuously and at large depths. Indeed, one of the aims of iMirabilis2, as a demonstrator cruise of iAtlantic, was to test the use of the RoCSI in the Autosub6000 and, hopefully, prove that the eDNA sampler worked well. Therefore the success of this mission was remarkable as one of the objectives of iAtlantic was accomplished! After deploying the Autosub6000 and leaving her to conduct the mission, CTDs were conducted at some of the stations where the ROV dives on Fogo were conducted. After this a further MB survey took place in order to better cover the southern area of Fogo, as several sampling events had taken place in the area. The day finished with an improvised guitar and percussion concert in the hangar by Iván C, Mario and Roger, that we very much enjoyed (Fig. 4.6).

Figure 4.6 Roger, Mario and Iván playing music in the hangar. (Image: Veerle Huvenne)

After finishing the MB survey we headed again to the so called "lander area", on the abyssal plain, in order to recover the LR and deploy again the LC. The MB survey performed the day before was very useful to plan a further ROV dive on Fogo, as the weather conditions did not allow to conduct an ROV dive on Cadamosto. However, surprisingly the sea conditions we found on Fogo were unexpectedly bad… the local effects caused by the islands generated wave fronts in different directions which made it completely impossible to conduct any ROV dives in the area. After several hours observing the situation and also considering a potential Autosub6000 deployment (but the weather did not allow a deployment of the gear), we decided to conduct two CTDs in the area where the previous ROV dives took place. We further monitored the weather situation, and as an ROV dive and an Autosub6000 mission were not possible (because the MB gear was not operative and therefore it was clear to conduct a meaningful mission was not possible), two relatively deep CTDs (ca 1900 and ca 2100 m depth respectively) have been deployed and after those MB survey has been conducted as the weather did not allow the deployment of any other gear. The **13^{th} of August** started with the MB survey, followed for a LC recovery and three CTDs close to Cadamosto. The sampling activities of the 13^{th} of August finished with a MB survey to cover part of the gaps from previous MB surveys we conducted in previous days. The **14^{th} of August** started with finishing the MB survey started the 13^{th} of August. After this we headed to Cadamosto and performed two Box Corer (BC) deployments, unfortunately both unsuccessful. After these trials we moved to the lander area to recover the LC and deploy the LR. Then we moved to Cadamosto performing a CTD at one of the stations included in the original plan (Fig. 2. 1) and then we moved to the area where we aimed to deploy again the Autosub6000, this work started the **15^{th} of August**. Unfortunately the Autosub6000 did not perform properly and therefore it was decided in a meeting with the Autosub6000 related scientists (Susan, Erik and Veerle), lead technician (Dan) and the cruise leader (Cova) to develop a alternative plan in an attempt to save at least some of the deep-water habitat mapping work. The plan was to install the RoCSI on the ROV Luso (after confirming with Antonio that this was feasible), and using the stills camera that the ROV had, and mount the camera from the camera lander on the ROV to take pictures straight down of the seafloor, in order to perform the photographic survey originally planned for the Autosub6000. Unfortunately the high-definition MB gear could not be mounted in the ROV. The plan to cover partially the Autosub6000 missions, was to use the transformed ROV Luso -after finishing with the work planned at Cadamosto-Fogo-Brava to cover the RoCSI sampling as well as the photosurvey. Later on this day we conducted a second ROV Dive at Cadamosto, which was very successful, displaying a fantastic volcanic seascape and diverse coral gardens. There was a fairly clear bathymetric zonation and not only the high diversity but also the high density displayed by the benthic fauna inhabiting the area were remarkable. Finalizing the day, we moved to the lander area, to deploy the second LB and the fourth LC. After this, already being the **16^{th} of August**, we moved again to Cadamosto where CTDs were conducted to cover the other sides of the seamount and to extend the oceanographic dataset to properly characterize the physical oceanography of the area. After these activities a further ROV dive at Cadamosto was planned, unfortunately the sea conditions did not allow to dive, therefore, considering that the Autosub6000 was ready to go, we decided to try again to conduct an Autosub6000 mission. The deployment took place but unfortunately due to the lack of communication between the Autosub and the equipment on board, the mission was aborted. As all landers were at that time deployed and it was impossible to conduct an ROV mission. Therefore, we aimed to keep going with the MB survey covering further gaps and areas around Fogo and Brava islands. This day we had the second birthday onboard: António Calado, from Luso team. He also had some surprises from the rest of the ROV team during the dive, as well as a tasty cake from Juan and Krazi and finally but not least, some surprises from Veerle, Cova and Bea. The **17^{th} of August** started with the recovery of the landers and after this we headed to Cadamosto, aiming to perform an ROV dive, which indeed was conducted, however it was necessary to stop the operations because the sea picked up, making the ROV recovery increasingly difficult. In the meantime the Autosub was prepared again for a new mission. Once the ROV was on board, the Autosub6000 was deployed and as apparently everything was working properly, we left the gear at 04:00 in the morning of the **18^{th} of August** to accomplish her mission, and we moved to the lander area to deploy once more the LR and the LC and recover the LB. Moving again to Cadamosto, the CTD stations on top of the seamount were completed and at 07:00 the recovery of the Autosub6000 was planned. The gear made a perfect mission, in terms of the path programmed being followed, the recovery was challenging, but at the end successful and Autosub6000 was welcomed on board by Iván C playing the bagpipes. Unfortunately once on board we realized that although the RoCSI successfully worked and gathered samples, the MB did not work and only oceanographic data were collected. Finishing the Autosub6000 recovery we moved to Cadamosto

and on the **19th of August** started with 2 CTD casts in the deeper areas of the seamount. After this we tried to box core on the seamount but the trials were not successful. Once the BC was on board we moved again to the "lander area" to recover the LC and deploy the last LB. After finishing these recovery and deployment, we moved again to Cadamosto Seamount where another ROV dive was conducted, already the **20th of August**, at the end of this dive a problem with the manipulator occurred. Once the Luso was on board, we steamed to the abyssal plain to conduct 2 MUC deployments, both successful and accomplishing another deep MUC during iMirabilis2, in this case 3184 m depth. As the ROV manipulator needed to be repaired (and this meant no dives could be performed) and the Autosub6000 also needed to be fixed, we decided to keep completing the sampling programme on Cadamosto, conducting some plankton nets on the top of the summit, as well as in two other stations at ca 2100 and ca 2000 m depth where also CTDs were previously conducted.
After this a MB survey was performed between the deeper areas of Cadamosto and Fogo to cover remaining gaps from the surveys performed in previous days. The MB survey was conducted during the rest of the day and the **21st of August** also started with MB surveys, after this the LR was recovered in the lander area and the LB was deployed. Once these two actions were completed we steamed to Cadamosto to conduct another ROV dive that lasted the whole day.

Figure 4.7 Antonio, Bruno, Verle, Miguel, Andreia, Cova and Erik in the ROV container (Image: Luso team)

Once the ROV was on board the LR was deployed again and the LB recovered finishing the day with these two sampling events. At 05:30 on the **22nd of August** we arrived to the slopes of Brava and performed an ROV dive there, after which we moved to the lander area, conducted a CTD and to recover the LC, this happened already the **23rd of August**. After the recovery of the camera, and considering the meteorological conditions, we decided to conduct a last MUC at 4000 m depth, which was successful. After this deployment and due to the meteorological conditions, with strong winds, we decided that the single activity we could conduct was MB survey, therefore, lines were prepared to perform MB surveys north of the Island of Brava. After finishing the survey we tried to do some more plankton nets but the current was too strong, therefore we moved to the lander area and recovered the last landers deployed: LR and LC, this already occurred the **24th of August;** this same day, at 15:00 the last two ROV dives (with the "transformed Luso including Andrew's camera and RoCSI) of iMirabilis2 took place, the first one with high emotion within the ROV container (Fig. 4.7), and with a depth record being achieved, and a fantastic reception of Luso and team with bag pipes from Iván, and everyone celebrating. After this we complete some MB lines to cover gaps and the **25th of August** the iMirabilis2 sampling events and survey finished, with the ship starting to head to Las Palmas where the arrival was foreseen for the 30th of August at 16:00. During the transit from Cabo Verde to the Canaries the scientific team were busy working in the preliminary results to include in this report, starting packing equipment and materials, preparing samples to be picked up in Vigo etc. We also have another special highlight during the transit as Murray, the iAtlantic coordinator celebrate on board Sarmiento his 50th Birthday the 27th of August! The dining room was decorated to celebrate this special birthday and Murray got also some presents and surprises from the scientific party as well as from the crew: after lunch our *Gaiteiros* have been playing songs dedicated to him!

5 Deviation from the original plan (C. Orejas)

The original plan of iMirabilis2 included work in the northern and southern part of the Archipelago. The planned work included working on the abyssal plains close to the northwestern and southwestern part of the archipelago as well as on two seamounts, Nola (Northwest) and Cadamosto (Southwest). The meteorological conditions of the area did not allow to work on the Nola Seamount with some of the gear we had on board (especially the ROV) as the area is almost continuously exposed to persistent Northwest winds. After monitoring the situation during several days previous to the expedition, we decided to focus our work in the southern part of the Archipelago.

Although the geographical area had been reduced to the southern part of the Archipelago, there were some added values to this new scope, which were also driven by the meteorological conditions. Under some wind conditions it was also not possible to work at Cadamosto Seamount, in those cases we moved to the slopes of the islands of Fogo and Brava. This addition allowed to establish a comparison between the benthic communities on the Cadamosto Seamount and the island flanks. Regarding the work on the abyssal plain, the work focused also in areas close to the southern part of the archipelago, therefore some deviation related to the originally selected areas took place as it was planned to work in abyssal plains close to the northern as well as to the southern part of the archipelago.

Considering the operations of the gear, the main problem during the expedition was the fact that the Autosub6000 mission repeatedly ran into problems, and hence could not be completed as planned for the area of the abyssal plain. Although three missions provided some data (mainly eDNA samples and CTD data), photographic and bathymetric surveys were not conducted due to several technical problems (see section 6.3.2 of this report). When an Autosub6000 mission could not take place or was aborted, or when the weather or other technical issues (e.g. camera, manipulator arm) prohibited the deployment of the ROV, the time slot was allocated to deploy other gear, therefore the CTD-Rosette sampling events as well as the sampling with MUC and BC were increased, as well as the amount of MB survey compared to the initial plans.

6 Technical report

6.1 CTD-Rosette (A. Mosquera-Giménez, P. Vélez, I. Mouzo)

6.1.1 Instrument details/settings. Calibration information

In each of the hydrographic stations, a SBE9 s/n 0851 CTD, working at 24 Hz, coupled with a SBE11 (deck Unit) and a SBE 33, with 24 bottles of 12 liters, was lowered at less than 50 m/min. The following sensors were installed on the SBE9 (**Error! Reference source not found.**.1.1):

Table 6.1.1.1 Sensors installed in the SBE9.

Channel	Sensor	Serial number	Calibration date
1. Frequency	Temperature	5332	27/02/20
2. Frequency	Conductivity	3761	20/02/20
3. Frequency	Pressure, Digiquartz with TC	0851	13/03/20
4. Frequency	Temperature,2	4721	11/02/20
5. Frequency	Conductivity, 2	3302	06/02/20
6. A/D voltage 0	Oxygen, SBE 43	1147	28/06/ 20
7. A/D voltage 1	Oxygen, SBE 43, 2	1142	24/06/20
8. A/D voltage 2	Turbidity Meter, Seapoint	11425	04/09/2010
9. A/D voltage 3	Free		
10. A/D voltage 4	Fluorometer, WET Labs- ECO-AFL/FL	3595	18/06/2014
11. A/D voltage 5	Turbidity Meter, WET Labs, ECO-NTU	3595	18/06/2014
12. A/D voltage 6	PAR/Irradiance, Biospherical/Licor	70337	05/04/2021
13. A/D voltage 7	Altimeter	396	

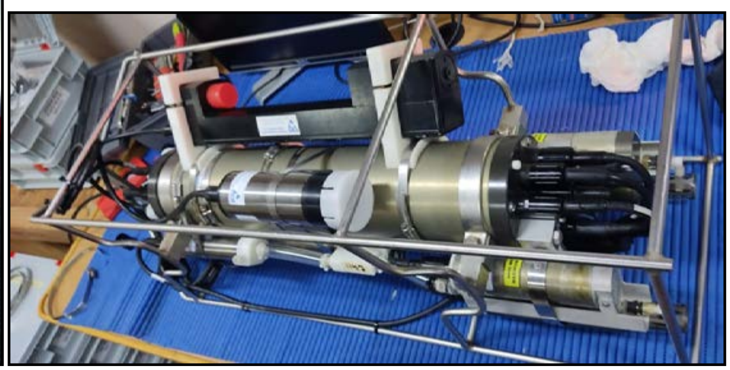


Figure 6.1.1.1 CTD-Rosette (left) and initial setting of the CTD (right) used on iMirabilis2 (Image: CTD team).

The SBE911 was equipped with dual temperature and conductivity (salinity) sensors, which allowed monitoring the drift of the primary sensor. As indicated in Figure 6.1.1.2, there was a small drift between the sensors, of 0.002°C for temperature and 0.005 for salinity. The difference in temperature was within the accuracy of the temperature sensor. Although for the conductivity (salinity) sensor the difference was larger than the accuracy of the sensor (0.003), the differences in salinity were consistent during all the cruise, reason why the measures taken by the sensors can be considered as accurate and it was not necessary to implement additional corrections.

In addition, a Dual RDI Ocean Surveyor 75 khz (Broadband and Narrowband) Vessel Acoustic Doppler Current Profiler (VADCP) was used when possible between stations to measure ocean currents (Figure 6.1.1.3). The Table 6.1.1.1 shows the configuration file of the ADCP used

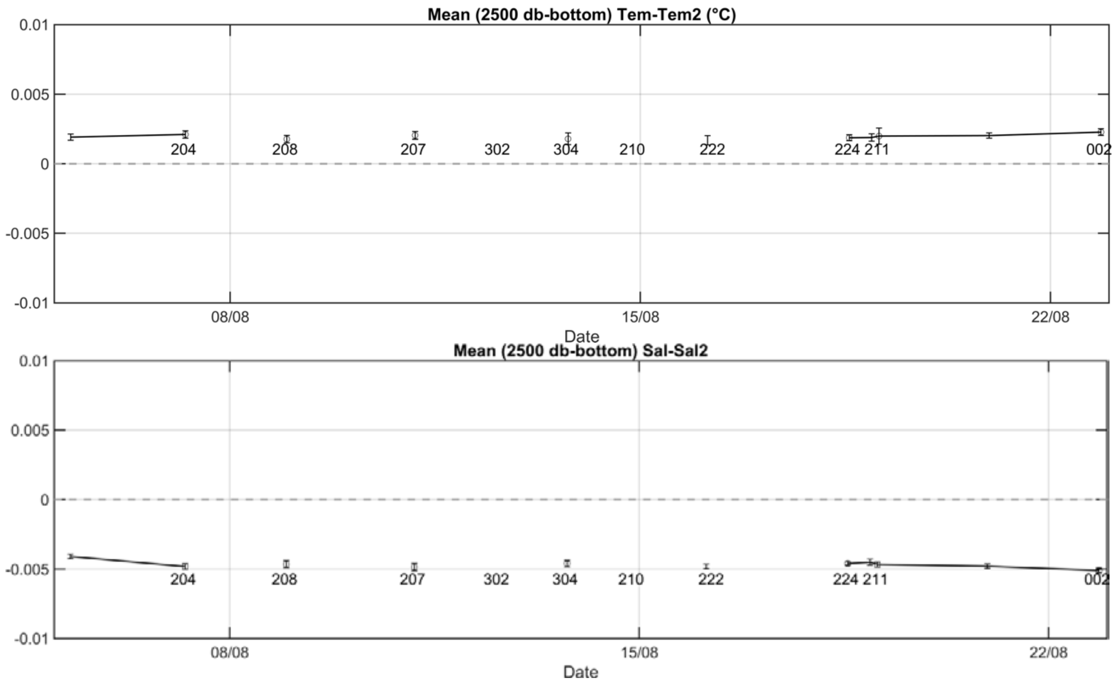


Figure 6.1.1.2 Time evolution of the difference between the primary and secondary sensors for temperature (top) and salinity (bottom), during the duration of the iMirabilis2 expedition.

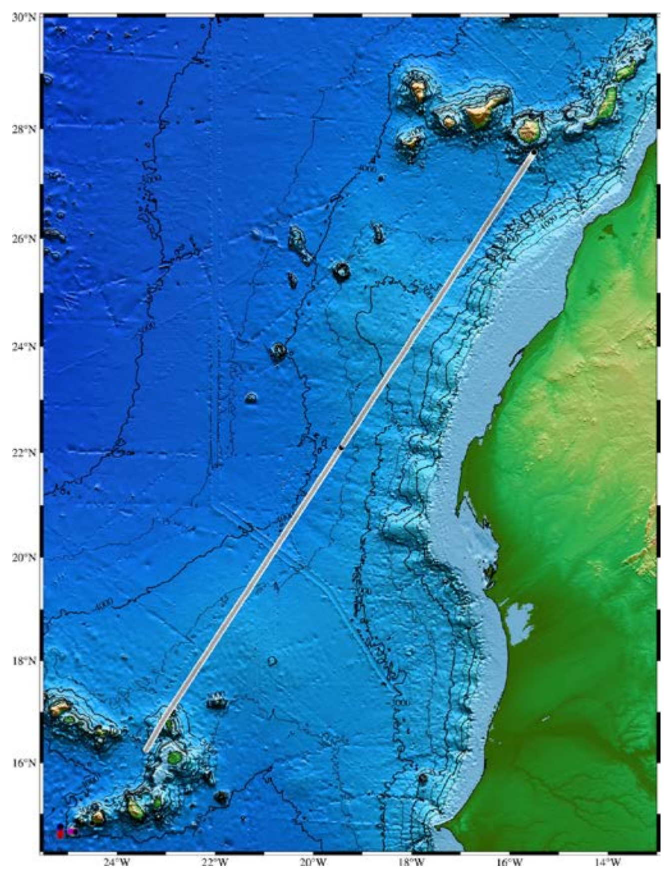


Figure 6.1.1.3 Map of the vessel mounted ADCP data registered.

Table 6.1.1.1 ADCP configuration file.

```
;--------------------------------------------------------------------------\
; ADCP Command File for use with VmDas software.
;
; ADCP type:     75 Khz Ocean Surveyor
; Setup name:    default
; Setup type:    High resolution (broadband) and long range profile
(narrowband)
;
; NOTE:  Any line beginning with a semicolon in the first
;        column is treated as a comment and is ignored by
;        the VmDas software.
;
; NOTE:  This file is best viewed with a fixed-point font (e.g. courier).
; Modified Last: 12August2003
;--------------------------------------------------------------------------/
; Restore factory default settings in the ADCP
cr1
; set the data collection baud rate to 38400 bps,
; no parity, one stop bit, 8 data bits
; NOTE:  VmDas sends baud rate change command after all other commands in
; this file, so that it is not made permanent by a CK command.
cb611
; Set for narrowband single-ping profile mode (NP), one hundred (NN) 16 meter
bins (NS),
; 8 meter blanking distance (NF)
NP00001
NN100
NS0800
NF0800
; Set for broadband single-ping profile mode (WP), one hundred (WN) 4 meter
bins (WS),
; 8 meter blanking distance (WF), 390 cm/s ambiguity vel (WV)
WP00001
WN125
WS0800
WF0800
WV390
; Enable single-ping bottom track (BP),
; Set maximum bottom search depth to 1200 meters (BX)
BP000
BX12000
; output velocity, correlation, echo intensity, percent good
WD111100000
;ND111100000
; One and a half seconds between bottom and water pings
TP000000
; Zero seconds between ensembles
; Since VmDas uses manual pinging, TE is ignored by the ADCP.
; You must set the time between ensemble in the VmDas Communication
options
TE00000000
; Set to calculate speed-of-sound, no depth sensor, external synchro heading
; sensor, no pitch or roll being used, no salinity sensor, use internal transducer
; temperature sensor
EZ1020001
; Output beam data (rotations are done in software)
```

```
EX00000
; Set transducer misalignment (hundredths of degrees)
EA04513
; Set transducer depth (decimeters)
ED00045
; Set Salinity (ppt)
ES36
; save this setup to non-volatile memory in the ADCP
CK
```

6.1.2 Problems encountered

The initial setting of the CTD included a Transmissometer WET Labs C-Star (Fig. 6.1.1.1), however it did not work properly, so it was removed in the Station 18 (CTD station 209). Because no other working Transmissometer was available, the Turbidity Meter Seapoint was assembled in its place from station 25 (CTD station 2095) forward. During the deployment in this station 25 some spikes were detected in the secondary conductivity sensor. For this reason, the connections were checked after the profile. Besides, the Altimeter failed in station 18 (CTD station 209), therefore it was replaced by the spare. Finally, during the upcast of the penultimate CTD station (station 78, CTD station 002), some spikes were detected again in the secondary conductivity sensor, for this reason, it was cleaned after the cast.
As the VADCP interfered with other instruments used, it was only possible to have it working when no other instruments were in use.

6.2 Shipboard acoustics: Multibeam, Subbottom profiler (V. Huvenne, P. Rodríguez)

6.2.1 Multibeam Atlas HYDROSWEEP DS

Description

The Hydrosweep DS multibeam sounder is a state-of-the-art multibeam sounder, designed to perform bathymetric surveys of the seabed to depths greater than 11000 meters, complying with IHO S44 standards for such surveys.
The Atlas Hydrosweep DS Multibeam Sounder is a complete system that includes all components from the transducers to the final data processing and printing.
The equipment is composed of the following modules:
- Transducers: Installed in a nacelle located at the bow of the vessel, at 6 m depth.
- Transceivers: This is the data acquisition and processing electronics. It is made up of different units:
  - AEU: Analog electronics unit. It contains the power electronics (transmission electronics and capacitor blocks) and reception (preamplifiers, digitizers).
  - DEU: Digitizer Unit. It includes all the processing and filtering unit of the acquired data. It also includes the low and high voltage power supplies for the rest of the units.
  - ICU: Interconnection Unit.
  - Control Computer: Manages the acquisition of data in different formats and controls the acquisition electronics.
- Auxiliary sensors (position, attitude, sound velocity, etc): They are connected to independent acquisition units (DIP) that forward the information to the network so that it is available for all instruments (Atlas MD, Atlas PS).

The acquisition of the raw data is done with Atlas' own software (Atlas Naviscan), creating the files (*.SBD). External software is also used, in this case PDS2000 from Teledyne, creating files (*.S7K) and (*.PDS).

6.2.1.1 Instrument details/settings. Calibration information

Technical Characteristics

- Emission frequency: 14.5 to 16 kHz.
- Operating range: 10 to 11000 meters
- Max. Range Resolution: 6.1 cm
- Accuracy: 0.5 m, 0.2% of depth (2 sigma)
- Pulse length: 0.17 to 25 ms.
- Sampling Frequency: <12.2 Khz.
- Max. emission rate: <10 Hz.
- Maximum coverage: 6 times the depth, 20 km maximum. In this campaign we have been at 5 times the depth.
- No. of beams: 141 by hardware and 960 with High Order Beamforming.
- Beam aperture: 1º x 1º.
- Beam spacing: Equi-angular, equidistant.
- Stabilization
  - Depth telegrams: Pitch, roll.
  - PDS software: Pitch, roll, yaw, wave height.
- Interfaces:
  - Applanix POS-MV attitude sensor.
  - Teledyne PDS and Naviscan EIVA acquisition softwares.
  - Surface sound velocity sensor
- EIVA NAVIPAC for Navigation and line planning

Working parameters

Operation	Sensor installation parameters:
Depth window:	TX Location:
Deep Search Window Variable	X= 16.08 m.
Swath Width	Y=0.01
Variable (150-200%)	Z= 6.57
Beam pattern	RX Location:
Across beam spacing Equal Footprint	X= 16.08 m.
Sidescan	Y=0.01
Coverage by swath	Z= 6.57
Port/Stdb: 300% - 8.000 m.	TX Offsets:
Sounder Environment	Roll=-0.19
Bottom Source Depth Manual	Pitch=2.15
C Mean source: System C-Profile	Yaw=0.01
C-Keel source: System C-Keel	TX Offsets:
Bottom Depths	Roll=-0.32
Manual Depth: 3000 m.	Pitch=2.48
Basic Settings	Yaw=-0.10
Transmission sequence: Single pulse	
Transmission source level: Depth controlled	Latency= 0.000 s
Advanced settings	
Transmision Shading: Automatic	

6.2.1.2 Methodology

Transects were conducted around the islands and in the lander and AUV deployment areas to determine the best positions for the campaign objectives, as well as to acquire further bathymetric data from the area. CTD profiles were used to introduce the sound speed profiles, which did not have much variability. The UTM 26N zone was used. Work was performed without synchronization.

No calibration was performed. Two lines made in the abyssal zone can be used for roll calibration.

6.2.1.3 Problems encountered

It was observed that for some parts of the survey, the echosunder worked at a less than optimal pinging rate (see Fig. 6.2.1.3.1). In those cases, the coverage was decreased which should increase the pinging rate, but this was not always the case. The problem seemed to come from the communication between the ATLAS hardware and PDS software.
If the agular limits were modified from the ATLAS software instead of using the PDS graphical interface, the ping rate was adjusted correctly and the data are correct.
The manufacturers recommend not to work at maximum power, instead they recommend to work with depth controlled amplitude, which makes data quality improve notably. If a constant amplitude is needed, to anlayse the backscatter data it is recommended to set the reference depth manually with an approximate depth to the maximum expected in the working area, instead of controlling it by the PHF. However, during iMirabilis2, optimal bathymetry data collection was the priority, hence the ping rate and amplitude depended on the variable depth.

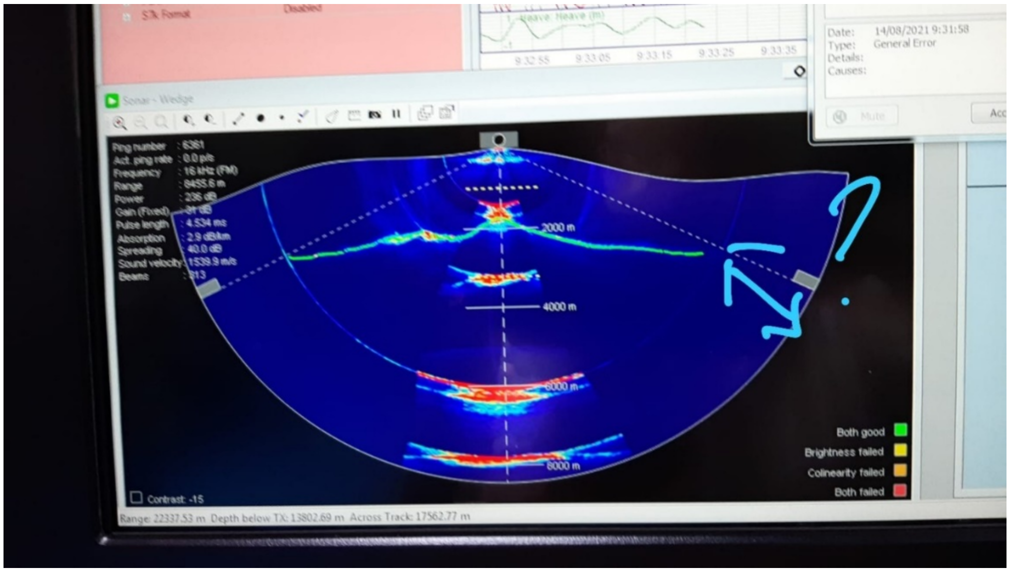


Fig. 6.2.1.3.1 Image of the echosunder working at a less than optimal pinging rate.

6.2.2 Parametric profiler ATLAS parasound P-35

Description

The Atlas Parasound P-35 parametric profiler is a high-resolution, narrow-beam, seismic profiler capable of working in any ocean on the globe. It uses a single transducer for transmitting and receiving.
The main application of this profiler is the acquisition of high-resolution seismic profiles of the superficial sedimentary layers, as well as the detection of buried elements in the seabed. The spatial resolution of the system allows to distinguish objects close to each other, in angle and/or space. The spatial resolution is given by the following factors:

- Angular resolution, which is given by the geometry of the transducer array.
- Range resolution, which is given by the bandwidth of the signal.
- The emission rate; it is related to the vessel speed, the higher the rate (or lower the vessel speed) the higher the horizontal definition of the profile.

The equipment is composed of the following modules:

- Transducers: installed in a nacelle located at the bow of the vessel, at 6 m depth.
- Transceivers: This is the data acquisition and processing electronics. It is made up of different units:
- AEU: Analog electronics unit. It contains the power electronics (transmission electronics and capacitor blocks) and reception (preamplifiers, digitizers).
- DEU. Digitizer Unit: Includes all the processing and filtering unit of the acquired data. It also includes the low and high voltage power supplies for the rest of the units.
- ICU: Interconnection unit.
- Control Computer: Manages the acquisition of data in different formats and controls the acquisition electronics.
- Auxiliary sensors (position, attitude, sound velocity, etc): are connected to independent acquisition units (DIP) that re-send the information to the network so that it is available for all instruments (Atlas MD, Atlas PS).

Specifications:

- Type of signals: Barker, CW, Chirp and user-defined signals.
- Broadcast modes:
    - Multiping, up to 16 pings simultaneously in the water.
    - Quasi-equidistant mode,
    - Single ping
- Primary frequency: 18-39 kHz.
- Secondary frequency: 0.5 to 6 kHz.
- Pulse length: 0.17 to 25 ms.
- Maximum sampling frequency: 12.2 kHz.
- Max. Range Resolution: 6.1 cm.
- Bottom detection accuracy: 0.2 m +/- 0.2% of depth (1 sigma).
- Beam Resolution: 4. 5º Alongtrack - 5º Acrosstrack.
- Transmission power: 35 kW.
- Power consumption < 3 kW.
- Electronic stabilization: pitch and roll.
- Background tracking.
- Maximum emission rate 10 Hz.

6.2.2.1 Methodology

Parametric profiles have been recorded only in a specific small area between Praia an Maio to explore the best suitable place to deploy the Multicorer to obtain sediment cores to conduct incubations on board (see section 6.7).
The configuration was optimized to obtain the best resolution at depths around 850 m.

6.2.2.2 Problems encountered

No problems encountered.

6.3 AUV Autosub6000 (D. Roper, R. Austin Berry, S.Fairbairn, E. O'Hobain)

6.3.1 Instrument details/settings. Calibration information

The Autosub6000 (Fig. 6.3.1.1) is a 6m torpedo style Autonomous Underwater Vehicle (AUV), designed to conduct deep-sea observations over a large spatial area. Observations such as sonar bathymetry, optical photographs or oceanographic measurements can be made at either a constant depth or a constant altitude from the seafloor, along a pre-planned track. Although Autosub6000 cannot compete with the spatial coverage of observations from the vessel on the surface, proximity to the seafloor affords significant advantages in resolution. Autosub6000 is operated fully autonomously with no real-time interaction from the vessel, or requirement for continuous tracking. This frees the vessel to conduct other research activities whilst Autosub6000 collects data.

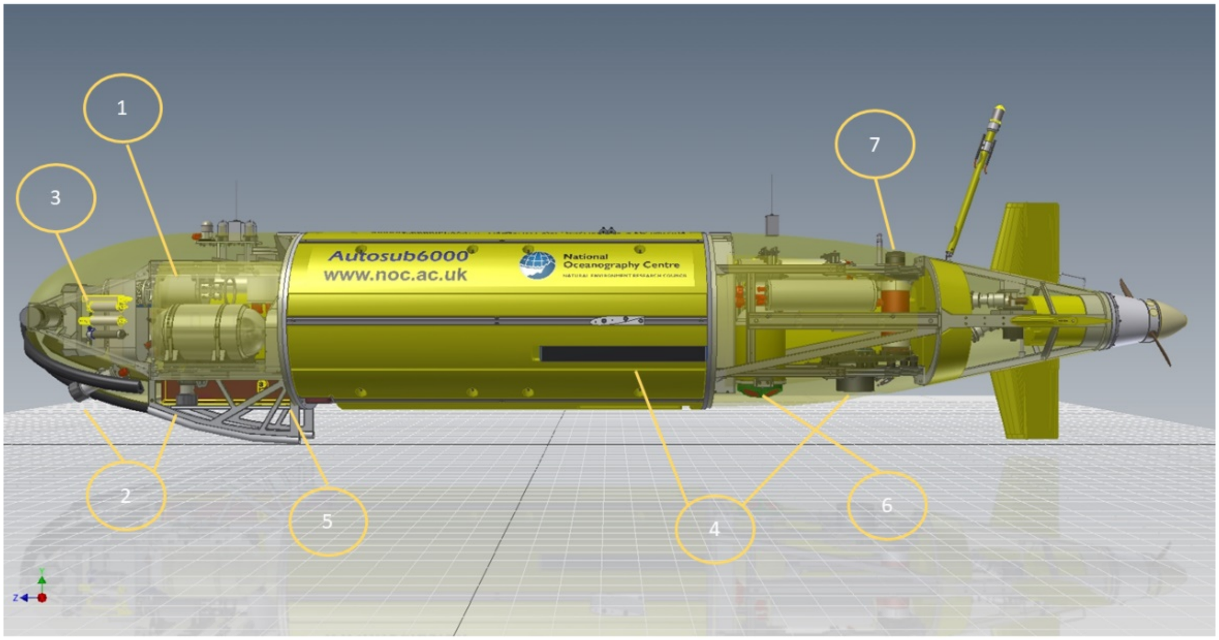


Figure 6.3.1.1. Autosub6000. iMirabilis 2 Configuration. 1. RoCSI eDNA sampler, 2. AESA Camera System, 3. Seabird 9+ CTD Sensors, 4. Edgetech 2205 Side Scan Sonar and Sub bottom Profiler, 5. Kongsberg EM2040 multibeam sonar, 6. Navigation Suite including iXSea Phins and Teledyne RDI WHN300 ADCP, 7. Sonardyne 6G Hi Power AvTrak.

6.3.1.1 Ship Integration

- Custom-built LARS deck beams with 2Tonn Counterweight (4 Parts) installed during mobilisation
  - Fw Beam
  - Aft Beam
  - Inboard Cross Brace
  - 2T Counterweight
- Gonio – Argos Relocation System
- WiFi – 2x Ubiquity Bullet High Gain Antennas
- Control Station in ship's Dry Lab, 1x Server Rack + 2x KVM workstation.
- UDP forwarding of USBL beacon positioning from HIPAP system to Autosub server

6.3.1.2 Endurance and Range

Estimate 20 Hours, approx. 70Km effective survey range.

6.3.1.3 Sensor Suite

- MBES: Kongsberg EM2040
- Sidescan + SBP Edgetech 2205
- iXSea PHINS inertial navigation system
- CTD

- o Seabird SBE 9+ (electronics bottle)
  - o Dual Seabird SBE 3+ (temperature sensors)
  - o Dual Seabird SBE 4C (conductivity sensors)
  - o Seabird SBE43 (dissolved oxygen sensor)
- AESA Camera System: Dual FLIR Grasshopper 2 (GS”-GE-50S5C-C) 5 M Pixel Cameras with Navitar Lenses, 10J Xenon Flashes.
- ADCP: Teledyne RDI Workhorse 300 kHz ADCP Navigator with Current Profiling
- eDNA: NOCS RoCSI sampler

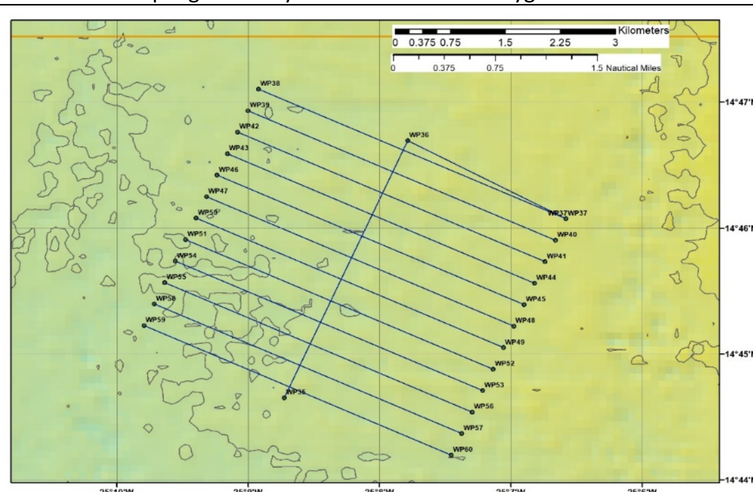
6.3.1.4 Acoustic Positioning and Communication

- Acoustic Comms and USBL Tracking (AUV Side): Sonardyne AvTrak High Power Directional
- Acoustic Comms Top Side: Sonardyne AvTrak High Power Directional
- USBL tracking (Top Side): RV Sarmiento de Gamboa HIPAP452

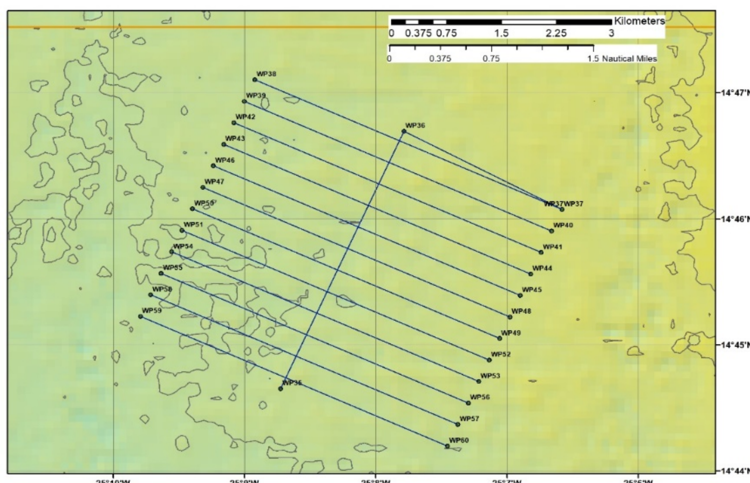
6.3.2 Autosub6000 missions. Description and problems encountered

A total of 7 Autosub6000missions were started, 5 of which were aborted and 2 ran till the end. No MB and photographic missions were completed. Three missions gathered CTD and ADCP data, three more missions gathered CTD and ADCP data as well as ROCSi samples.

In the following tables a summary of each mission has been included.

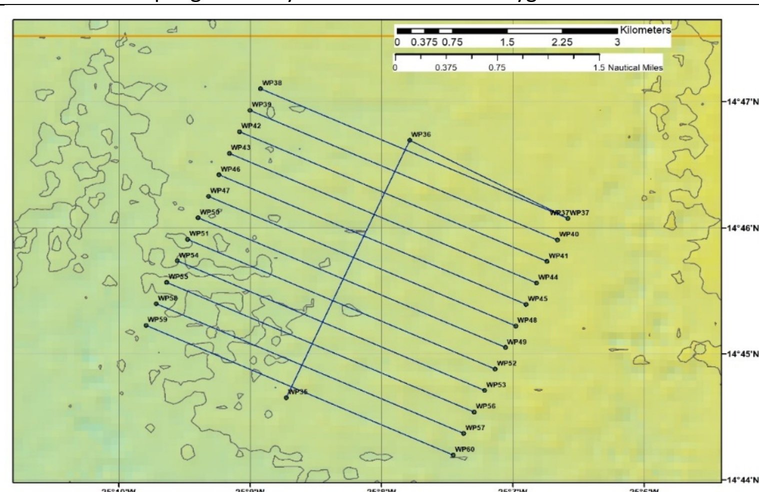
Mission Number	157
iAtlantic Station Number	16
Date	07/08/2021
Description of the plan	Initial multibeam survey of area starting at Lat 14.74420683080, Long -25.14542534090 plus eDNA sampling on survey and at minimum oxygen zone. - Deck Test for all suitable systems - Hot Start off port side of Sarmiento de Gamboa - Fast dive to 4000m then more gentle until ADCP contact made with bottom - Circle and wait for position offset from the Acoustics or timeout - Start RoCSI/EM2040 then run survey. - Power off RoCSI/EM2040 after lawnmower survey complete - Ascend to Oxygen Minimum Zone (475m) then power on RoCSI. - Maintain depth for 30 mins for RoCSI sampling. - Return to surface, Turn off RoCSI at 50m, wait until we arrive to pick it up.
Objectives	1. Gather Multibeam data of survey area 2. Enable planning of low altitude camera survey 3. eDNA sampling of survey area and minimum oxygen zone.
Map	

Outcome	Mission Aborted at 2000m, see error NOCSUBOPS-872
Data Products	Vertical CTD profile to 2000m ADCP current measurements to 2000m

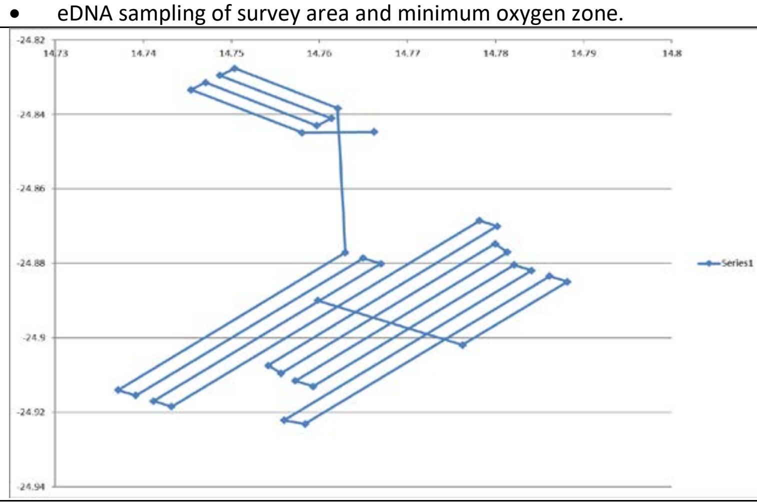
Mission Number	158
iAtlantic Station Number	27
Date	10/08/2021
Description of the plan	Initial multibeam survey of area starting at Lat 14.74420683080, Long -25.14542534090 plus eDNA sampling on survey and at minimum oxygen zone. 2nd autosub mission of the iMirabilis2 Cruise - Repeat of M157 with Rocsi sampling at start of the mission. - MAX DEPTH = 4160m (deepest seabed is expected to be 4210m) - Deck Test for all suitable systems - Hot Start off port side of Sarmiento de Gamboa - Descend to Oxygen Minimum Zone (approx 475m) - Allow 5 minutes at OMZ for depth to stabilise. - Turn on RoCSI - Maintain depth for 40 mins for RoCSI sampling. - Turn off RoCSI - Fast dive to 4000m then more gentle until ADCP contact made with bottom - Circle and wait for position correction from the Acoustics or timeout - Start RoCSI/EM2040 then run survey. - Power off RoCSI/EM2040 after lawnmower survey complete - Return to surface, wait until we arrive to pick it up.
Objectives	4. Gather Multibeam data of survey area 5. Enable planning of low altitude camera survey 6. eDNA sampling of survey area and minimum oxygen zone.
Map	
Outcome	Mission Aborted at 3520m. See error report NOCSUBOPS-884
Data Products	Vertical CTD profile to 3520m ADCP current measurements to 3520m

Mission Number	159; Start Waypoint -14.752144 Lat , 24.754167 Long
iAtlantic Station Number	32
Date	11/08/2021
Description of plan	3rd autosub mission of the iMirabilis2 Cruise - Descend to 300 m - Get nav update to correct drift.

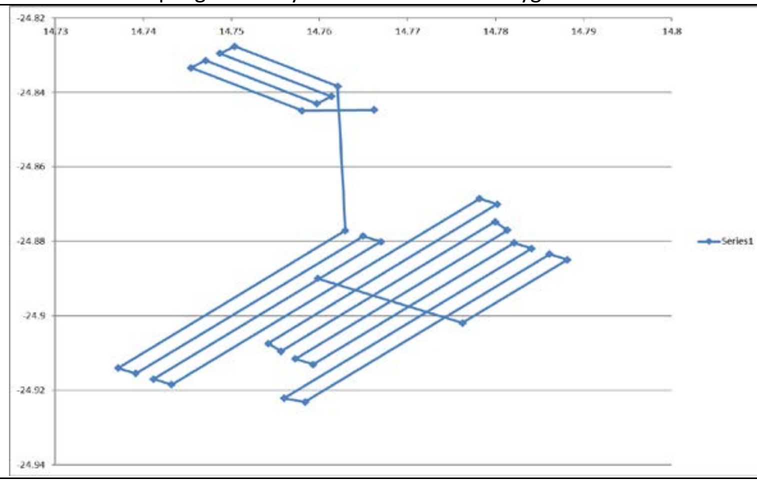
	- Turn on RoCSI - Sample at 300m for 1 hour - Descend to 400m - Sample at 400m for 1 hour - Descend to 500m - Sample at 500m for 1 hour - Turn off RoCSI and ascend.
Objectives	1. Get eDNA samples from 300 to 500m around oxygen minimum zone.
Map	
Outcome	AUV unable to maintain depth. Mission ran to the end. Error report NOCSUNOPS-887
Data Products	CTD profile to 400m ADCP current measurements to 400m RoCSI samples

Mission Number	160
iAtlantic Station Number	45
Date	15/08/2021
Description of plan	4th autosub mission of the iMirabilis2 Cruise - Repeat of Station 16 with RoCSi sampling from 400m to end of lawnmower - MAX DEPTH = 4160m (deepest seabed is expected to be 4200m) - Deck Test for all suitable systems - Hot Start off port side of Sarmiento de Gamboa - Start EM2040 on surface to ensure it is working. - Dive to start waypoint - Fixed stern dive to 400m - Turn on RoCSI - Fixed Stern Plane dive to 4050m then go to 100m altitude - Circle and wait for position for 30 mins for correction from the Acoustics or timeout - Run survey. - Power off RoCSI/EM2040 after lawnmower survey complete - Return to surface, potter until we arrive to pick it up.
Objectives	7. Gather Multibeam data of survey area 8. Enable planning of low altitude camera survey 9. eDNA sampling of survey area and minimum oxygen zone.
Map	
Outcome	Mission Aborted at 3300m NOCSUBOPS-893

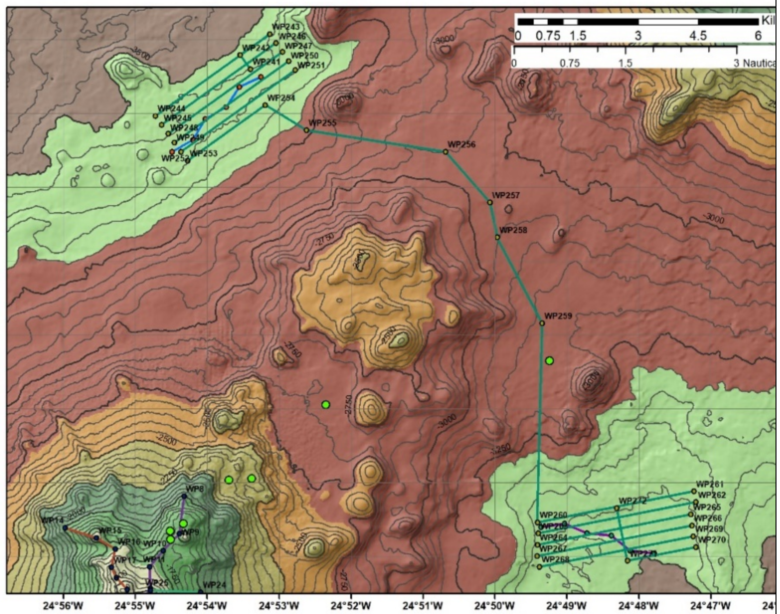
Data Products	Vertical CTD profile to 3300m ADCP current measurements to 3300m RoCSI Samples from water column

Mission Number	161
iAtlantic Station Number	53
Date	16/08/2021
Description	5th science mission of the iMirabilis2 Cruise Start coordinates: -14.752144 Lat , 24.754167 Lon - MAX DEPTH = 3700m (deepest seabed is expected to be 3500m) - Deck Test for all suitable systems - Hot Start over the Port side - Wait on the surface for manual EM2040 start - Fast dive to 2980m then more gentle until ADCP makes contact with bottom - Circle and wait for position offset from the Acoustics or timeout - Start RoCSI eDNA then run survey. - Turn off EM2040 after survey - Ascend to 500m depth, turn off RoCSI - Turn off RoCSI - Return to surface to wait until we arrive to pick it up.
Objectives	• Gather Multibeam data of survey area • Enable planning of low altitude camera survey • eDNA sampling of survey area and minimum oxygen zone.
Map	
Outcome	Mission Aborted at surface. Error report NOCSUBOPS-900
Data Products	None

Mission Number	162
iAtlantic Station Number	56
Date	16/08/2021
Description of plan	6th science mission of the iMirabilis2 Cruise. Same location as mission 162 - MAX DEPTH = 3700m (deepest seabed is expected to be 3500m) - Deck Test for all suitable systems - Hot Start over the Port side - Wait on the surface for manual EM2040 start - Fast dive to 2980m then more gentle until ADCP makes contact with bottom - Circle and wait for position offset from the Acoustics or timeout - Start RoCSI eDNA then run survey. - Turn off EM2040 after survey - Ascend to 500m depth, turn off RoCSI

	- Turn off RoCSI - Return to surface and wait until we arrive to pick it up.
Objectives	• Gather Multibeam data of survey area • Enable planning of low altitude camera survey • eDNA sampling of survey area and minimum oxygen zone.
Map	
Outcome	All Track lines completed successfully. EM2040 multibeam system did not log pings. Error log: NOCSUBOPS-905
Data Products	RoCSI samples at 100m altitude CTD ADCP Water track velocities

Mission Number	163
iAtlantic Station Number	53
Date	14/08/2021
Description of plan	7th science mission of the iMirabilis2 Cruise Start coordinate: -14.752144 Lat, 24.754167 Lon - MAX DEPTH = 3700m (deepest seabed is expected to be 3500m) - Deck Test for all suitable systems - Hot Start over the Port side - Switch on EM2040 and EdgeTech - Wait on Surface for Go Command - Fast Dive to 200m - Powered Accent to surface - Wait on Surface for data verification (Go Command) - Transit on surface to start waypoint - Fast dive to 3300m then more gentle until ADCP makes contact with bottom - Circle and wait for position offset from the Acoustics or timeout - Turn off EM2040 after survey - Return to surface and wait until we arrive to pick it up.
Objectives	• Gather Multibeam and Side Scan data of survey area

<table>
<tr><td>Map</td><td>
</td></tr>
<tr><td>Outcome</td><td>Recovery line wrapped around propeller, mission aborted after initial data verification dive.</td></tr>
<tr><td>Data Products</td><td>CTD to 200m
ADCP Water track velocities to 200m</td></tr>
</table>

6.4 RocSI eDNA Sampler (S. Evans)

6.4.1 Instrument details/settings. Calibration information

The new high-resolution autonomous sampler, the Robotic Cartridge Sampling Instrument (RoCSI) (Fig. 6.4.1.1) was recently developed at National Oceanography Centre, UK. It is pressure rated to 6000 m and has been integrated into the nose of Autosub6000 for the iMirabilis2 expedition.

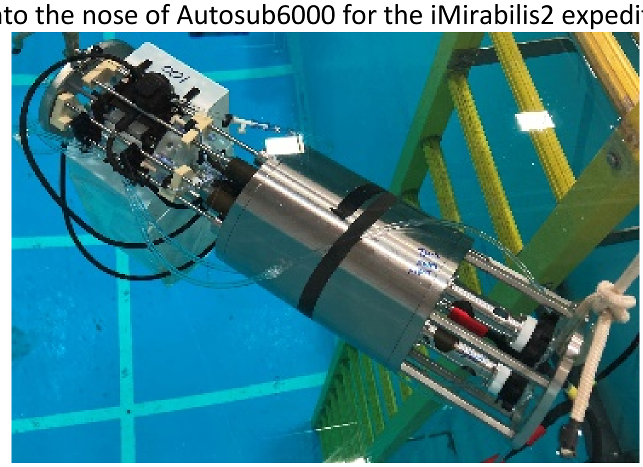


Figure 6.4.1.1 RoCSI in the NOC test tank. (Image: Susan Evans, NOC)

The RoCSI is designed to filter and preserve predefined volumes of water *in-situ*, collecting genetic material such as environmental DNA (eDNA) on a 0.22 µm filter. Extensive calibration of the flow meter and pressure sensors was conducted at the NOC prior to the cruise. However, during the cruise these components were continually tested on deck. Between each deployment when back on deck, all tubing was cleaned by flushing with a 10% bleach solution followed by Milli-Q water either manually using a syringe or using the RoCSI sample and stabiliser pumps.

6.4.2 Problems encountered

During the deployment and during on deck testing, there were some issues with the pressure sensor which gave very high readings (~35 bar). This was likely due to an electrical fault with the pressure sensor itself. On deck, the actual pressure in the sample line was tested using a hand-held pressure gauge using both Milli-Q water and high biomass water collected using the CTD-rosette. For the remaining deployments, the pressure sensor was unplugged from the plumbing and the volume of water filtered was based on just the flow meter reading.

The RFID scanner which was designed to read the identification tags on individual samples came loose during the AUV missions. The plastic holder was tightened but this did not solve the problem and in the end the RFID scanner was physically removed from the slot to prevent any interference with the rotation of the sampling belt. Modifications to this component will be considered in future RoCSI design reviews.

When RoCSI was integrated onto ROV LUSO (more detail in section 7.3.3), there were some issues with power supply despite extensive and successful testing before deployment. In the first ROV + RoCSI deployment, the RoCSI did not switch on at the programmed time and from the GUI diagnostics, RoCSI did not receive the required power at depth to switch on suggesting an issue with the portable battery housing used. For the 2nd deployment, RoCSI was powered directly from the ROV using a new cable made up the night before the deployment but unfortunately RoCSI did not switch on again. It is possible this was caused by a programming error. Further investigation is required.

6.5 ROV Luso (A. Calado, A. Afonso, M. Souto, B. Ramos, R. Bettencourt)

6.5.1 Instrument details/settings. Calibration information

The ROV Luso (Fig. 6.5.1.1) is a remotely operated vehicle capable of diving to depths of 6,000m and represents the ability to reach and operate on 97% of the seabed on a global scale.

Figure 6.5.1.1 ROV Luso deployment by moonlight. (Image: Monica Albuquerque / EMEPC / iMirabilis2) (Image: Luso team)

This equipment was acquired by EMEPC in 2008 as part of Portugal's Continental Shelf Extension Project with the aim of selectively collecting of geological samples from the seabed to provide scientific support to the Portuguese submission presented to the United Nations in May 2009. This equipment represents

an opportunity to undertake a unique array of multidisciplinary research, development and innovation activities.
The Luso performed its first mission in 2008 and, since then, has been involved in multiple oceanographic campaigns focused on the deep sea, in a total of 259 dives and 1084 hours of operation in 535 days offshore, with a maximum depth achieved during the iMirabilis2 campaign at 3512m depth.
The ROV Luso is a vehicle adapted for science in order to maximise the chances of collecting various types of samples (geological and biological - with different requirements in packaging the samples - sediments and water), and is equipped with various sensors that collect and provide key information in real time relating to the physical and chemical characteristics of the body of water in which the ROV is operating.
The vehicle already underwent several modifications. It was given added height, allowing the development of a larger sample box, the incorporation of a suction sampler with 5 individual chambers and an area for storing a group of corers. New sensors were also incorporated, such as CO_2, CH_4, turbidity, dissolved oxygen and fluorescence sensors, an inertial navigation system or a multibeam echosounder (not operational during iMirabilis2). Specific tools were also developed for the ROV, such as a rock saw for sampling in situ (developed in partnership with the LARSyS - IST) and new corers with internally designed restraint systems (developed in partnership with the company Isonewt).
In resume, these are the main pieces of equipment installed on the ROV for operation during the iMirabilis2 expedition:

- 2 schilling robotic manipulators, the RigMaster and the Titan4 with 5 and 7 functions, respectively.
- Sony FCBH10 Argus RS Focus Zoom HDTV camera and Sony FCBER8530 Argus RS Focus Zoom 4K camera
- 8 lights in total: 4 x 250W DSPL Halogen 4 x 150W Argus RS HID
- Kongsberg Still camera 10Mpx+ flashgun
- DVL, Doppler Velocity Log, as a stand alone to measure currents and navigation in Bottom track mode or input data for INS, model WorkHorseNavigator 1200
- 2 CTD's(measurement of salinity, temperature and pressure) with fluorescence, dissolved O_2 turbidity, pH and Potential redox sensors (SAIV SD204 and Idronaut Ocean seven 316 plus), and input data into the INS;
- Contros CH_4 and CO_2 sensors;
- Compartment for geological and biological samples;
- Suction sampler with 5 independent sampling chambers;
- Niskin bottles (2.5l capacity) to collect water samples;
- Push corers for collecting sediment;
- ImencoGreen line lasers, for scale and measuring (60 cm apart);
- Forward looking Sonar Kongsberg MS1000;
- AltimeterKongsberg Mesotech 1007;
- Depth sensor SAIV TD303;
- Compass KVHC100 and Gyroscope KVHDSP3000 ;
- USBL Acoustic positioning system HIPAP 452 (installed at the vesses), to measure the position of the ROV, and as a input to the INS, with 2 c-Node transponders installed on the ROV;
- Multibeam Norbit WBMS (not operational during iMirabilis2)
- Inertial Navigation System, to measure roll, pitch, heading and position, model iXblueRovinsNano

For more detailed information go to section 10.12 where the full specifications datasheet has been included.

In the last 2 dives of the campaign, the ROV was reconfigured for data and image acquisition in the area of operation initially planned for the AUV Autosub6000. The main differences from the previous configuration were:

- The RoCSI in the first battery-powered dive and in the second with electrical power from the ROV;
- a structure suitable for implementing equipment in front of the ROV;
- the photographic camera of the landers with its electronic bottle and flashes;
- relocated the ROV camera for redundancy;
- installed light at the bottom of the ROV for shadow zone lighting;
- installed extra flotation for extra weight compensation;
- removing batteries and transponder from tracklink 10000H system to compensate/remove weight;
- a monitoring camera was relocated to have realtime images of the RoCSI

Regarding the scientific sensors that need to be calibrated periodically, find below the tables (Table 6.5.1.1 and Table 6.5.1.2) that resumes the on-date calibrations for the sensors.

Table 6.5.1.1 – ROV Luso sensors calibration dates

Sensor	Recommended calibration interval	Last calibration date
Idronaut CTD including extra sensors	Every 2 years	November 2019
SAIV CTD including extra sensors	Every 2 years	November 2019
Contros CO_2	Annually	March 2021
Contros CH_4	Annually	Verified in October 2019 (not calibrated anymore because it's a discontinued sensor)

Table 6.5.1.2 – ROV Dives done during Leg 1 of iMirabilis2 Campaign.

Operation	Work area	Depth (m)	Reached seafloor	in water	out of water	Duration
D01_Station12	Southwest of Fogo Island	2150	Yes	Aug 6, 2021 8:11 AM	Aug 6, 2021 5:50 PM	09:38:01
D02_Station17	Southwest flank of Cadamosto Seamount	2000	Yes	Aug 7, 2021 7:54 PM	Aug 7, 2021 11:33 PM	03:39:36
D03_Station24	SouthWest of Cadamosto seamount	2000	Yes	Aug 9, 2021 3:16 PM	Aug 10, 2021 1:28 AM	10:12:00
D04_Station31	South of Fogo Island	1990	Yes	Aug 11, 2021 6:55 PM	Aug 12, 2021 2:03 AM	07:07:54
D05_Station46	Northwest of Cadamosto Seamount	2000	Yes	Aug 15, 2021 11:44 AM	Aug 15, 2021 10:31 PM	10:47:00
D06_Station55	South of Cadamosto Seamount	2000	Yes	Aug 17, 2021 12:21 PM	Aug 17, 2021 8:12 PM	07:51:00
D07_Station64	Northeast of Cadamosto Seamount	2000	Yes	Aug 19, 2021 4:20 PM	Aug 20, 2021 12:40 AM	08:20:35
D08_Station74	Northwest flank of Cadamosto Seamount	1700	No	Aug 21, 2021 11:15 AM	Aug 21, 2021 11:36 AM	00:21:01
D09_Station75	Northwest flank of Cadamosto Seamount	1700	Yes	Aug 21, 2021 12:26 PM	Aug 21, 2021 8:10 PM	07:43:13
D10_Station77	Southeast of Brava Island	2000	Yes	Aug 22, 2021 6:50 AM	Aug 22, 2021 2:50 PM	07:59:58
D11_Station83	NorthEast of Cadamosto Seamount – abyssal area	3400	Yes	Aug 24, 2021 2:45 PM	Aug 24, 2021 11:20 PM	08:35:04
D12_Station87	South of Fogo Island – abyssal area	3500	Yes	Aug 25, 2021 5:00 PM	Aug 26, 2021 12:44 AM	07:44:32

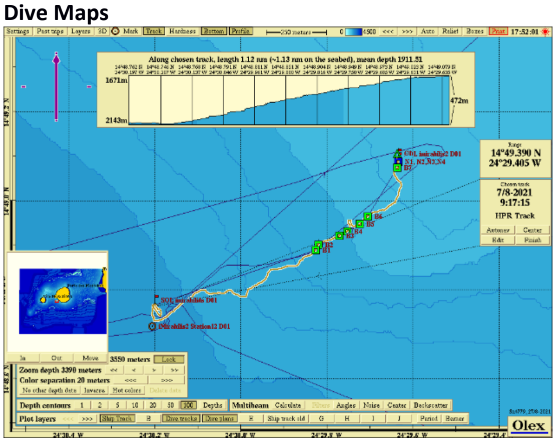
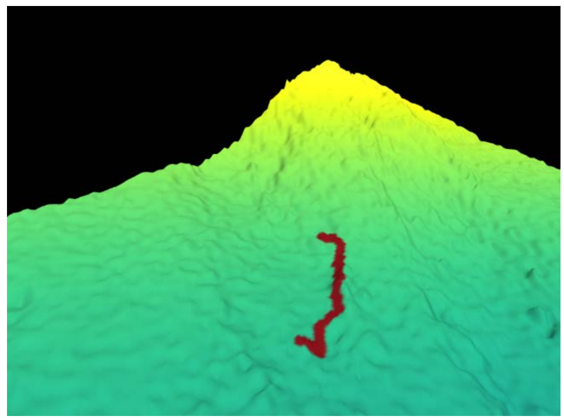
6.5.2 Problems encountered

During the iMirabilis2 expedition the ROV Luso did a total of 12 dives which represented 89 hours 58 minutes and 54 seconds of operation. Find below a table with a summary of each dive as well as information about the main problems encountered.

6.5.3 Summary of each ROV dive

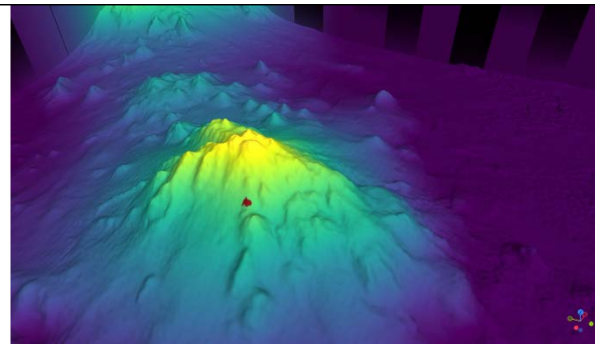
In the following boxes a summary of each ROV dive is presented.

iMirabilis2_D01_S12

Date and Time (UTC)	6th August de 2021 08:11
Duration (HH:mm:ss)	09:38:01
Working Area	SW Fogo Island
Latitude	14º48'46.5420''N
Longitude	024º30'12.0840''W
Initial Depth(m)	2150
Dive Maps	
	
Main Problems Encountered	- Raw video recording had some problems (Abyssal video Ok) - Solved - Punctual data transfer issues to video overlay - Solved - 4k camera telemetry not working – Solved - Problems with the ROV positioning detected because the ROV was not well showed in the Olex software - Solved

iMirabilis2_D02_S17

Date and Time (UTC)	7th August de 2021 19:54
Duration (HH:mm:ss)	03:39:36
Working Area	SW Cadamosto Seamount
Latitude	14º38'57.0300''N
Longitude	024º55'55.5060''W
Initial Depth(m)	2000
Dive Maps	



Main Problems Encountered

- 4K camera stopped working when we arrived on the seafloor.
- Telemetry problems passing the correct information to the overlay at the Abyssal video
- Dive aborted due to persistent problem with the 4K camera.

iMirabilis2_D03_S24

Date and Time (UTC) 9th August de 2021 15:16

Duration (HH:mm:ss) 10:12:00

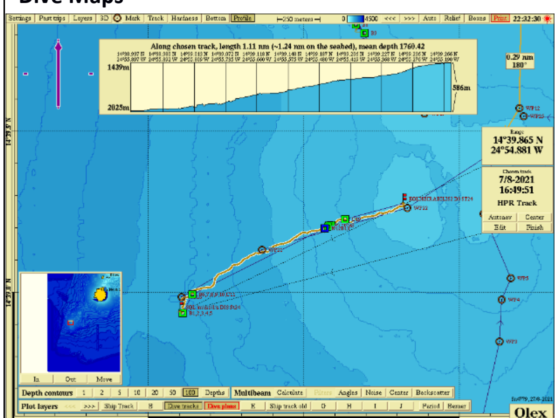
Working Area SW Cadamosto Seamount

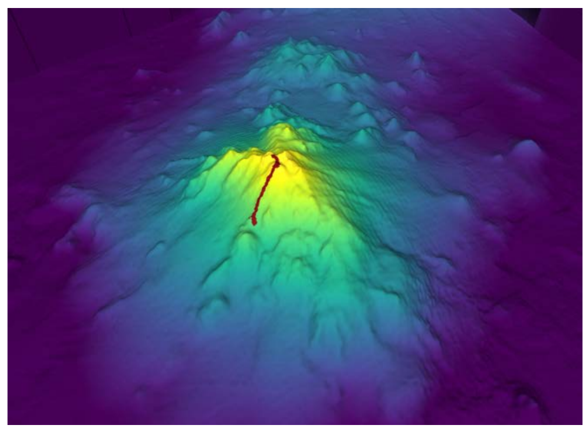
Latitude 14º38’55.1760’’N

Longitude 024º55’54.5880’’W

Initial Depth(m) 2000

Dive Maps





Main Problems Encountered

- Some “no video” frames on 4k video image
- Control of 4K camera stopped working. Dive continued without zoom capability

iMirabilis2_D04_S31

Date and Time (UTC) 11th August de 2021 08:11

Duration (HH:mm:ss) 07:07:54

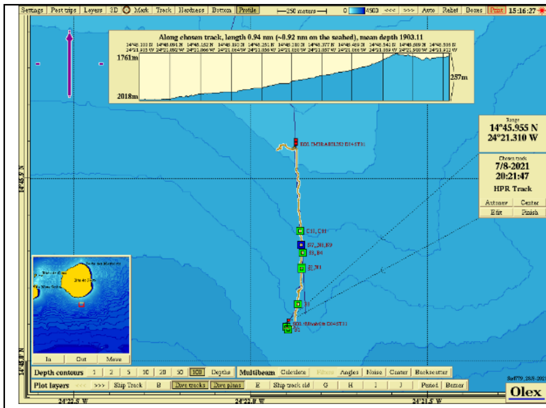
Working Area S Fogo Island

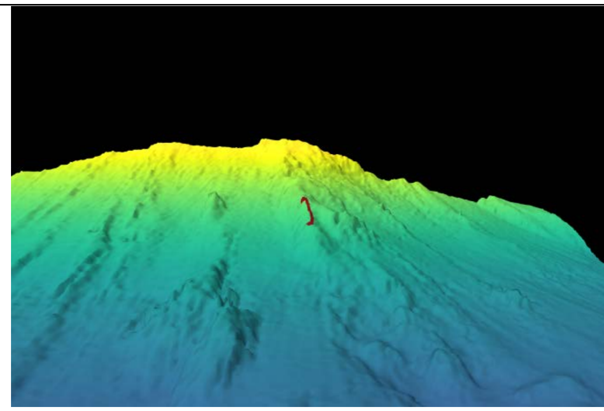
Latitude 14º45’05.4780’’N

Longitude 024º21’52.7220’’W

Initial Depth(m) 1990

Dive Maps





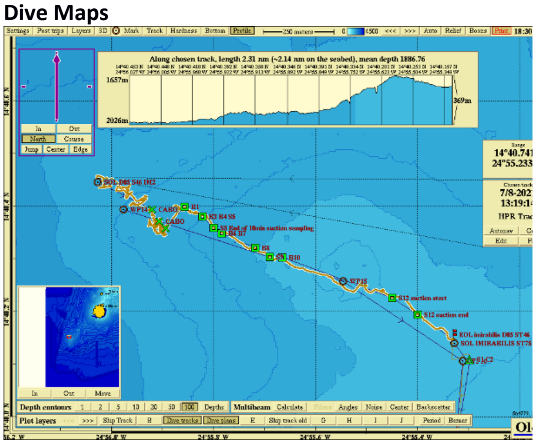
Main Problems Encountered

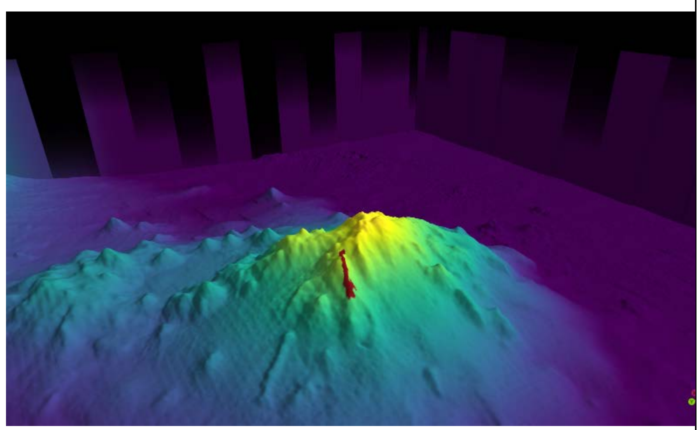
- 4K video image with some “no video” frames. 4k camera turned off and replaced by the High-Definition camera.

iMirabilis2_D05_S46

Date and Time (UTC)	15th August de 2021 11:44
Duration (HH:mm:ss)	10:47:00
Working Area	NW Fogo Cadamosto Seamount
Latitude	14º40’24.7560’’N
Longitude	024º56’01.9440’’W
Initial Depth(m)	2000

Dive Maps





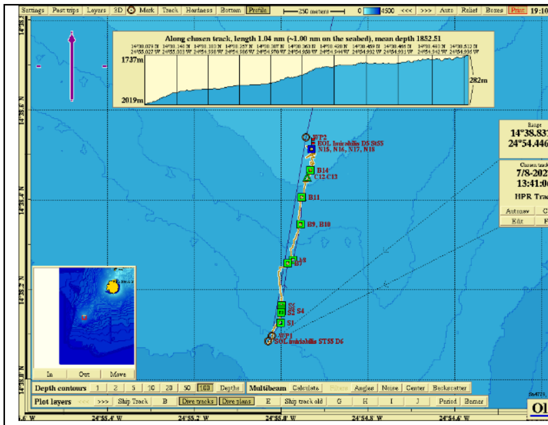
Main Problems Encountered

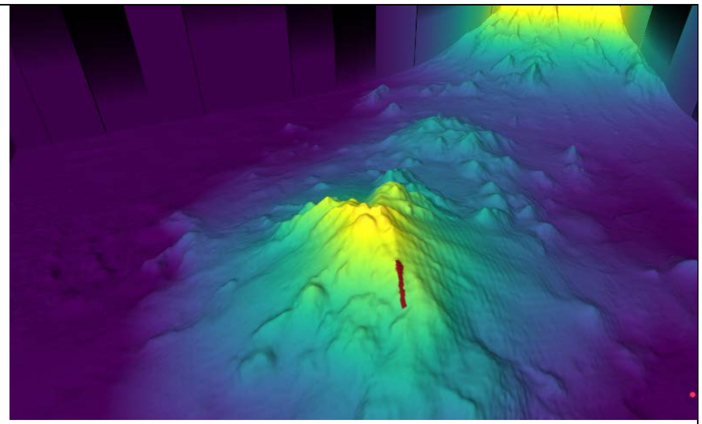
- 4K video image with some “no video” frames. 4k camera turned off and replaced by the High-Definition camera.
- Fishing cable on the seafloor but part of it was in the water column, in a very dangerous configuration. We moved away a bit from the area to avoid the cable.
- Compass stopped working. Problem Solved.

iMirabilis2_D06_S55

Date and Time (UTC)	17th August de 2021 12:21
Duration (HH:mm:ss)	07:51:00
Working Area	S Cadamosto Seamount
Latitude	14º38’03.9180’’N
Longitude	024º55’01.8480’’W
Initial Depth(m)	2000

Dive Maps





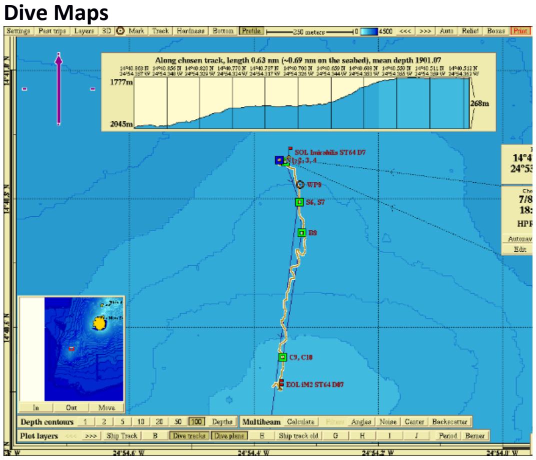
Main Problems Encountered

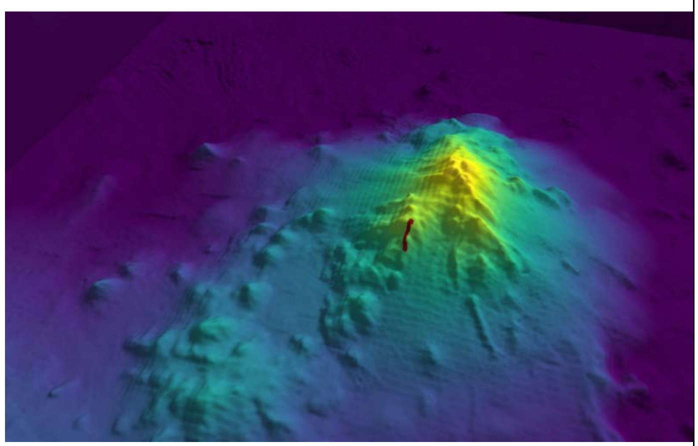
- 4K video image with some "no video" frames.
- Some drop frames during the video recording.

iMirabilis2_D07_S64

Date and Time (UTC)	19th August de 2021 16:20
Duration (HH:mm:ss)	08:20:35
Working Area	NE Cadamosto Seamount
Latitude	14º40'46.8980''N
Longitude	024º54'52.5540''W
Initial Depth(m)	2000

Dive Maps





Main Problems Encountered

- 4K video image with some "no video" frames.
- T4 manipulator not working at the end of the dive.

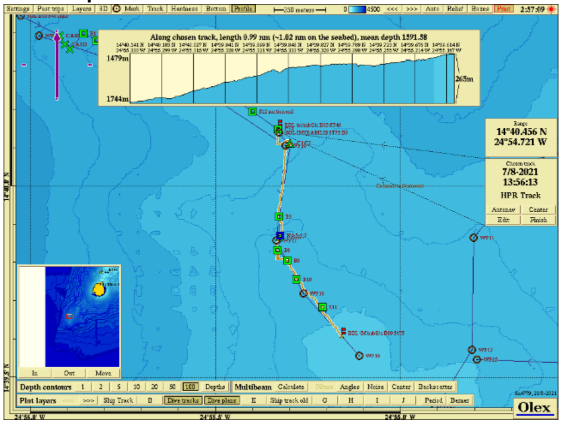
iMirabilis2_D08_S74

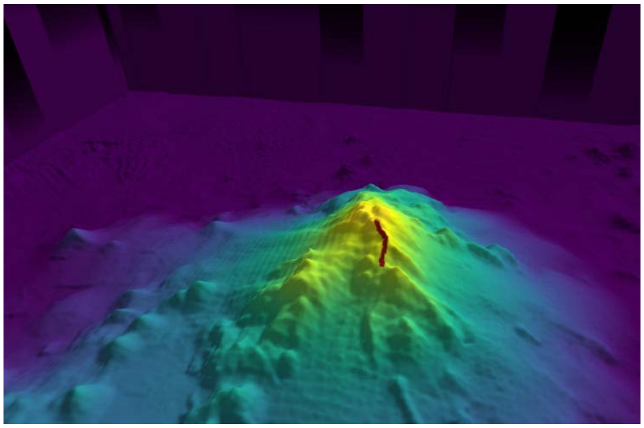
Date and Time (UTC)	21th August de 2021 11:15
Duration (HH:mm:ss)	00:21:01
Working Area	NW Cadamosto Seamount
Latitude	No ROV position
Longitude	No ROV position
Initial Depth(m)	1700
Dive Maps	
Main Problems Encountered	- Dive aborted near surface. Positioning System not working

iMirabilis2_D09_S75

Date and Time (UTC)	21th August de 2021 12:26

Duration (HH:mm:ss)	07:43:13
Working Area	NW Cadamosto Seamount
Latitude	14º40’08.7840’’N
Longitude	024º55’19.3980’’W
Initial Depth(m)	1700
Dive Maps	

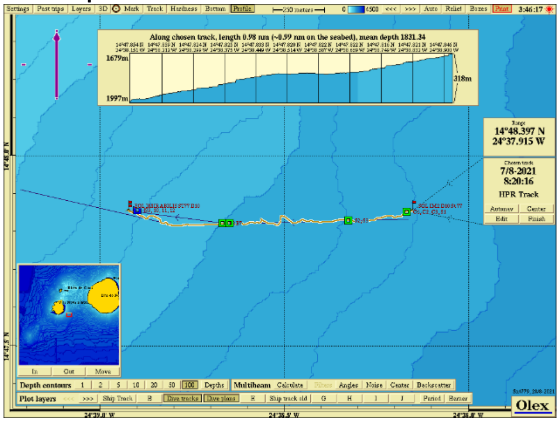


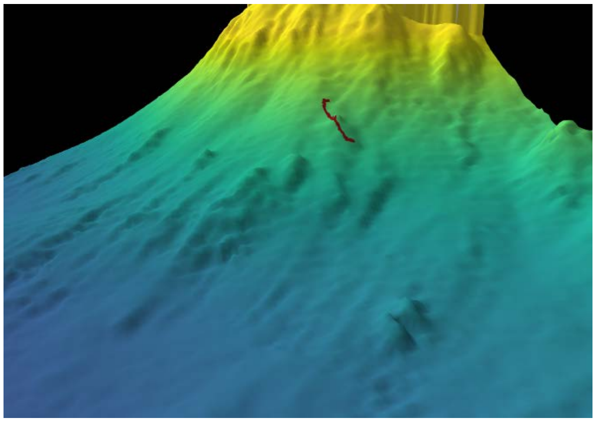


Main Problems Encountered	- Launch and Recovery System overheated. The water cooling pump from the vessel was turned off by mistake. Solved after a stand-by period to cool down the oil temperature. - 4K video image with some “no video” frames. - Still camera with some problems in the image. Was turned off.

iMirabilis2_D10_S77

Date and Time (UTC)	22th August de 2021 06:50
Duration (HH:mm:ss)	07:59:58
Working Area	SE Brava Island
Latitude	14º47’52.6860’’N
Longitude	024º38’08.4780’’W
Initial Depth(m)	2000
Dive Maps	

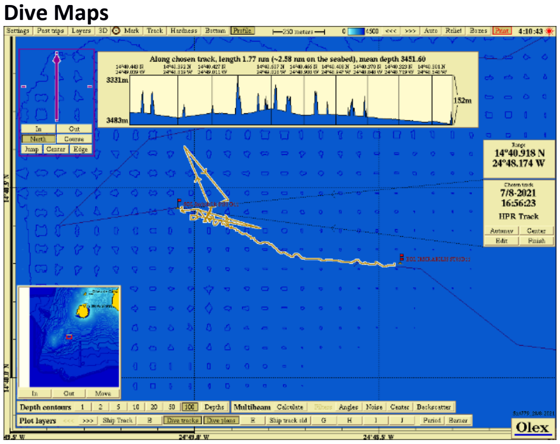
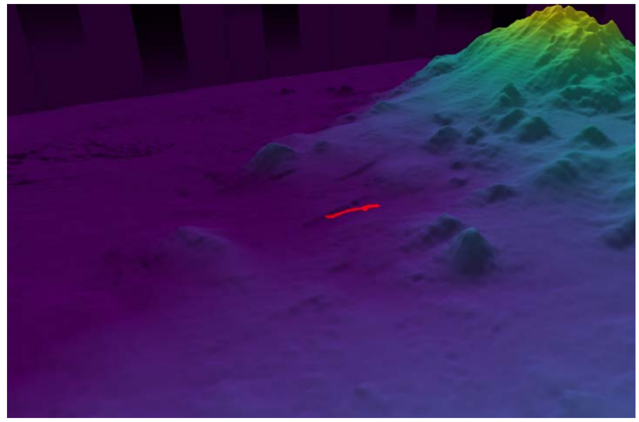




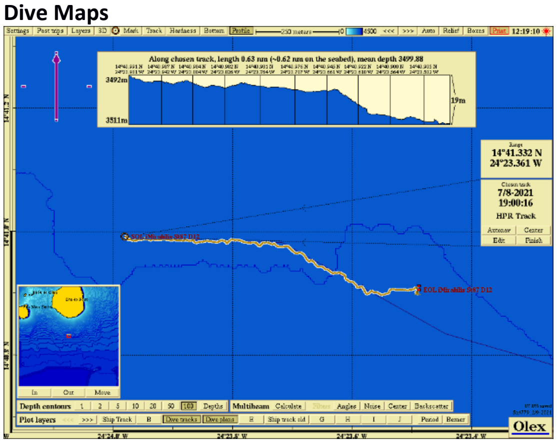
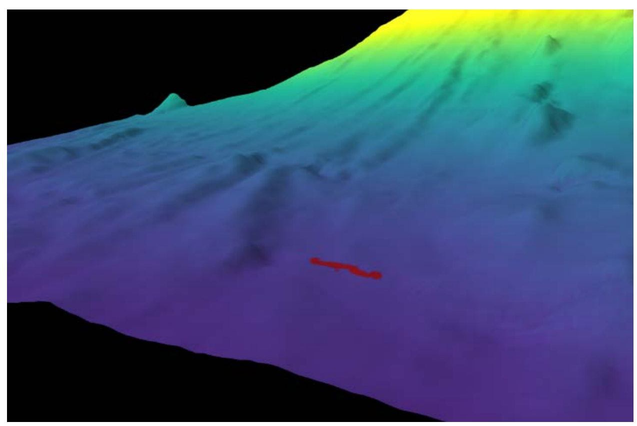
Main Problems Encountered	- 4K video image with some “no video” frames.

iMirabilis2_D11_S83

Date and Time (UTC)	24th August de 2021 14:45
Duration (HH:mm:ss)	08:35:04
Working Area	E Cadamosto Seamount base
Latitude	14º40’ 29.4240’’N

Longitude	024º49'04.3320''W
Initial Depth(m)	3400
Dive Maps	
	
Main Problems Encountered	- 4K camera image with lots of breaks

iMirabilis2_D12_S87

Date and Time (UTC)	24th August de 2021 17:00
Duration (HH:mm:ss)	3500
Working Area	S Fogo Island, Abyssal Area
Latitude	14º40' 59.5080''N
Longitude	024º23'55.2360''W
Initial Depth(m)	3500
Dive Maps	
	
Main Problems Encountered	- 4K camera stopped working. It have moved to the HD cam to continue the operation. - Stills cam not working. It was turned off for the rest of the dive.

6.6 Seafloor Landers (A. Sweetmann, D. de Jonge, A Smith)

6.6.1 Benthic Respirometer Lander

6.6.1.1 Instrument details/settings. Calibration information

The benthic respirometer lander (Fig. 6.6.1.1.1) is a KUM seafloor lander that can perform *in situ* incubations down to 6000 m. The lander holds a Deep-Sea Power and Light battery, two KUM lander computers, two heavy duty KUM QUAT releases, and four chambers of 22x22 cm, spaced apart approximately 0.5 m, each with a stirrer, oxygen optode, syringe samplers, substrate injector, and drive

motors for the chamber, chamber door, and syringe sampler. The computer is programmed before deployments to autonomously run an experimental set-up at the seafloor. Weights (300 kg) attached to the lander legs allow the lander to sink autonomously and reach the seafloor upright. The drive motors push the chambers into the sediment, sealing off a patch of sediment and bottom water to incubate. The depth of the chambers being pushed down is programmed and aims to retrieve ~15 cm sediment and ~15 cm bottom water. Isotopically labelled substrate is injected into the chamber and distributed equally throughout the chamber by the stirrers (60 rpm). After the substrate has been allowed to settle (1.5 hours with stirrers turned off) the stirrers are switched on to maintain a diffusive boundary layer within the chamber, and detect the change in oxygen concentration as the sediment community processes the substrate is measured over the time in the incubation, usually 48 hours. Additionally, at 7 pre-programmed points in time, a 50 ml water sample from inside the chamber is taken using syringe samples. At the end of the incubation, the chamber doors close, and a hydrophone signal is sent from the vessel to active the releases. The positive buoyancy of the glass Nautilus floats delivers the lander back to the surface, where we can recover it and process the sediment and water samples in the shipboard lab.
The respirometer is outfitted with four Aanderaa oxygen optodes (model 4330F). The manufacturer provided individual multipoint (40-point) calibrations for these oxygen optodes, conducted at the end of 2019 and beginning of 2020. Due to drift of sensing foil behaviour over the months until iMirabilis2, a recalibration of the optodes is necessary to correct the provided calibration coefficients to convert raw readings to oxygen concentrations. This is a laborious task, and will be conducted back at the lab of HWU right after iMirabilis2.
The benthic respirometer lander has a sinking rate of ~75 m/min and an ascent rate of ~60 m/min. Preparing the lander for deployment takes about 3 hours (excluding battery charging). Processing the lander samples takes about 4 hours. Turn-around time for lander deployment is approximately 12 hours.

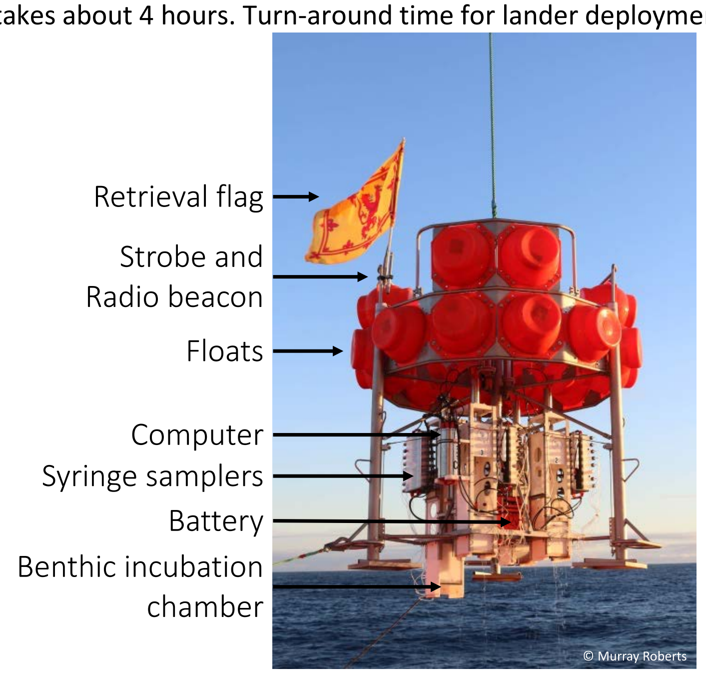


Figure 6.6.1.1.1 Recovery of the Benthic Respirometer Lander. Its various components are annotated. (Image: Murray Roberts, University of Edinburgh).

6.6.1.2 Problems encountered

During iMirabilis2, this specific benthic lander was used for the first time. After the first deployment, chamber 1 had conducted a successful experiment, chamber 2 and 3 had successfully retrieved sediment but failed to inject substrate or obtain water samples, and chamber 4 had not functioned. Inspection of the computer showed melted components for chamber 4. Contact with the manufacturer confirmed this failure could be caused by a software issue, but they did not have a solution ready. We tried various versions of the program (an older version without optodes, an updated version with bug fixes by the manufacturer) and switched around the computer driving different chambers, but we did not manage to solve the issue. Therefore, each deployment could conduct only one experiment and obtain two background samples.

6.6.2 Baited Camera Lander

6.6.2.1 Instrument details/settings. Calibration information

The baited camera lander is a KC Denmark lander that can collect imagery of activity around attached bait down to a depth of 6000 m. The lander holds a NIKON D7200 camera, two flash strobes, a housing with computer and battery, a bait plate, two heavy duty KUM QUAT releases, and syntactic foam. One weight stack of 250 kg in the lower middle of the lander allows it to autonomously reach the seafloor upright. Just like the benthic respirometer lander, a hydrophone sound signal releases the weight for lander ascent and recovery.

The camera is pointed at the bait plate which is attached lower on the side of the lander to rest on the seafloor, resulting in an angled view of the plate and surrounding sediment. The bait plate is relatively small in order to focus the organisms in the centre of the images. Camera settings used during iMirabilis2 were exposure of 1/25 seconds, equivalent focal length of 160 cm (5.2 ft), aperture Fstop of 16.0, ISO of 200, and a picture interval of 150 seconds (2:30 min). The Baited Camera Lander was left at the seafloor for approximately 24 hours before recovery, resulting in approximately 600 pictures per deployment. The bait was weighed before and after each deployment to calculate the scavenging rate (g/ d) of the different baits.

The baited camera lander (Fig. 6.6.2.1.1) has a sinking rate of ~20 m/min and an ascent rate of ~ 60 m/min. Preparation for lander deployment takes about 1 hour, data recovery takes about 2 hours, and lander turn-around time is about 4 hours.

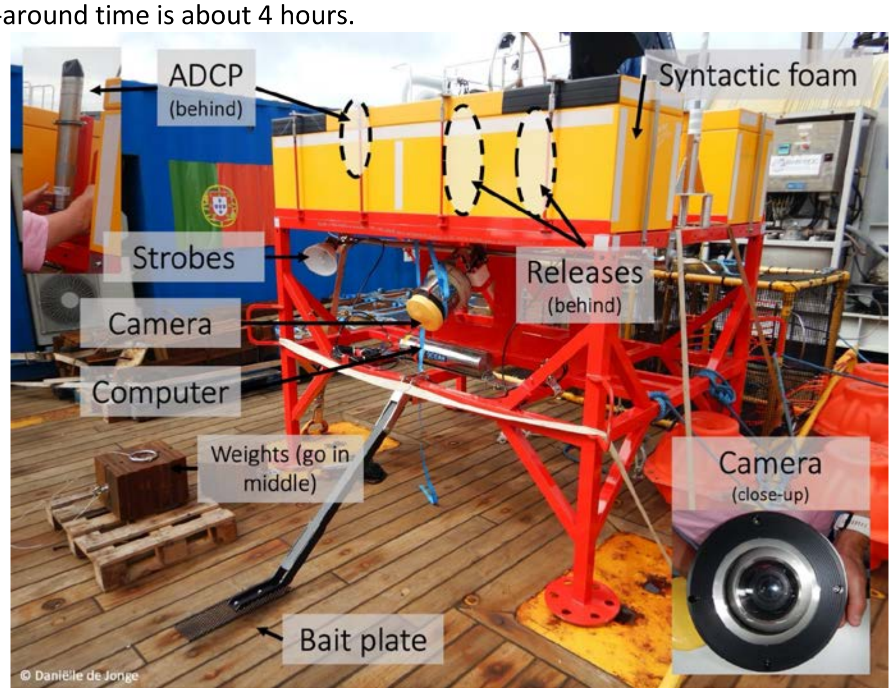


Figure 6.6.2.1.1 The Baited Camera Lander with its various components annotated. (Image: Daniëlle de Jonge, HWU).

6.6.2.2 Problems encountered

During the first deployment, not enough weight was attached to the lander which meant it didn't sink to the seafloor. The lander was recovered, refitted with extra weights (up t0 250 Kg) and deployed to the seafloor successfully. After this, no problems were encountered, as the lander functioned fully as required.

6.6.3 Baited Trap Lander

6.6.3.1 Instrument details/settings. Calibration information

The baited trap lander (Fig. 6.6.3.1.1) is a seafloor lander consisting of a frame and plastic mesh design to sample larger fauna. Bait is attached on the inside of the trap and to fishhooks on the in- and outside of the trap, luring in scavengers and associated fauna. The one-way entrances and baited fishhooks trap the animals inside, allowing us to retrieve the specimens upon lander recovery for reference specimens and tissue samples. The lander carries one weight stack of 180 kg to allow it to autonomously reach the seafloor upright, and one heavy duty KUM QUAT release that releases the weight stack upon receiving the hydrophone signal for lander recovery. Floats attached to a mooring line and a flagpole provide positive buoyancy for ascent.

The baited trap sinks with a speed of about 30 m/min and ascends with a speed of about 50 m/min. Preparing the baited trap for deployments takes ~1 hour, processing samples after recovery takes ~4 hours, turn-around time is ~1 hour.

Figure 6.6.3.1.1 Recovery of the Baited Trap Lander, with rattail fish attached to fishhooks in- and outside the trap. The white HDPE bottles with holes and bait inside function as amphipod traps. (Image: Murray Roberts, University of Edinburgh).

6.6.3.2 Problems encountered

No problems were encountered with the baited trap lander.

6.7 *Ex situ* sediment incubations (A. Sweetman, D. de Jonge, A Smith)

6.7.1 Instrument details/settings. Calibration information

Two LMS incubators (series 3, model 300W) (Fig. 6.7.1.1) were used for incubating a total of 16 sediment cores. The cores were obtained with the 'KC Denmark' MUC (see section 7.9.3). Incubating temperatures were set at 6.5ºC and 8.5ºC (for scientific rationale, see section 7.9 Functional ecology of soft bottom deep-sea benthos off Cabo Verde. *Ex situ* sediment incubations´). Aeration of overlying water in the cores was arranged through 8 aquarium pumps holding 16 tubes each with an air stone. Sediment Community Oxygen Consumption (SCOC) measurements throughout the experiment were done with 8 FireSting optodes, when cores were sealed off with an air-tight core lid and top water gently stirred. The FireSting optodes were calibrated on the ship using a two-point calibration in seawater at experimental temperature (controlled using a Thermo NesLab RTE17 water bath) with a salinity of 36 PSU. The saturation (100% and 0%) of the seawater was controlled by bubbling air and nitrogen, respectively, for at least 15 minutes.

Figure 6.7.1.1 *Ex situ* sediment incubation set-up. Sediment cores sealed at the bottom are placed in black boxes with filtered seawater held at the experimental temperature hat was maintained in the LMS incubators. During SCOC measurement intervals the cores were sealed at the top, gently stirred (white bars in image), and oxygen concentration measured using FireSting optodes (metal rods in image). (Image: Daniëlle de Jonge, HWU).

6.7.2 Problems encountered

There was a discrepancy between the size of the MUC cores (inner diameter 9.5 cm) and the size of the incubation cores (inner diameter 10.0 cm) due to a miscommunication. Therefore, it was not possible to seamlessly extrude the sediment from the MUC into the incubation core without disturbing the overlying water and sediment surface. As a solution, overlying water was siphoned off the collected MUC core into a clean container before extruding and slicing about 15-18 cm of the sediment to transfer to an incubation core. The siphoned water was then gently trickled back into the transferred core to minimize resuspension of sediment. The discrepancy in diameter also introduced air pockets on the sides of the incubation core, so care was taken that seawater reached the full length of the core. If necessary, the core was topped off with filtered (5 µm) seawater held at the experimental temperature.

6.8 Multicorer (MUC) (V. Huvenne, P. Rodríguez, I. Casal, M. Sánchez)

A total of 9 multicore deployments were carried out with the 'KC Denmark' MUC . The first 4 multicores were obtained in a shallower area between the islands of Praia and Maio. The other cores were taken in the main study areas around Cadamosto Seamount and in the abyssal area used for lander work (Table 6.8.1, Fig. 6.8.1). Multicores 5 and 8 were taken at locations where GEOMAR previously took gravity cores, to complement the long-term records with a more accurate sampling of the recent sediments.

Table 6.8.1 Multicores taken during the iMirabilis2 expedition

Station_No	MUC_No	Date	Time	Lat_N	Long_W	Depth_m	pull_out_tons	cable_out_m	core_length_cm	No_Cores	sliced?	RoseBengal?	Subcore_whole?	eDNa	Comments
3	1	04/08/2021	03:06	15.31651	23.36908	876	1.7	unknown		5	N	N	N	N	for Andrew Sweetman - experiment
4	2	04/08/2021	04:42	15.3165	23.36908	876	5.3	unknown		6	N	N	N	N	for Andrew Sweetman - experiment
5	3	04/08/2021	05:43	15.31649	23.36907	876	1.6	unknown		6	N	N	N	N	for Andrew Sweetman - experiment
6	4	04/08/2021	06:48	15.31651	23.36908	876	1.6	unknown		6	N	N	N	N	for Andrew Sweetman - experiment
29	5	10/08/2021	21:49	14.63284	25.50151	4394	7.1	unknown	34		Y	2	3	2	
65	6	20/08/2021	03:55	14.71092	24.82081	3184	4.9	3142	20	6	Y	2	3	1	
66	7	20/08/2021	08:31	14.61939	24.90371	2584	7.8	2554	13	2	Y	1	N	0	core may have landed on slope, landed on seabed twice or otherwise disturbed. 1 empty tube, 3 tubes no water
80	8	23/08/2021	03:25	14.7238	25.15682	4276	6	4170	35	5	Y	1	1	1	two core tubes sliced for macrofauna for Danielle de Jonghe (0-2cm, 2-5cm)
82	9	23/08/2021	20:02	14.85667	25.05179	4195	8	4088	35	5	Y	2	2	1	depth from echosounder may be wrong

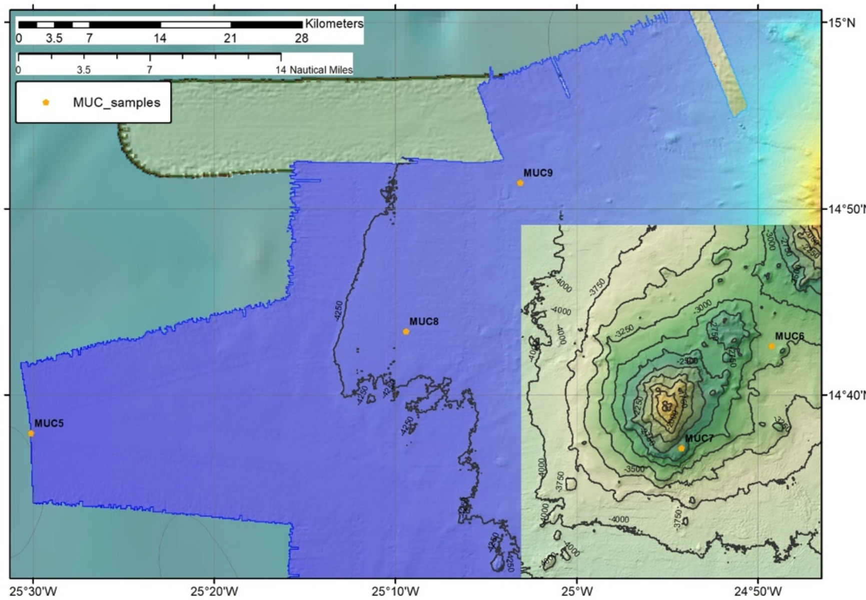


Figure 6.8.1 Map of MUC sample locations for paleoceanography sampling.

6.8.1 Instrument details/settings. Calibration information

See UTM technical report in section (10. 8)

6.8.2 Problems encountered

As indicated in Table 6.8.1, one MUC deployment on Cadamosto Seamount seemed disturbed. It is possible that the core landed on a slope (and potentially fell over or did not have a clean recovery from the seabed), or it may have landed twice without closing in between. This resulted in one empty tube and 3 tubes not being sealed well (hence missing the overstanding water by the time they were recovered on deck). Therefore, the results from MUC7 should be considered with caution.

6.9 Box Corer/Van Veen Grab (V. Huvenne, I. Casal, M. Sánchez)

A total of 7 BC deployments were carried out on and around Cadamosto Seamount. Typically we would choose the BC for locations that could have coarser sediments or more difficult coring conditions. As a result, only 2 BC deployments were really successful, with two more yielding a small amount of washed-out sediment (Table 6.9.1, Fig. 6.9.1).

Table 6.9.1 Box cores taken during the iMirabilis2 expedition

Station_No	BC_No	Date	Time	Lat_N	Long_W	Depth_m	pull_out_tons	cable_out_m	core_length_cm	sliced?	RoseBengal?	Subcore_whole?	Comments
20	1	08/08/2021	12:35	14.70102	24.87258	2800	3.1	unknown	17	Y	Y	Y	core probably partly washed out
21	2	08/08/2021	16:19	14.61949	24.9038	2548	2.9	unknown	36	Y	Y	Y	
22	3	08/08/2021	19:43	14.67061	24.90856	1750	5.6	1757	3	N	N	N	Very small sample of gravelly sand. Core washed out, discarded
41	4	14/08/2021	08:32	14.67403	24.90564	1800	4.6	1777	5	N	N	N	gravelly sand. Small bag sample taken from top of boxcore
42	5	14/08/2021	11:20	14.67249	24.90866	1791	4.3	1820	0	N	N	N	core fell over and tangled in cable
52	6	16/08/2021	12:55	14.68481	24.8898	2447	6.9	2430	0	N	N	N	core fully washed out
62	7	19/082021	04:30	14.71089	24.82073	3185	5.7	3147	0	N	N	N	clamp on cable got blocked in core mechanism, core didn't close

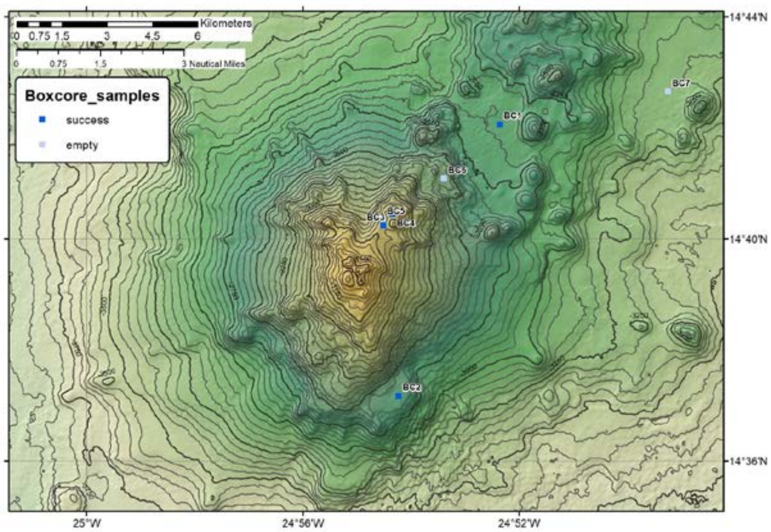


Figure 6.9.1 Map of boxcore locations around Cadamosto seamount. Legend indicate successful and empty deployments

6.9.1 Instrument details/settings. Calibration information

See UTM technical report in section (10. 8).

6.9.2 Problems encountered

As indicated in Table 6.9.1, several of the BC operations were unsuccessful. This may have been because the seabed was too hard or too coarse (BC06), but for BC05 and BC07 this was due to mechanical issues: BC05 fell over (probably because the slope was too steep) and hence was tangled in the coring cable. For BC07 unfortunately one of the clamps on the coring cable was caught/wedged in the coring mechanism, again preventing the core from closing properly. For future use, this clamp will be wrapped in tape to avoid similar issues.

6.10 Plankton net (A. Gori, C.Orejas, B. Vinha)

A total of 7 plankton net deployments were conducted over Cadamosto Seamount, Fogo and Brava slopes (Table 6.10.1). The collected samples will be processed for stable isotopes and fatty acids analysis (see section 7.5) and taxonomy.

Table 6.10.1 WP2 Plankton Net deployments

Deployment number	Date	Time	Latitude	Longitude	Depth	Location	Obs.
1	20/08/2021	11:08	14,6584	-24,9175	1400	Cadamosto	
2	20/08/2021	13:02	14,669	-24,8942	2116	Cadamosto	
3	20/08/2021	15:29	14,6456	-24,9381	2037	Cadamosto	
4	24/08/2021	00:23	14,6965	-25,1231		Cadamosto	Aborted
5	26/08/2021	02:26	14,7529	-24,3654		Fogo	Aborted
6	26/08/2021	03:35	14,8122	-24,5028	2146	Fogo	
7	26/08/2021	06:32	14,7972	-24,6359	1972	Brava	

6.10.1 Instrument details/settings. Calibration information

A WP2 net (200 µm) was deployed vertically at 40 m^{-1} until approximately 100 m above the bottom, and then recovered at the same speed. Plankton was collected in a bucket and subsequently subdivided as follow:

Shrimps were individually fixed for stable isotope and fatty acid analyses at -80ºC.

Fish were individually fixed for stable isotopes and fatty acid analyses at -80ºC.

All the remaining zooplankton (with abundant gelatinous component) was fixed for stable isotopes and fatty acid analyses at -80ºC, as well as in 10% formalin for taxonomical analyses.

6.10.2 Problems encountered

Due to oceanographical and meteorological conditions two out of the seven deployments had to be aborted.

6.11 Seabird ecology (JC Abella, H Dinis, N. Barbosa, J. González-Solís)

This work has been conducted in Leg0, however as it is part of the iAtlantic capacity building activities, in order to fully document the work conducted from the ornithology team on board we include this section in the expedition report.

6.11.1 Methodology

Our materials were few and simple:

- identification seabirds guide (id)
- field work data collection sheets (Fig. 6.11.3.1)
- rule for assigning bands
- GPS App (tracking 10 minutes route and direction, Fig. 6.11.3.2)
- binoculars, camera (help on finding & id, Fig. 6.11.3.3)

CAMPAÑA: iMirabilis 2 BARCO: Sarmiento de Gamboa RECORRIDO: Vigo (23/07/2021) --> Gran Canaria (30/07/2021)								
EQUIPO: J.CAbella; H.Dinis; N.Barbosa ANCHO BANDA: 300m CENSO TOTAL EN TRAMOS DE 10MIN								
N_CENS	FECHA	HORA	OBSERVADOR	90/180	ESTADO MAR	BEAUFORT	DIRECCION VIENTO	
COBERTURA NUBES (%)	LLUVIA (0/1)	VISIBILIDAD	VELOCIDAD (NUDOS)	RECORRIDO (km)	AREA PROSPECTADA (KM2)	RUMBO (º)	LAT	LONG
OBSERVACIONES								

HORA	SNAPSHOT	TIPO ITEM	ITEM	CANTIDAD	EDAD	ACTIVIDAD	DISTANCIA	DENTRO / FUERA	COMP	CODIGO OBSERVACION	OBSERVACIONES
	0	*AVES*	*CALBOR*			*1*		*1*	*3*	*1*	

Figure 6.11.3.1 Field work data sheet

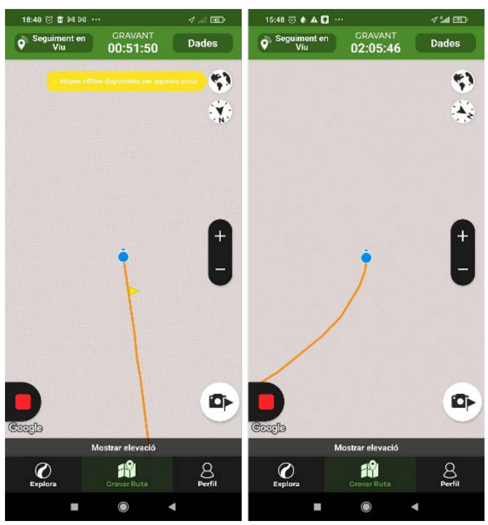


Figure 6.11.3.2 left: Wikiloc App tracking the route and direction; right : change of direction which indicates the moment when we stop watching.

Figure 6.11.3.3 left: Nadito using binoculars to look for seabirds and trying to identify them. Right: Herculano using a camera to take pictures that will help us later to identify the birds if necessary (Images: J.C. Abella)

The sampling methods used were according to the distance sampling approach. That implies to know some ship parameters before starting, in order to determine the bird position on line-transect strips. These parameters are: deck's height from sea to seawatch, vessel speed, linear transect.

The eye height of the observer was important for the sighting angle and it will affect how to calculate the position of survey bands. To have the best visibility the recommended place to work is the highest place on the vessel and where the sight is clear, this is usually at the bow (Fig. 6.11.3.4).

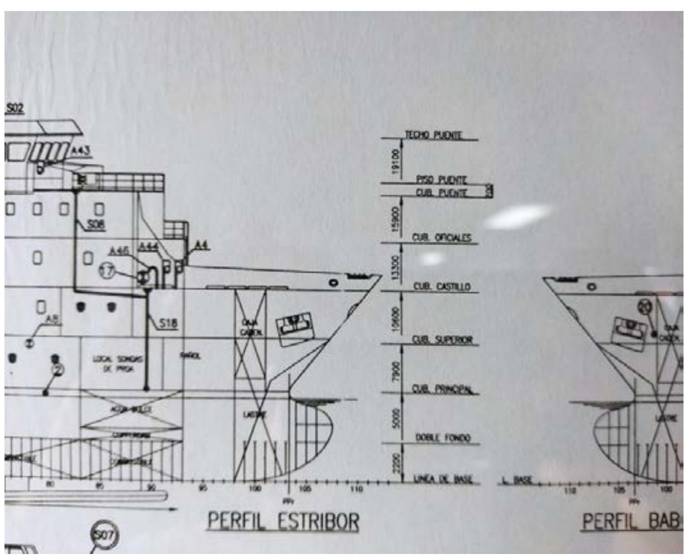


Figure 6.11.3.4 The bow bridge deck from we were watching at sea.

The height of the bridge deck plus the observer's eye height -assuming the little up because fuel consumption lastly- was 13,5 meters above sea level, then we calculated the band width indicating the distance from the observer. With the help of insulating tape with a different colour for each band we designed a ruler with colour bands (see Fig. 6.11.3.5, and Fig. 7.11.3.6) that we used to locate birds in terms of distance from the observer (0-50 m green-A, 50-100 m yellow-B, 100-200m sky blue-C, 200-300m red-D, >300m black-E).

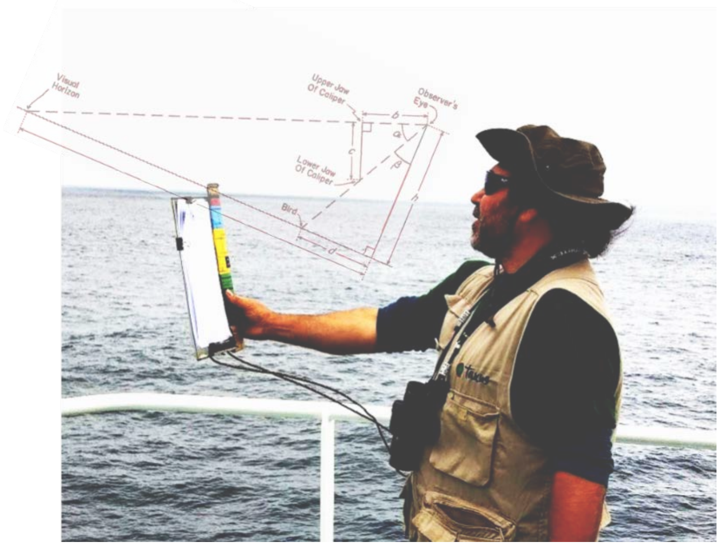


Figure 6.11.3.5 Joan Carles' demonstrates how to estimate the distance of a bird from the ship. The top of the ruler must be at the horizon, the arm outstretched and then he locates the position of the bird (d). The bandwidth will be bigger for the distances closer to the vessel and thinner for the distances further away. (Trigonometric figure modified from Heinemann 1981). (Image: seabird ecology team)

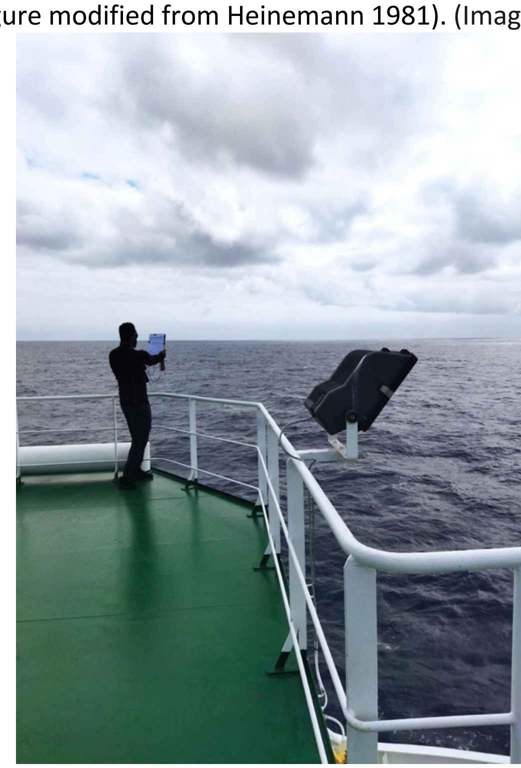


Figure 6.11.3.6 Herculano counting birds (image: J.C. Abella).

The preferred vessel speed to conduct a census is 10 knots, the recommended speed is between 4 and 10 knots. This speed range is necessary because the speed can modify the snapshot taken and the length of line transect (1200m at 4 knots in 10 min). The line direction must be the same for at least 10 minutes.
Good sea and weather conditions are key to perform a good census. We used the Douglas scale of sea conditions as a reference because it can affect our survey work. When the values were over 3 we had to stop surveying. Most days we had sea conditions under 3 and sunny days. When the ship's direction changed, we started a new survey. The crew was very kind to let us know when a change in the direction would take place. The survey time unit always was 10 minutes, regardless of the ship's speed.

6.11.2 Problems encountered

No problems encountered

7 Scientific report

7.1 Physical oceanography off Cabo Verde (Á. Mosquera-Giménez, P. Vélez-Belchí, P. Rodríguez, I. Mouzo)

7.1.1 Personnel involved

The personnel involved in physical oceanography during iMirabilis2 are listed in Table 7.1.1.1.

Table 7.1.1.1 Personnel involved in physical oceanography.

Name	Institution	Role and responsibilities
Pablo Rodriguez Fornes	Technician leader (UTM, CSIC) pablo@utm.csic.es	VADCP operator
Iván Mouzo Bellino	Technician (UTM, CSIC) imouzo@utm.csic.es	CTD operator
Ángela Mosquera Giménez	Technician (IEO, CSIC) angela.mosquera@ieo.es	Hydrographic and dynamic characterization

7.1.2 Introduction. Aims

The Cabo Verde Islands are located between the North Equatorial Current (NEC) at the North and the North Equatorial Counter Current (NECC) at the South. When it reaches Africa, the NECC splits in two currents, an eastward flow called the Guinea Current, and a northward flow, that joints the NEC forming a front known as the Cabo Verde Frontal Zone, that acts as a barrier between the North Atlantic Central Waters (NACW) and the South Atlantic Central Waters (SACW). In addition, this northward flow produces a cyclonic circulation in the region between the NEC and the NECC, called the Guinea Dome, and therefore an upwelling in this area. Besides, the proximity of the Islands to the continent, makes them affected by the coastal upwelling, especially during the seasons of winter and fall. Due to these particular circumstances, it is important to carry out an oceanographic characterization in order to improve the knowledge of an area so scarcely studied. This will also help to set up the environmental frame for the other studies carried out in the area.

Special attention was given to the characterization of the Cadamosto seamount. Seamounts are underwater mountains which create a perturbation in the oceanic flow. This perturbation under idealized circumstances, known as Taylor column, has the potential to isolate the oceanic circulation over the summit from the ocean circulation in the open waters. This can lead to the occurrence of upwelling phenomena that enrich and isolate the seamount ecosystem (Boehlert and Genin 1987, Mohn et al. 2009, Lavelle and Mohn 2010). However, Cadamosto is close to the spatial scale where the Taylor column is formed, since its diameter was smaller than the Rossby radius of deformation in the area, 60 km (Chelton et al. 1998).

Therefore, the main objectives of the physical oceanography contribution during iMirabilis2 were to characterize the hydrographic conditions and to determine the water mass distribution in order to find its role on the spatial and vertical distribution of the benthic organisms in the study area.

7.1.3 Sampling methodology

In order to achieve the planned objectives, a set of hydrographic stations were carried out (Fig. 7.1.3.1 and Table 7.1.2.1) to determine the hydrographic conditions and identify the water masses in the area.

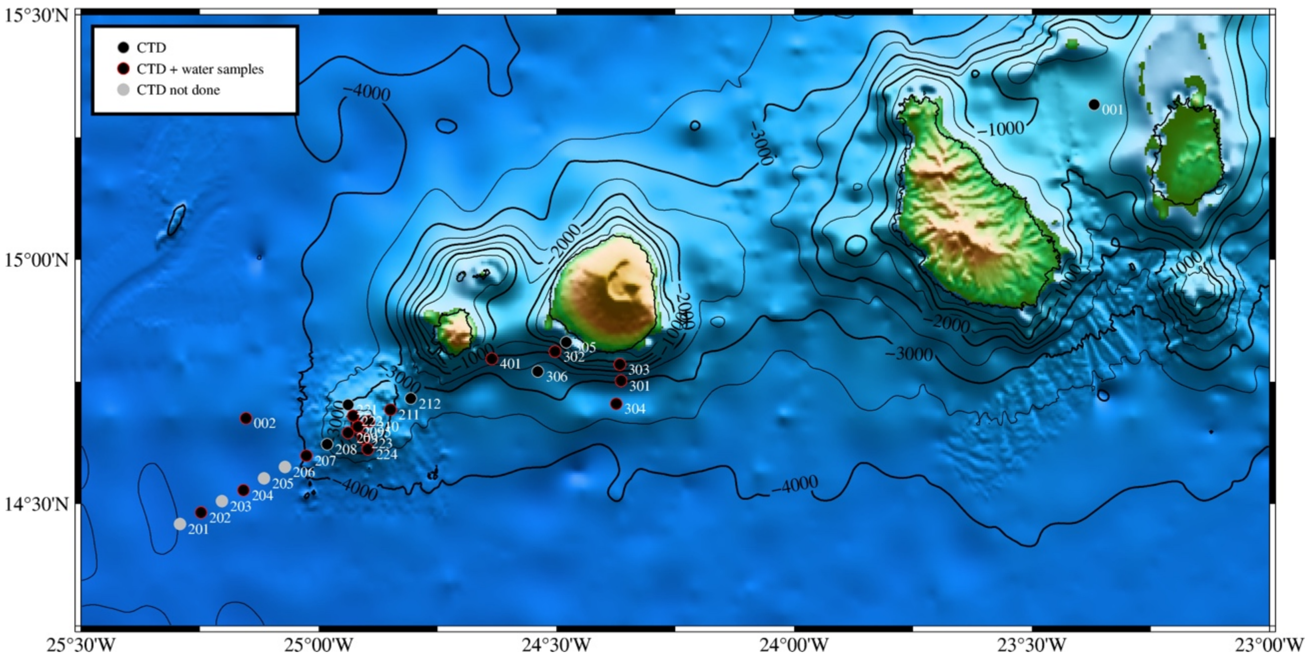


Figure 7.1.3.1 CTD station distribution for the iMirabilis2 expedition.

Due to the weather conditions and the adjusted agenda, the original plan had to be modified. Therefore, some stations were added during the cruise and other ones were not possible to be sampled.

Table 7.1.2.1 Number of stations in each area of study. See section 10.2 for a list of all the CTD stations, including position and date.

Region	Stations sampled
1. Lander's Team Sampling Areas (Abyssal plains close to cadamosto seamount)	2 stations, numbered 001 and 002
2. Cadamosto seamount	13 stations, numbered 202, 204, from 207 to 212, from 221 to 224 and 2095
3. Fogo	6 stations, numbered from 301 to 306
4. Brava	1 station, numbered 401

The water column was sampled from the surface to 10 meters above the bottom. Water samples were taken when required at different levels along the cast and at the bottom to determine eDNA (see section 7.3), POC, PON, stable isotopes and lipids/fatty acids (see section 10.7). Additionally, when possible, VADCP measurements were taken between stations in order to estimate the circulation of the study region.

7.1.4 Processing methodology

Hydrographic data were acquired with CTD SBE911+ using the acquisition software Seasave V7 of Sea-Bird. Seasave V7 acquires, converts, and displays real-time or archived raw data from Sea-Bird profiling CTDs. Seasave V7 is part of Seasoft V2 software suite of Sea-Bird. The raw data was processed with a set of routines form the SBE Data processing package of Sea-Bird. This routine allows to transform the data to ascii format (*.cnv), correct for the cell thermal mass effect, the alignment between the conductivity and temperature sensors, and average in pressure bins. On a second step, MATLAB (matrix laboratory) multi-paradigm numerical computing environment and fourth-generation programming language, was used to analyze the data.

VADCP data was acquired with an RDI Ocean Surveyor 75 kHz using the acquisition software VmDas and the raw data will be processed with CODAS software.

7.1.5 Preliminary results

The vertical profiles of all the stations sampled (Fig. 7.1.5.1) were quite consistent. The first 50 m were occupied by the mixed layer, followed by a step seasonal thermocline and halocline that reached 150 m. Next, the presence of the South Atlantic Central Waters (SACW) generated another thermocline and halocline, less conspicuous, around 900 m, where the presence of the Antarctic Intermediate Waters (AAIW) showed a minimum in salinity and a slow rate of temperature descent. The salinity slightly increased until 1200 m, from this point forwards, the rate of salinity descent slowed down, and the temperature decrease was even slower, typical characteristics of the presence of North Atlantic Deep Waters.

The oxygen showed high concentrations in the mixed layer, but it strongly decreased in the seasonal thermocline, followed by a slightly weaker decrease in the region of the SACW, reaching the oxygen minimum zone between 400 and 500 m depth. After the minimum, the oxygen kept increasing with depth, with a reduction of the increasing rate around 1500 m and even a slight decrease from 3500 m forwards.

The fluorescence shows that all the photosynthetic activity is concentrated in the first meters of the water column, with the chlorophyll maximum at around 60 m, coincident with the rapid decrease of oxygen concentration.

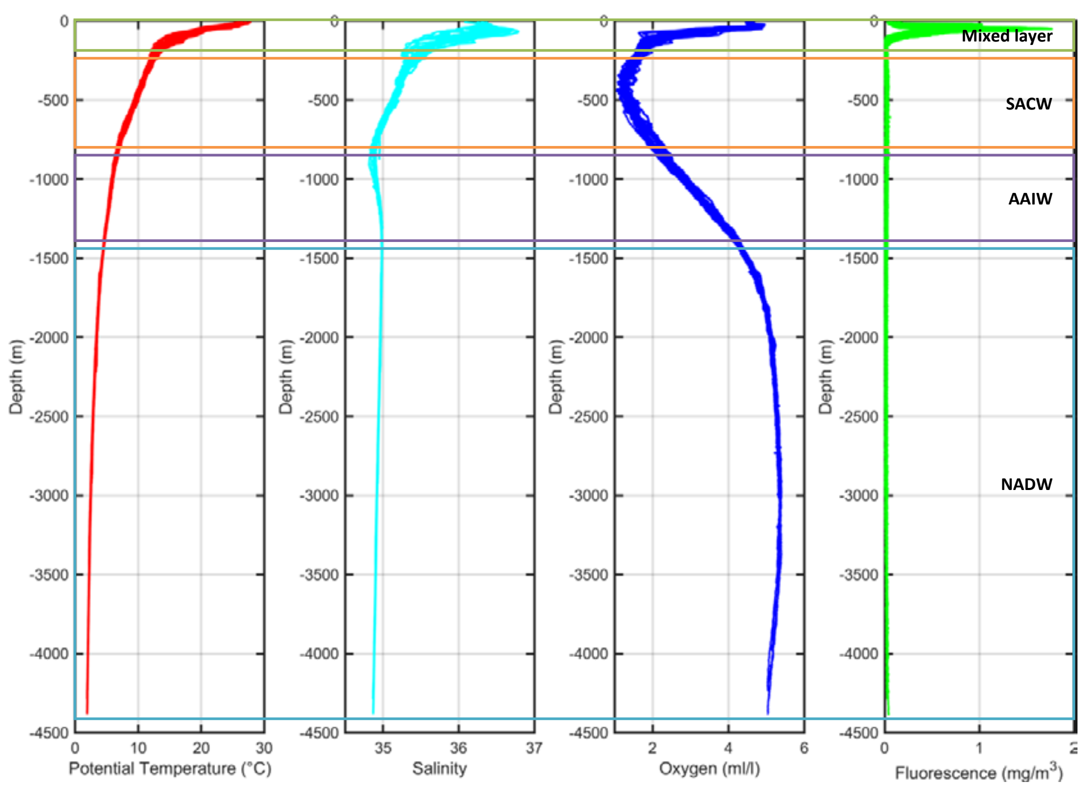


Figure 7.1.5.1 Profiles of potential temperature, salinity, oxygen and fluorescence of all the CTD stations sampled in iMirabilis2. The colour rectangles indicate the different water masses founded in the region.

The θ/S diagram shows a similar distribution for all the stations (Fig. 7.1.5.2) and therefore, as it was shown before, it is possible to identify the three different water masses. Below the mixed layer, identified by a rapid decrease of temperature and a slight increment in salinity, the first water mass found was the SACW, characterized by a rapid decrease in both temperature and salinity, between densities of 26 and 27.38 kg/m^3. Under this water mass the AAIW was found, determined by a minimum in salinity and temperature, with densities between 27.38 and 27.82 kg/m^3. The deep waters were occupied by the NADW, with salinities higher than those for the AAIW, reducing salinity and temperature with depth following the isopycnal of 27.82 kg/m^3.

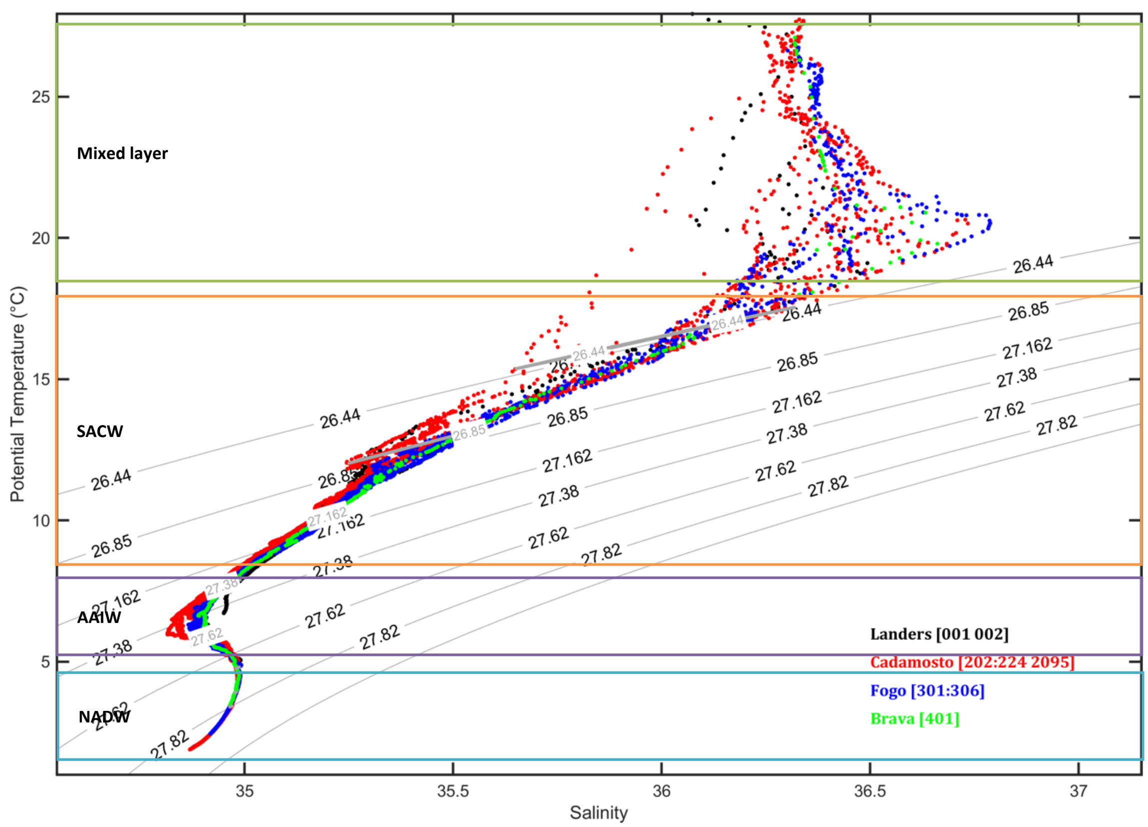


Figure 7.1.5.2 θ/S diagram of all the stations sampled during iMirabilis2. The thin black lines correspond to the density isolines, while the thick grey lines correspond to the γ^n isolines. The colour rectangles indicate the different water masses founded in the region and described in the text.

A characteristic of the waters masses of this area is the variation of the central waters with the latitude (Fig. 7.1.5.3). Waters from higher latitudes will be saltier, and therefore closer to the characteristics of the North Atlantic Central Waters, than those of lower latitudes, that have salinity values closer to the South Atlantic Central Waters.

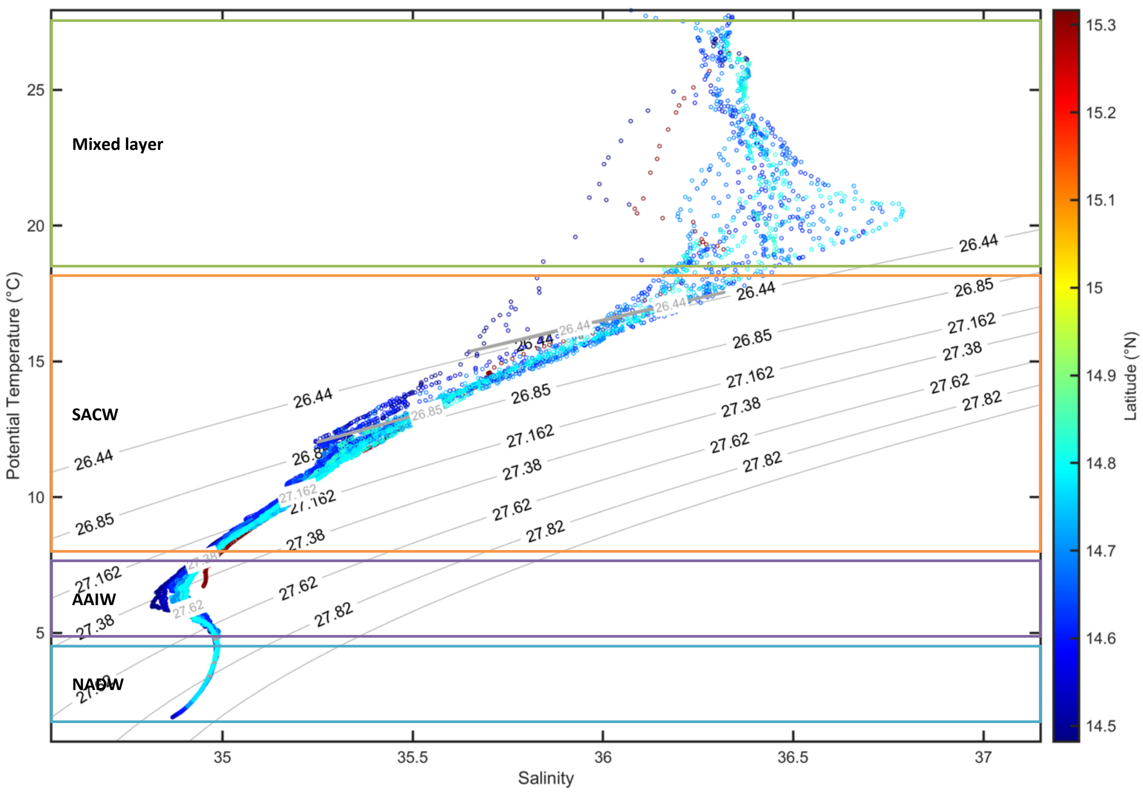


Figure 7.1.5.3 θ/S diagram of all the stations sampled during iMirabilis2. The colour bar shows the latitudinal distribution of the stations. The thin black lines correspond to the density isolines, while the thick grey lines correspond to the γ^n isolines. The colour rectangles indicate the different water masses founded in the region.

The distribution of the stations sampled allowed to create 5 vertical sections: 2 over the Cadamosto seamount, 2 over the island of Fogo and 1 from the island of Brava to the island of Fogo.
The first of these sections, called Cadamosto – R1 (Fig. 7.1.5.4), is a southeast – northwest section over the top of the seamount. It shows the standard distribution of water masses for this area, with a mixed layer in the first meters of the water column, associated with maximum values of temperature and salinity that decrease rapidly with depth and also with a high photosynthetic activity and a great oxygen consumption rate. Bellow this layer, the presence of the SACW shows a rapid decrease of temperature and salinity, as well as a reduction in the oxygen concentration reaching its minimum around 400 m. At 900 m, the minimum of salinity and temperature are indicators of the presence of AAIW and under this a slight decrease of temperature and salinity indicates the presence of the NADW.
This is the same water mass distribution that is found on the other 4 sections (Figs. 7.1.5.5 to 7.1.5.8). However, it is worth to point out a characteristic in the sections corresponding to the Cadamosto seamount, especially in R1 (Fig. 7.1.5.4), but also slight conspicuous in R2 (Fig. 7.1.5.5). Near the top of the seamount, at both sides of it, maxima of fluorescence are found. Those are associated with a very slight uplift of the isohalines and also the isotherms, with a slight sinking of them at the top of the structure. This could be compatible with the presence of a Taylor cap in the summit of the seamount, although, at this moment, it is not possible to rule out other phenomena as meanders of the NEC or eddies shed from the other islands. Here a more in detailed analysis has to be carried out to determine the origin of these uplifts.

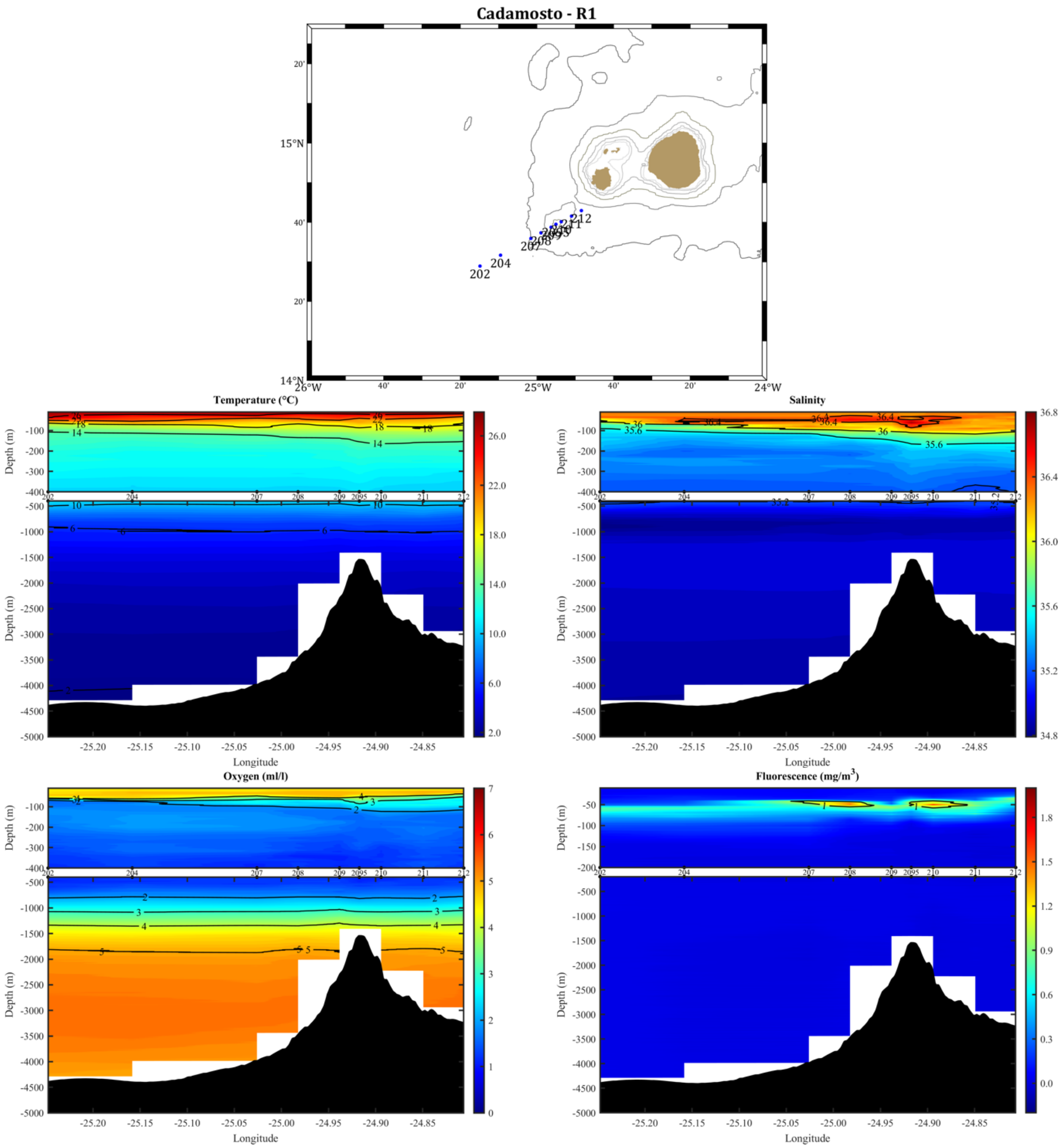


Figure 7.1.5.4 Southeast – northwest (stations 202 to 212) vertical section of potential temperature (up-left), salinity (up-right), oxygen concentration (down-left) and fluorescence (down-right) across the Cadamosto seamount. For each one of the vertical sections, the upper panel corresponds to the top 400 meters, and the lower panel to the 400-5000 m depth range, with exception to the fluorescence figure, where the upper panel corresponds to the 200 meters, and the lower pannel to the 200-5000 m depth range. The numbers between both panels correspond to the station number.

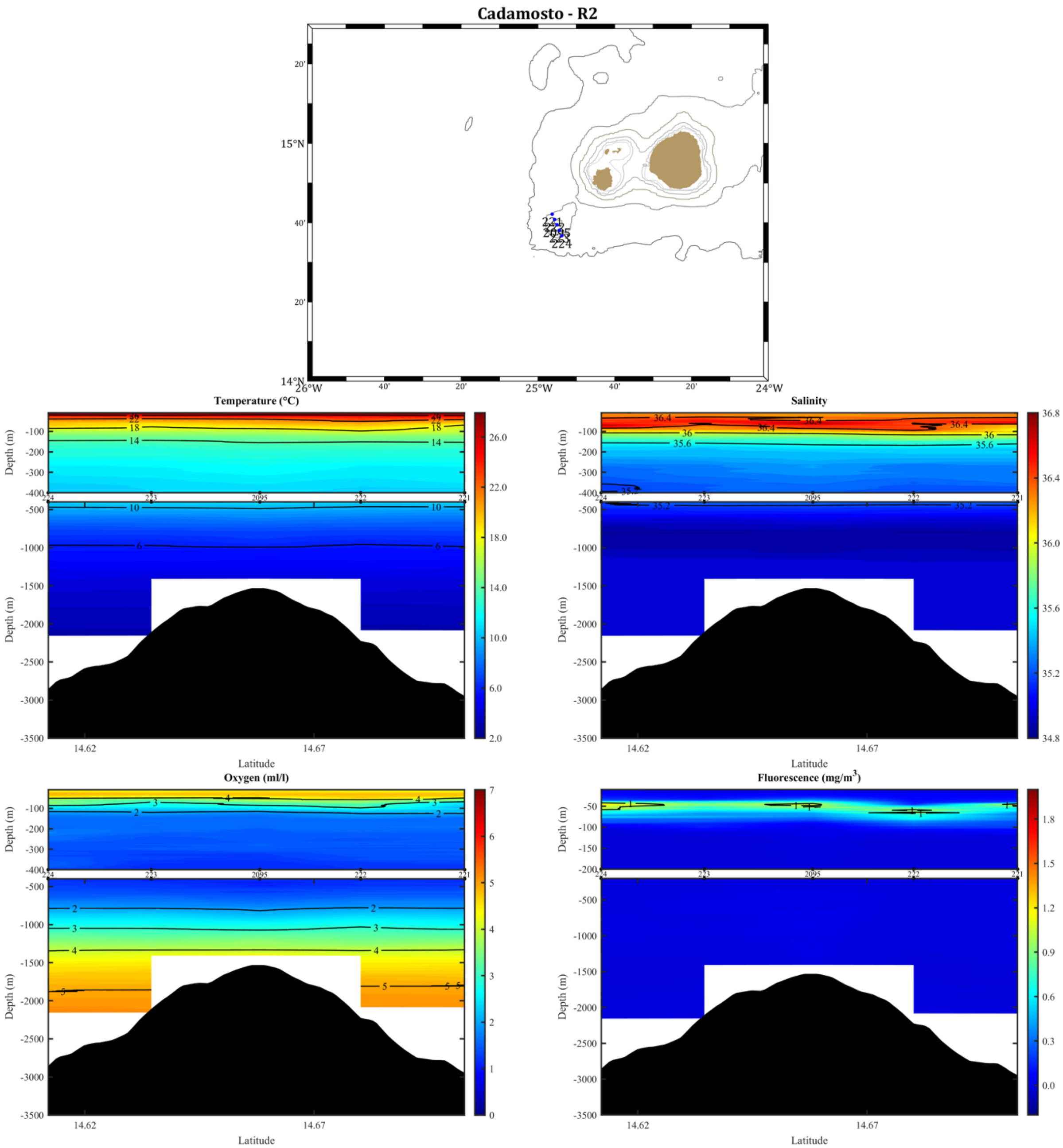


Figure 7.1.5.5 Northeast – southwest (stations 221 to 224) vertical section of potential temperature (up-left), salinity (up-right), oxygen concentration (down-left) and fluorescence (down-right) across the Cadamosto seamount. For each one of the vertical sections, the upper panel corresponds to the top 400 meters, and the lower panel to the 400-3500 m depth range, with exception to the fluorescence figure, where the upper panel corresponds to the 200 meters, and the lower pannel to the 200-3500 m depth range. The numbers between both panels correspond to the station number.

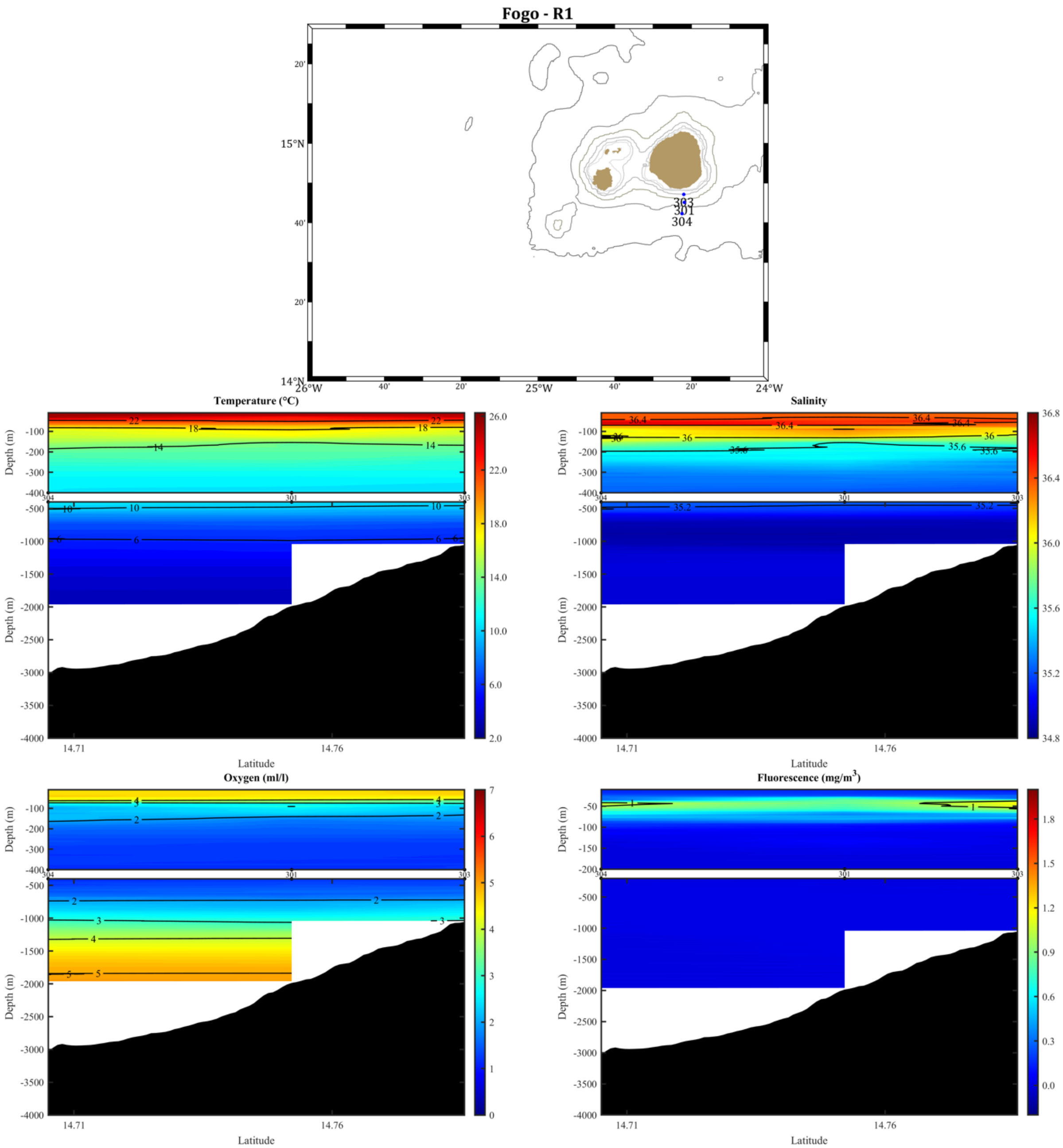


Figure 7.1.5.6 North – south (stations304, 301 and 303) vertical section of potential temperature (up-left), salinity (up-right), oxygen concentration (down-left) and fluorescence (down-right) from island of Fogo. For each one of the vertical sections, the upper panel corresponds to the top 400 meters, and the lower panel to the 400-4000 m depth range, with exception to the fluorescence figure, where the upper panel corresponds to the 200 meters, and the lower pannel to the 200-4000 m depth range. The numbers between both panels correspond to the station number.

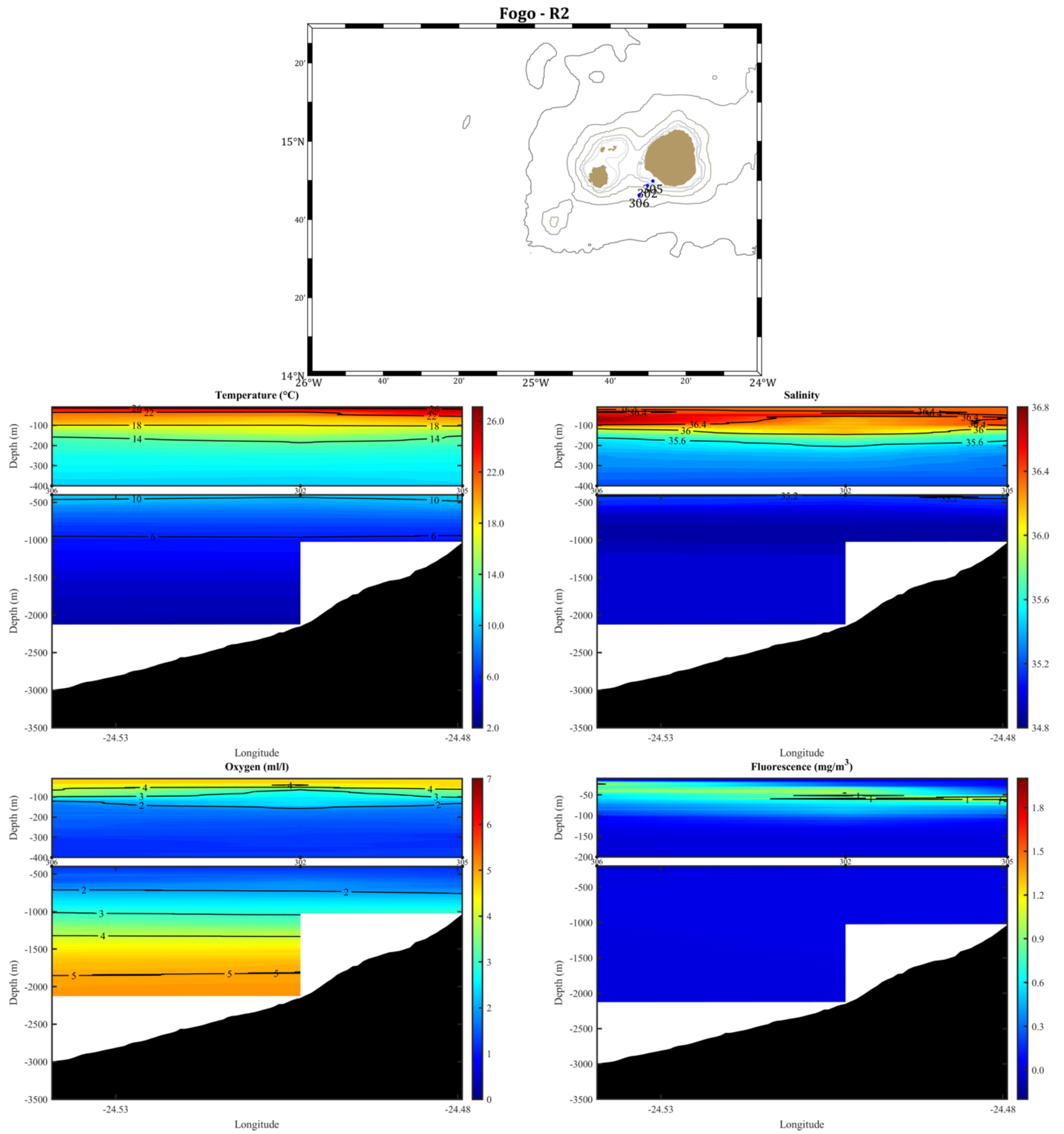


Figure 7.1.5.7 Southeast – northwest (stations 306, 302 and 305) vertical section of potential temperature (up-left), salinity (up-right), oxygen concentration (down-left) and fluorescence (down-right) from the island of Fogo. For each one of the vertical sections, the upper panel corresponds to the top 400 meters, and the lower panel to the 400-3500 m depth range, with exception to the fluorescence figure, where the upper panel corresponds to the 200 meters, and the lower pannel to the 200-3500 m depth range. The numbers between both panels correspond to the station number.

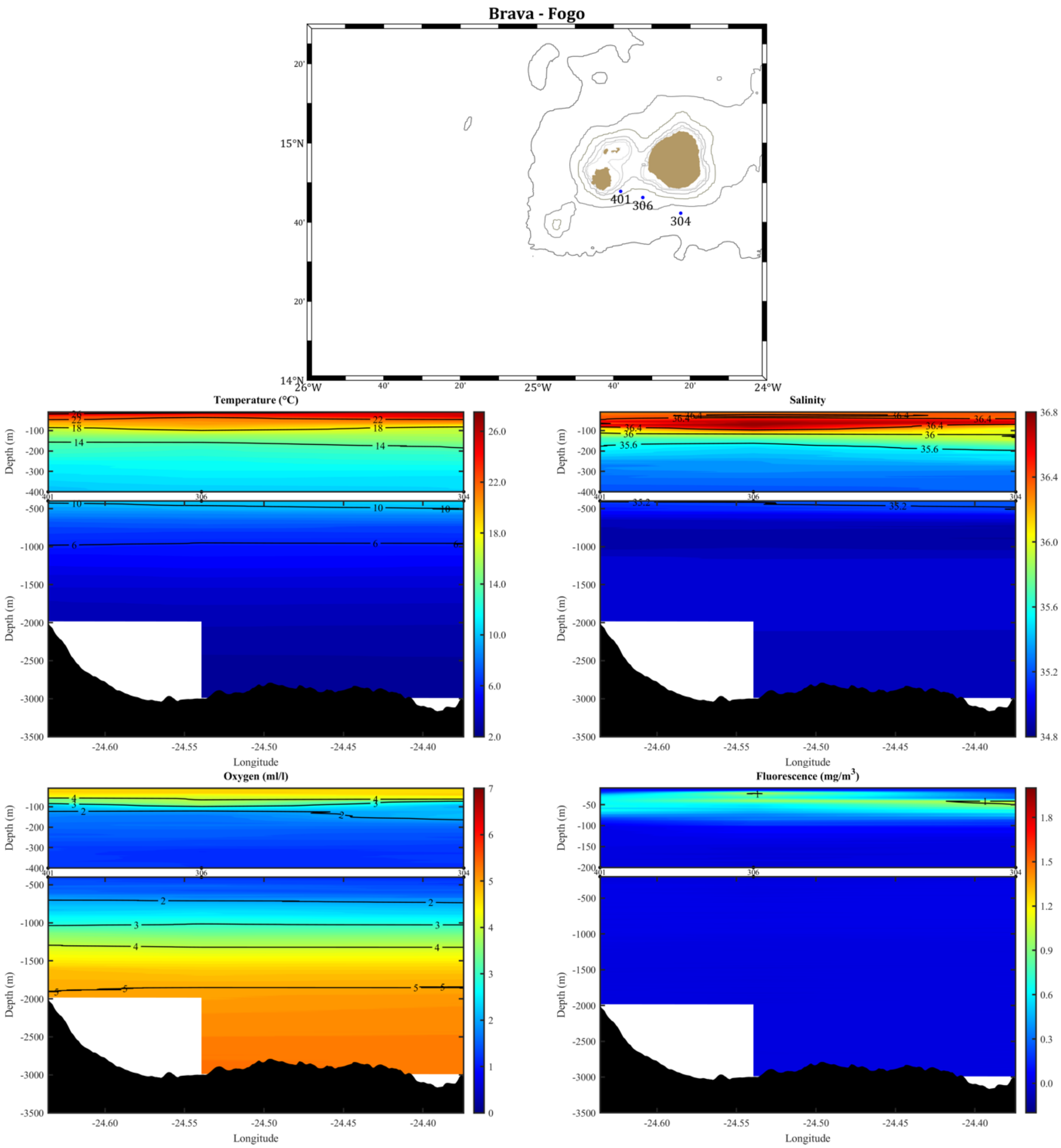


Figure 7.1.5.8 East – West (stations 401, 306 and 304) vertical section of potential temperature (up-left), salinity (up-right), oxygen concentration (down-left) and fluorescence (down-right) from the island of Brava to the island of Fogo. For each one of the vertical sections, the upper panel corresponds to the top 400 meters, and the lower panel to the 400-3500 m depth range, with exception to the fluorescence figure, where the upper panel corresponds to the 200 meters, and the lower pannel to the 200-3500 m depth range. The numbers between both panels correspond to the station number.

A general overview of the surface currents and sea surface temperature of the Cabo Verde Archipelago (Fig. 7.1.5.9) shows a cyclonic circulation around the southern islands with and associated lower temperatures and higher chlorophyll concentration on surface. It is worth to point out that this gyre includes the Cadamosto seamount, and could be an indicator of the modification of the water flow that produces the presence of this underwater feature.

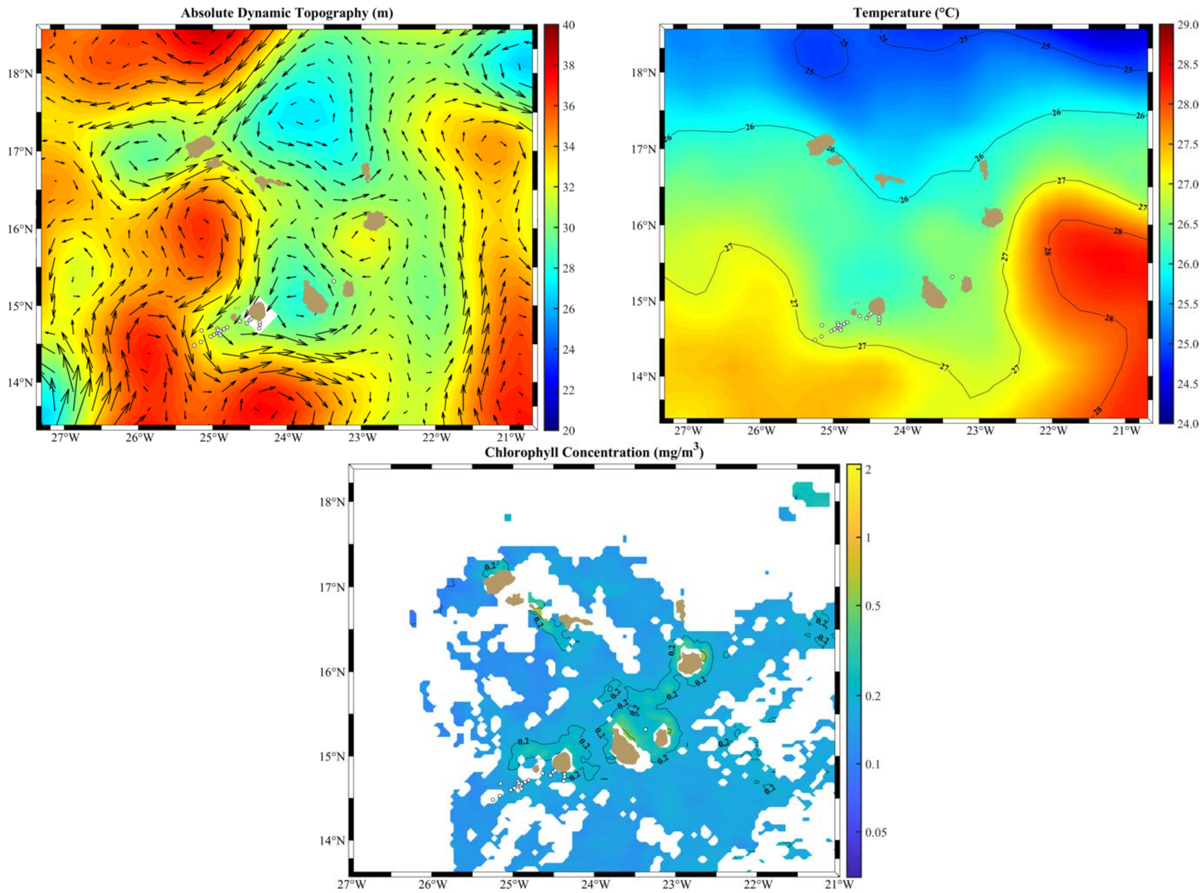


Figure 7.1.5.9 Maps of Absolute Dynamic Topography (left), Temperature (right) and Chlorophyll Concentration (down) of Cabo Verde Islands. The images of Absolute Dynamic Topography and Temperature used correspond to the 10 of August of 2021, the day that the CDT station at the top of the Cadamosto seamount was carried out, while the Chorophyll figure correspond to the 8-day period from the 5 to the 12 of August of 2021. The Ssalto/Duacs altimeter products were produced and distributed by the Copernicus Marine and Environment Monitoring Service (CMEMS) (http://www.marine.copernicus.eu). NOAA High Resolution SST data provided by the NOAA/OAR/ESRL PSL, Boulder, Colorado, USA, from their Web site at https://psl.noaa.gov/data/gridded/data.noaa.oisst.v2.highres.html. Moderate-resolution Imaging Spectroradiometer (MODIS) Aqua Chlorophyll Data (2018 Reprocessing) provided by NASA Goddard Space Flight Center, Ocean Ecology Laboratory, Ocean Biology Processing Group (NASA OB.DAAC, Greenbelt, MD, USA. doi: 10.5067/AQUA/MODIS/L3M/CHL/2018) at https://oceandata.sci.gsfc.nasa.gov (accessed on 28/01/2022).

In addition of the CTD, a vessel mounted ADCP was used when possible. The data obtained was classified in 8 different sections (Fig. 7.1.5.10) summarized in Table 7.1.5.1.

Table 7.1.5.1 ADCP sections. (See section 10.2 and 10.3 for more information).

Section	Region	Sampled points	Observations
Section 1	South of Fogo	1	No data registered
Section 2	West of Cadamosto	2-17	South – north direction
Section 3	Northwest of Cadamosto	18-34	Southwest – northeast direction
Section 4	Cadamosto submit	35-66	South – north direction

Section 5	Cadamosto submit	67-93	West – east direction
Section 6	Cadamosto submit	94-122	East – west direction
Section 7	Cadamosto submit	123-131	West – east direction
Section 8	Cabo Verde – Canary Islands	132-1100	Southwest – northeast direction

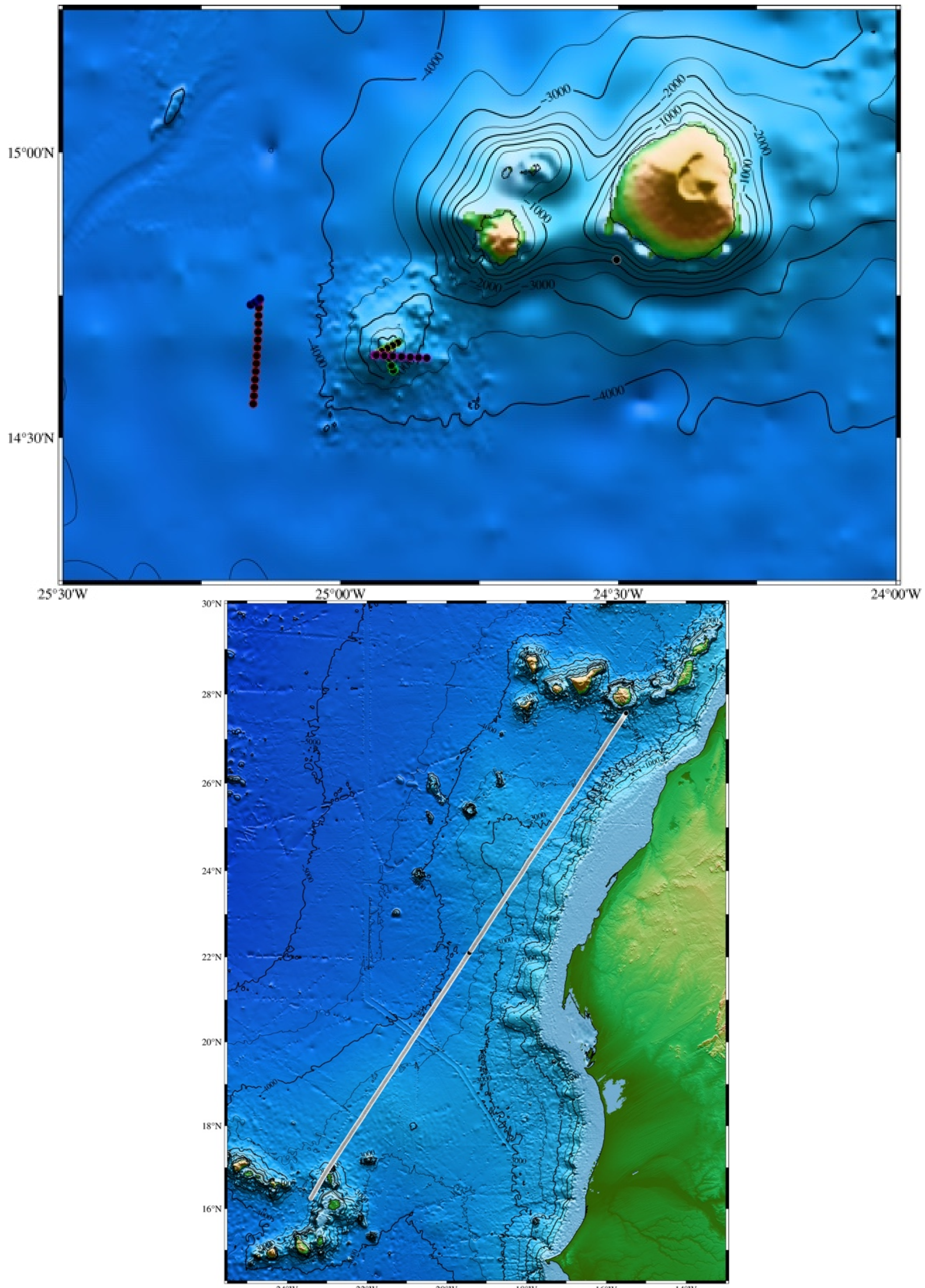


Figure 7.1.5.10 Maps of the vessel mounted ADCP data registered. In the map above the first seven section are depicted (section 1 in grey, section 2 in red, section 3 in blue, section 4 in green, section 5 in cyan, section 6 in yellow, and section 7 in magenta); in the map below is represented the section 8 in white.

In order to study the circulation predominant in each of the layers identified with the CTD data, the ADCP velocity components were averaged in the Mixed Layer (from surface to approximately 50 m), the Seasonal Thermocline layer (from 50 to 150 m) and the South Atlantic Central Waters (from 150 to 900 m) and represented in maps (Fig. 7.1.5.11). In the section at the west of the map (section 2) a front in the Mixed Layer is observed, with a circulation to the east in the north part and to the west in the south. This front does not reach the Seasonal Thermocline, which shows a predominant flow to the northeast. The SACW presents a slow flow less homogeneous but veering to the east. The section at the north of section 2 (section 3) shows a flow to the southeast in the Mixed Layer, veering to the north in the Seasonal Thermocline and ending in weaker northwest flow in the SACW. The sections on the top of Cadamosto Seamount, from 4 to 7, show a similar circulation pattern, with a flow to the east in the Mixed Layer, to the south in the Seasonal Thermocline and to the southeast in the SACW. The circulation in the return transit to Las Palmas (section 8) consists in bands of flow to the northwest and southeast that decays in the deeper layers.

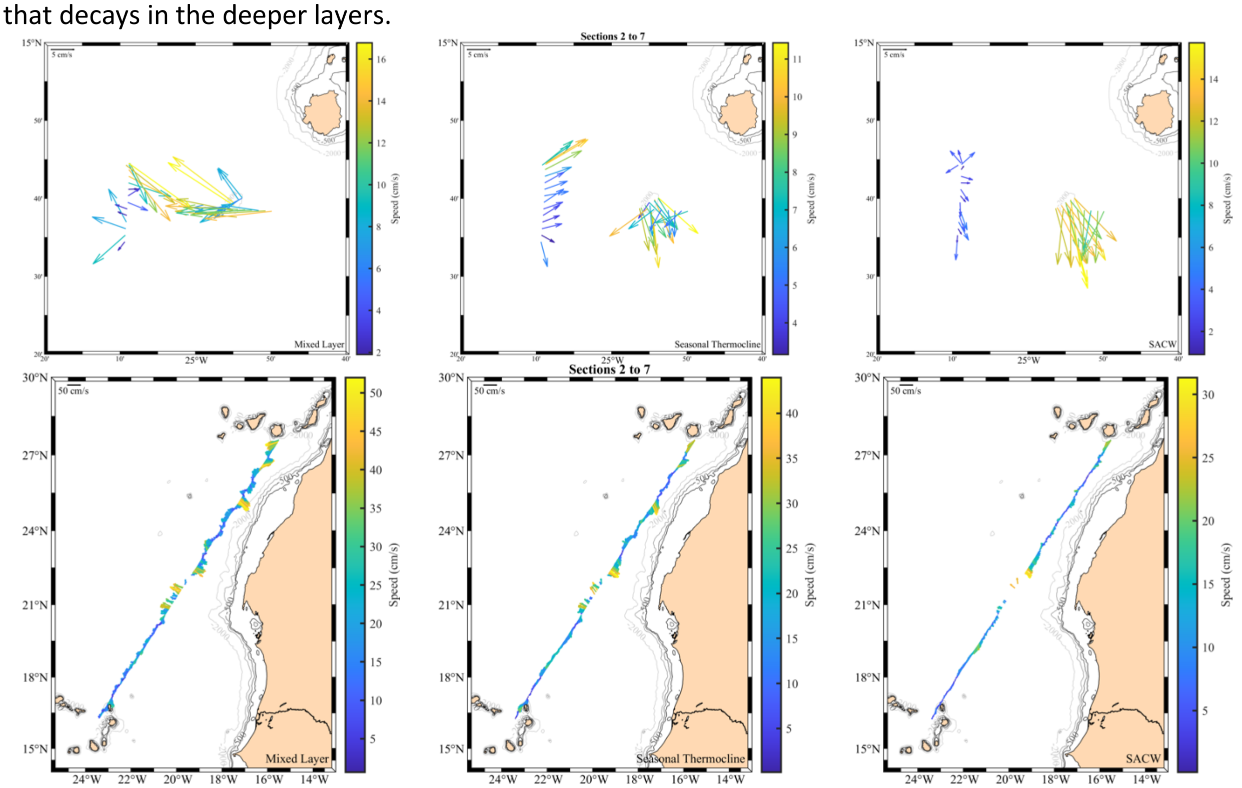
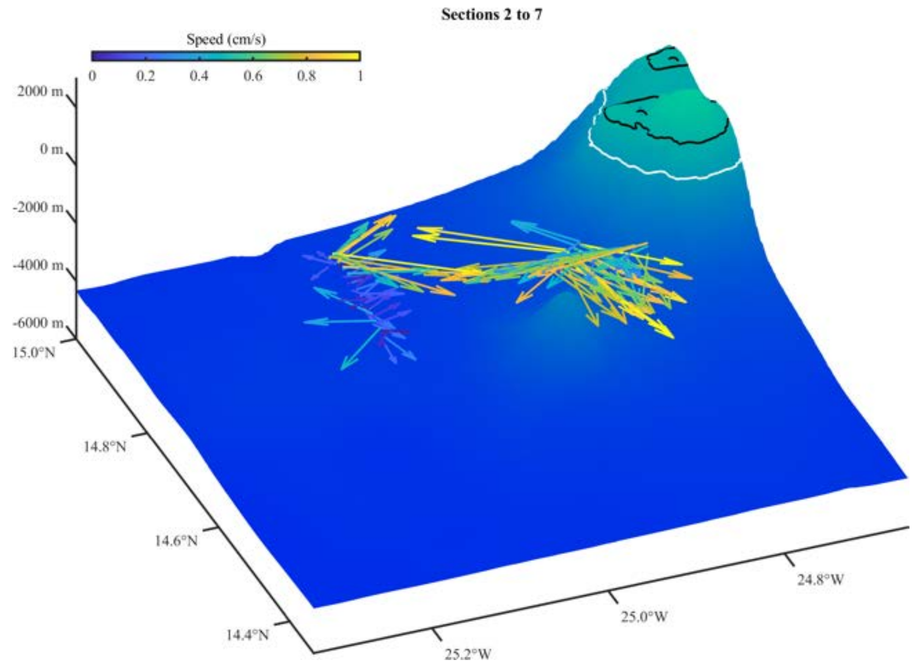


Figure 7.1.5.11 Maps of ADCP velocity averaged at three layers (Mixed Layer, Seasonal Thermocline and SACW).

The same observations are represented in Figure 7.1.5.12 but in a 3D map. For the sections across the top of the seamount, the circulation shows a veering to the south with depth, with a flow to the northwest/west at the surface and to southeast at the SACW layer. This circulation may indicate upwelling on the summit of the seamount.



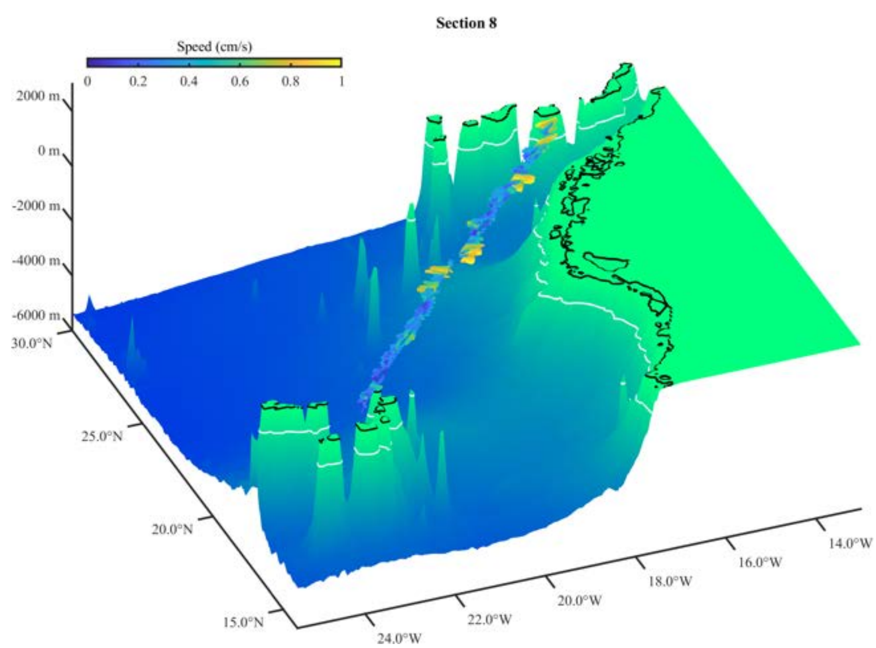


Figure 7.1.5.12 Maps of ACDP velocity averaged at three layers for section 2 to 7 (above) and for section 8 (below).

Although the amount of ADCP data was scarce, due to its opportunistic character, it was enough to point out the importance of the dynamics in Cabo Verde. The dynamics described with the ADCP data was consistent with the satellite data (Fig. 7.1.5.9), where the circulation was composed by a set of cyclonic and anticyclonic gyres which can give place to the presence of fronts, upwellings and downwelling's. Besides, the fluorescence data of the CTD suggested the presence of an upwelling on the summit of the Cadamosto Seamount, that seems to be supported by both the satellite and the ADCP data.

7.1.6 Datasets to be submitted to PANGEA

CTD data: 22 stations with 6 variables (Tabe 7.1.6.1) and vessel mounted ADCP data: 8 sections with 6 variables (Table 7.1.6.2).

Table 7.1.6.1 CTD data variables.

Variable	Units
Temperature	°C
Salinity	psu
Oxygen	ml/l
Fluorescence	mg/m^3
Neutral density	kg/m^3
Pressure	db

Table 7.1.6.2 ADCP data variables.

Variable	Units
Depth	m
Zonal velocity component	m/s
Meridional velocity component	m/s
ADCP transducer temperature	°C
Ship zonal velocity component	m/s
Ship meridional velocity component	m/s

7.2 Habitat mapping abyssal plains off Cabo Verde (V. Huvenne, S. Evans, E. Simón-Lledó)

7.2.1 Personnel involved

V. Huvenne, S. Evans, E. Simón Lledó, with help and contributions from A Calado, A. Afonso, M. Souto, B. Ramos, R. Bettencourt, D. Roper, R. Austin Berry, S. Fairbain, E. O'Hobain, A. Sweetman.

7.2.2 Introduction. Aims

The NOC team aimed to work on the development of better approaches to habitat mapping at multiple scales. This work involved new data collection methods (e.g. the development of new sensors and new technologies, such as the eDNA sampler installed on the Autosub AUV), new data analysis methods that can deal with the vast amounts of data provided by the new sensors and vehicles, and new approaches to data synthesis to produce comprehensive and accurate habitat maps. We aimed to apply these new approaches to the Cabo Verde surveys planned for the iMirabilis2 expedition.
However, most of the aims of the habitat mapping work, e.g. within the iAtlantic scope, had to be reconsidered owing to the technical difficulties experienced with the Autosub6000 during the expedition (e.g. see section 6.3). Nevertheless, i) shipboard bathymetric data covering a vast, previously unmapped, deep seabed area were successfully obtained, ii) the use of the RoCSI eDNA sampler could be demonstrated (see section 7.3), and ii) some, so far unexplored, abyssal areas extending along the slopes of the islands were surveyed as a result of a fruitful collaboration between the ROV, AUV and Lander teams, who successfully reconfigured the *Luso* ROV for abyssal image data acquisition, setting thereby a new depth record for the device (3510 m).

7.2.3 Sampling methodology

Bathymetry data collection

Bathymetry data were collected with the shipboard Atlas Hydrosweep multibeam system (see section 6.2 and 10.8). Data collection took place under two modes: either through dedicated multibeam surveys, carried out at a target speed of 7kn, or opportunistically during transits at a speed of 10-11kn. Depending on the weather conditions and sea state, also the transit data was of good quality.
The main areas chosen for targeted surveys were:

- The deep-water area west of Cadamosto Seamount where we carried out the lander work, and where we had originally planned the AUV missions to take place.
- South of Brava and Fogo: dedicated bathymetric surveys were planned south of the islands of Brava and Fogo in order to provide detailed bathymetry data for the planning and operation of ROV missions in the area.
- Around Brava: towards the end of the cruise, as a result of equipment failure and weather conditions, we had some spare time which we used to collect further bathymetry data around the island of Brava and the small islets north of it.

Some of the areas described above had not been mapped before, while the bathymetry data available for others was of lower resolution and quality. The area of Cadamosto Seamount was not mapped in detail during this expedition, owing to the fact that a detailed bathymetric grid was obtained in recent years by colleagues from GEOMAR (Thor Hansteen), and was kindly provided for cruise planning to the science team.

Imagery collection

The *Luso* ROV was reconfigured, i.e. after conducting video and image transects on Seamount areas, for abyssal megafauna assessment which are more optimally surveyed using vertical-facing stills (e.g. Durden et al. 2015, Simon-Lledó et al. 2019). The new set-up was built to collect vertical-facing images (for quantitative analysis, e.g. facilitates image scaling based on camera altitude during dives and lens information) and oblique-facing video (for qualitative analysis, e.g. aid taxonomic and behavioural interpretation of vertical facing stills). Two still cameras were mounted vertically-facing on a (fiberglass) pole fixed to an annex metallic frame specifically built prior to the surveys to provide an extended (26 cm) anchoring point towards the front of the ROV, i.e. to ensure a clear field of view (Fig. 7.2.3.1a). The stills cameras models were a *Cannon Power Shot G11* (camera 1, *Luso* stills cam) and a *Nikon D7200* (camera 2, by AKS). Camera specifications and settings are provided in Table 7.2.3.1. Two strobes (see specs in section 6.5.2) were mounted slightly oblique facing, to minimise backscatter, on the sides of the pole (Fig. 7.2.3.1a). Camera 1 was connected to the ROV's power supply, while camera 2 and the strobes were linked and powered by their own battery system (see section 6.5.2). One of the ROV lights was mounted vertically facing on the bottom of the ROV base to minimise the shadowing created at the seabed by the ROV lighting system (at the top of the platform, Fig. 7.2.3.1b). The 4K Video camera was left in an oblique-facing position on the upper front area of the ROV, as was mounted in previous dives e.g. Seamount surveys (see section 6.4, and 7.4). Last, the ROV's was equipped with a sonar altimeter that displays a default altitude of 0.74 m when the ROV is placed at the seabed (e.g. at ROV base = 0 m altitude), despite the real altitude of the sensor with regards to the ROV base was much lower.

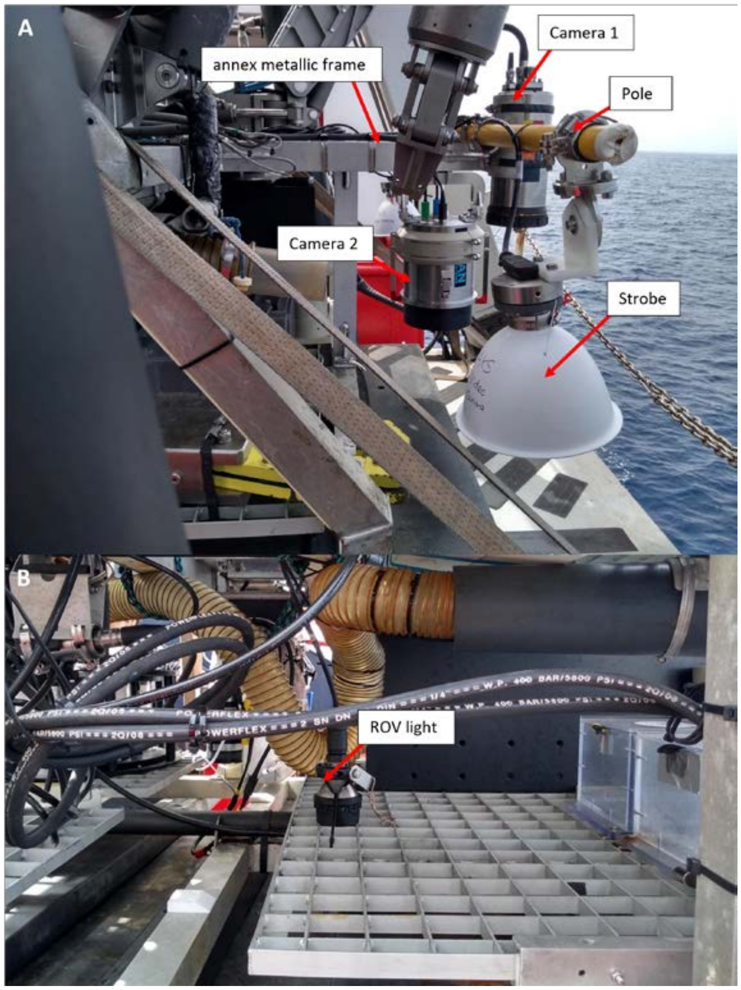


Figure 7.2.3.1 Image collection set-up; cameras, strobes, and lighting as mounted on the *Luso* ROV for abyssal seabed surveys.(Images: E. Simon-Lledó).

Table 7.2.3.1 Specifications and settings of the photographic cameras used.

Specifications	**Camera 1**	**Camera 2**
Owner	*Luso* Team	AKS Team
Model	Cannon Power Shot G11	Nikon D7200
Pixels	3648 x 2736	6000 x 4000
Angle of view (in water)	H: 44.5°; V: 34.7°	H: 57°; V: 40°
Settings		
ISO	Auto	200
Exposure	Auto	1/25 sec
Focal length	6.1 mm	20 mm
Aperture	F2.8	F8
Interval	17 sec	20 sec
Flash	No	Yes (2 strobes)
Zoom	None	None
Image format	png	jpg and raw (nef)
Time	UTC (sync with ship GPS)	UTC+1 (+3 sec)*

(*) relative to cam 1 and ROV time

Image surveys

Two abyssal seabed surveys were conducted at the end of the expedition (Table 7.2.3.2). Two short ROV dives were conducted to obtain preliminary insights on the abyssal megafauna found towards the east of the Cadamosto seamount, in two areas located at a similar latitude (14° 40.43') and depth (3400 – 3500 m, at bottom), separated 46 km, and sheltered by the islands of Brava and Fogo (i.e. from the NE winds). These locations were chosen to be sufficiently deep to harbour habitats in the boundary between the bathyal and the abyssal ecosystems, while sheltered from weather conditions constraining the use of the ROV.

Table 7.2.3.2 Summary of times (UTC), coordinates (WGS 1984), and depth (m) for each ROV mission, as recorded in the vessel's station log. Notes: times: deployment from and recover to deck; coordinates (WGS 1984) and depth (m): as recorded from vessel at the time of start/end)

Survey	Station	Date	Start time (UTC)	End time (UTC)	Latitude (start / end)	Longitude (start / end)	Depth (start - end)
01.ROV11	#084	24/08/21	14:47	23:22	14°40'27.82" 14°40'17.66"	-24°49'1.84" -24°48'25.13"	3499 – 3374
02.ROV12	#087	25/08/21	17:01	00:47(26th)	14°40'58.69" 14°40'52.90"	-24°23'56.97" -24°23'27.81"	3490 – 3567

Table 7.2.3.3 Summary of times (UTC), coordinates (WGS 1984), and depth (m) of each ROV transect image survey at the seabed, as recorded by the ROV.

Survey	Station	Bottom start time	Bottom end time	Latitude (start / end)	Longitude (start / end)	Depth (start / end)
01.ROV11	#084	16:52	21:00	14° 40.463' 14° 40.294'	-24° 49.031' -24° 48.419'	3413 – 3443
01.ROV12	#087	19:00	22:22	14° 40.978' 14° 40.900'	-24° 23.950' -24° 23.478	3498 – 3510

Survey 01. Station #084, ROV11

Survey 01 was conducted across an abyssal area located in the east of the Cadamosto seamount (Fig. 7.2.3.2). Issues with the vessel's usbl caused a substantially biased positioning in the first half of the seabed transect (e.g. approx. the first 2+ hours at bottom). This was somewhat corrected by reducing the travelling distance between the vessel and the ROV. Moreover, relatively strong currents at bottom during the first half of the transect, and issues with weather throughout the whole transect (increasingly larger waves causing a substantial roll of the vessel, up to ~6°, and heave in the ROV) made it very difficult to maintain a constant speed nor a sufficiently low altitude above the seabed (i.e. maintaining camera 2 at the target altitude of 1.75 m, which given the bias in the altimeter readings and the distance of cam 2 from the ROV base, was calculated to be 2.26 m in the altimeter display). Transiting below the 2.26 m (altimeter display) was constrained by the strong heave of the ROV, being constantly pulled up by the umbilical, which generated substantially large sediment clouds when getting back to the aimed altitude. Aiming for a higher altitude (i.e. altimeter display ~4 m) and maintaining the same heading direction made it easier to transit until the end of the dive. As a likely result from battery consumption, the strobes of cam 2 started working only intermittently up from 19:26 and fully stopped at 19:40; much darker images were collected with this camera up from that point. On the ROV video, this station was labelled as #83, but it was in fact #84.

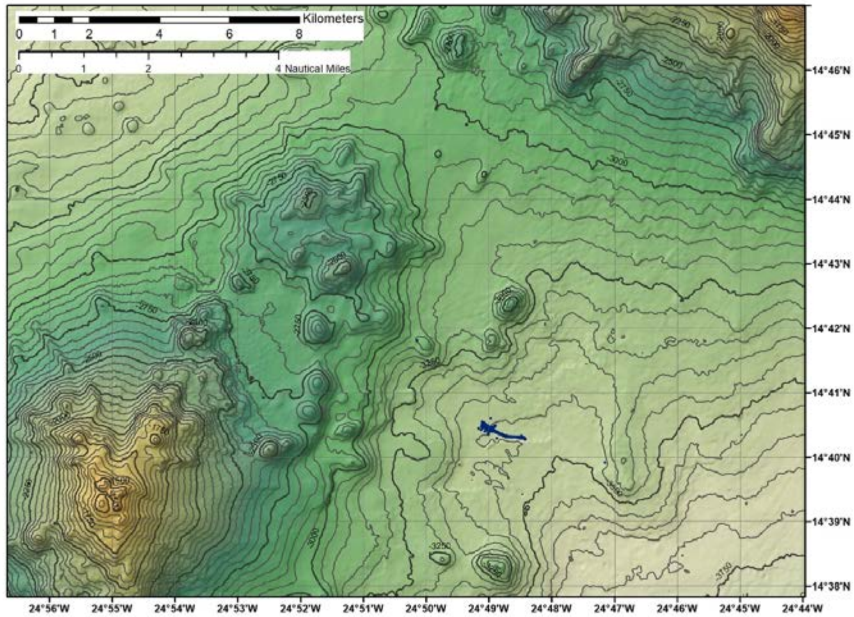


Figure 7.2.3.2 Location map showing the track(in dark blue) of ROV Dive 11 at ca. 3450m depth, between Cadamosto and Brava.

Survey 02. Station #087, ROV12

Survey 02 was conducted across an abyssal area located on the slope of Fogo island (Fig. 7.2.3.3). Camera 1 did not work during this dive, but issues with the strobes of cam 2 were solved, and these flashed almost until the end of the mission (when the battery supply of cam 2 ran out). Altitude above the seabed could be maintained (altimeter display < 2.5 m) throughout most of the dive, but speed was variable. An extra section of the dive, at the end, when none of the still cameras were collecting images, was dedicated to zoom into some algae falls that were seen throughout the dives, with the video camera. A pallet colonised by squat lobsters was also observed with the video camera at the end of the dive.

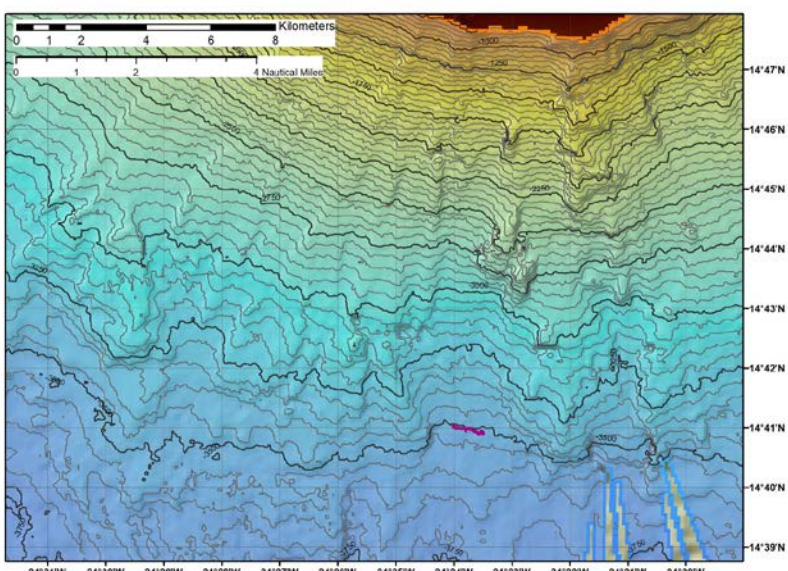


Figure 7.2.3.3 Location map, showing the track (in fuchsia) of ROV Dive 12, at 3500m water depth, south of Fogo.

7.2.4 Processing methodology

Bathymetry data processing

The shipboard bathymetry data were processed using the CARIS HIPS & SIPS software. The .s7k files were imported using the conversion wizard. Tidal predictions for the region were obtained from the POLPRED service in NOC Liverpool. However, it became clear that the tidal variation in the area was minimal (< 0.5m amplitude), hence during the cruise the data were processed with a 'zero tide'.

Sound velocity profiles were initially created based on World Ocean Atlas data, but were later on replaced by profiles calculated from our own CTD measurements during the cruise. Data were processed with the CTD information closest in time.

The first dedicated multibeam survey included a limited patch test to check on a potential roll offset, but the values for roll and pitch correction as listed in the vessel file provided by the UTM technical team (see section 6.2) were deemed correct.

The multibeam data were merged with the attitude, navigation, tide and sound velocity information, and a nominal error propagation was calculated with zero error on all sensors. From this the data could be gridded using the CUBE algorithm. Grid size was chosen at 100m for the deep-water areas ("Box south" and the transit lines) and at 50m for the shallow water areas (around Brava and Fogo). The CARIS project was set up in UTM Zone 26N, WGS84.

Once gridded, the data was given a first-pass manual clean to remove the worst errors and spikes. Further detailed cleaning will be necessary at a later stage. The grids were exported as GeoTiffs, again in UTM Zone 26N, WGS84.

Image type and numbers

Images from each dive were downloaded from each camera and visualised. A second copy was generated, named as "Processed". In this "Processed" folder, dark images (either collected at the water column, or lacking a flash) from Camera 2 were separated and colour corrected to see how many of these corresponded to water column and seabed shots (Table 7.2.4.1). Note that each of these was not necessarily a usable image, as a large proportion were blurry (high altitude), unfocused (collected under strong heave), have no data (collected in the water column without flash), or the seabed is covered by sediment clouds. Note also that many of the seabed images exhibit a high overlap. Determination of usability in seabed images will require a more specific assessment (e.g. manually, on a picture by picture basis).

Table 7.2.4.1 Images and type collected during each ROV survey.

Survey, station	Camera	Images collected (total)	Seabed*	Water column
Survey 01, #084	1	1871	885	(none usable)
Survey 02, #084	2	1596	754	842 (474 non-usable)
Survey 02, #087	2	1416	542	874 (514 non-usable)

(*) Usability not assessed

Metadata processing

Image exhif data (containing time of collection) was extracted from the images collected from both cameras using *BR's EXIFextracter* software. Survey metadata obtained from the ROV at 1" interval (e.g. ROV's altimeter-based altitude at 1" interval and position at 1-10" intervals) were linked where possible with each picture using a custom R script based on the time of collection and the relative position of each of the camera lens from the base of the ROV (Fig. 7.2.4.1). A correction was applied to the altitude of each image to account for the bias (+74 cm) in the altimeter data (e.g. when the ROV is stranded on the seabed, altimeter displays 0.74 m). Raw ROV altitude, and position data files (e.g.

Imirabilis2_D12_S87_altitude.txt, Imirabilis2_D12_S87_position.txt, etc.) of each dive -used to link image data- were, however, not corrected. Time of collection of the images obtained from Camera 2 (UTC+1 and +3 sec) was also corrected in the resulting image metadata .csv file (but not in the exhif of the images!) to match that of the ROV and Camera 1 images (UTC). Data processing generated a total of 3 csv files: one for the images of Camera 1 (ROV_ST084_iMirab_cam1), and 2 csv files for the images of Camera 2 (ROV_ ST084_iMirab _cam2, and ROV_ iMirab_ST087_cam2).

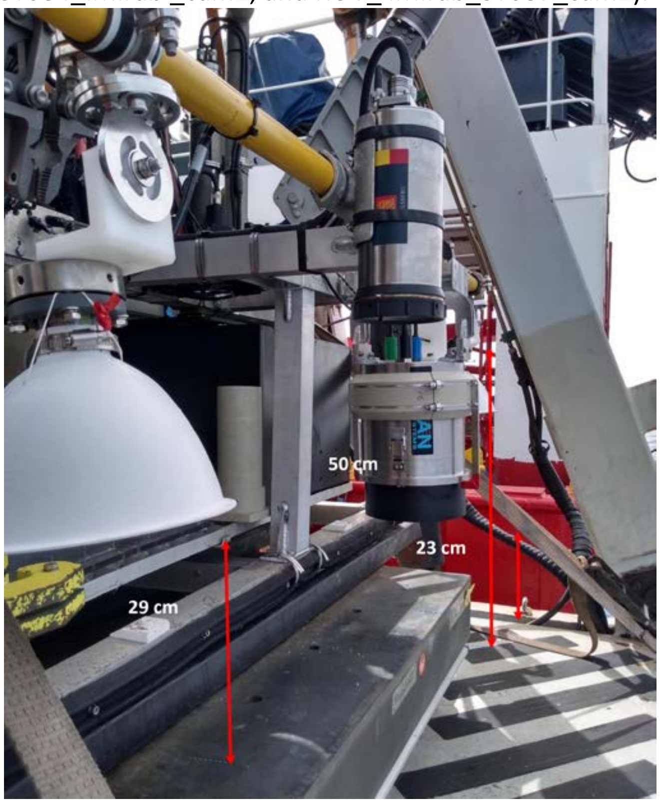


Figure 7.2.4.1 Distances from each of the camera lens, and strobes, to the base of the ROV. (Image: E. Simon-Lledó).

Image scaling

Based on each camera's acceptance angles, image width and length on the seabed can be calculated as a function of the image collecting altitude (h) based on the field of view of the camera lens (see e.g. Jones et al. 2009), as follows:

Camera 1:

$$\text{Image length} = 2\text{h} \times \tan(44.5 \div 2)$$
$$\text{Image width} = 2\text{h} \times \tan(34.7 \div 2)$$

Camera 2:

$$\text{Image length} = 2\text{h} \times \tan(57 \div 2)$$
$$\text{Image width} = 2\text{h} \times \tan(40 \div 2)$$

7.2.5 Preliminary results

A total area of 8210 km^2 was mapped with the shipboard multibeam system (Fig. 7.2.5.1). The data show the intricate detail of the volcanic areas around Fogo and Brava, characterised by numerous subcones, steep island flanks with channels, ridges, and evidence of sediment flows. The deeper area to the west, even at abyssal depths, still contains influences of sediment or volcanic flows, and features an 80 m high cliff, which is 14 km long.

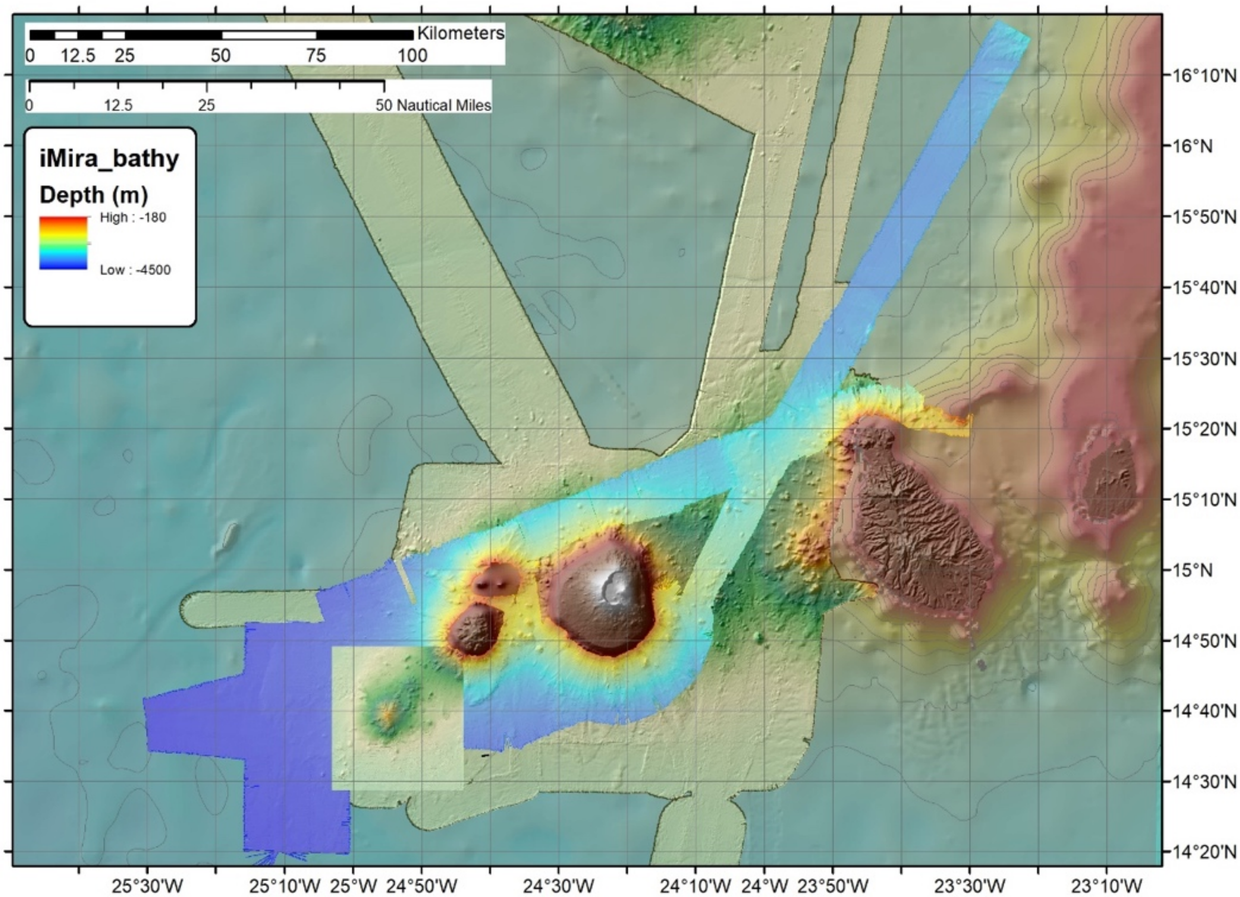


Figure 7.2.5.1 Bathymetry data collected during iMirabilis2

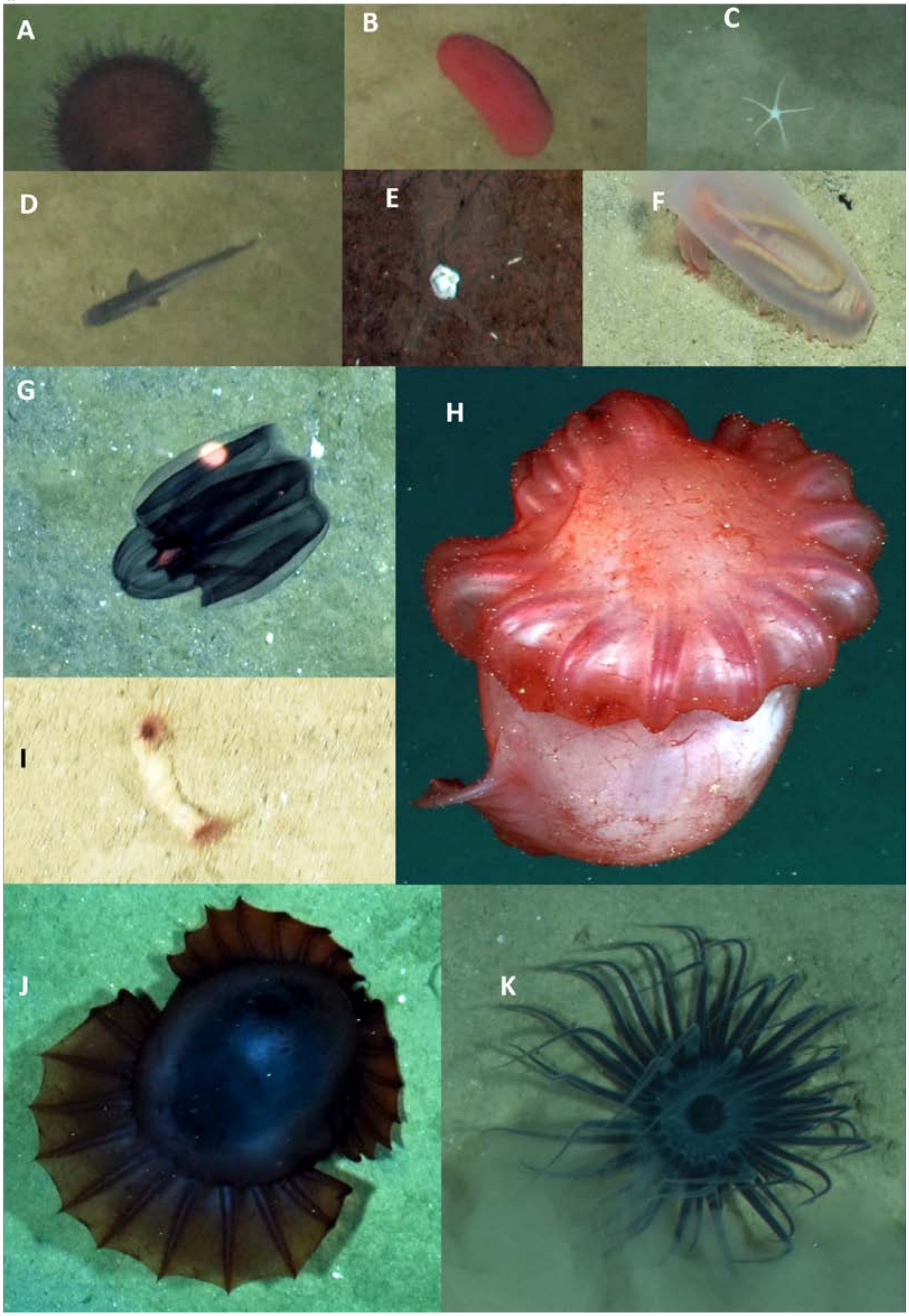


Figure 7.2.5.2 Different megafaunal specimens observed during abyssal ROV surveys. **A-D:** Images collected with Cam 1. **E-K:** Images collected with Cam 2. (Image: A. Sweetman and E. Simon-Lledó).

Preliminary inspection of image data suggests a very low megafaunal abundance in both of the locations surveyed, as is characteristic of abyssal megabenthic communities. Inspection of oblique video data also suggests a relatively higher abundance of mobile, swimming fauna, such as hydrozoan and scyphozoan jellyfishes (e.g. *Crossota* sp and *Poralia* sp, respectively), ctenophores, and swimming holothurians (e.g. *Enypniastes eximia*, Fig. 7.2.5.2H & J). On the seabed, the holothurian *Amperima* sp (Fig. 7.2.5.2F) was one of the most frequently observed taxa. A few fishes were also observed, such a rat-tails (*Coryphaenoides* sp) and some Ipnopidae specimens (*Ipnops meadi* and *Bathytyphlops* sp; Fig. 7.2.5.2D). An interesting biological trace imprinted in the sediment surface (i.e. lebensspuren) was very frequently found in the 2 dives; formed by a small sediment mount with a series of small holes depicting a relatively perfect circle around it (Fig. 7.2.5.3A). Last, decomposing algae mats, possibly composed by brown seaweeds (e.g. *Sargassum* sp), were also found in both dives, particularly in the second location, where these organic falls generated extensive (> 1m) organic mats (Fig. 7.2.5.3B).

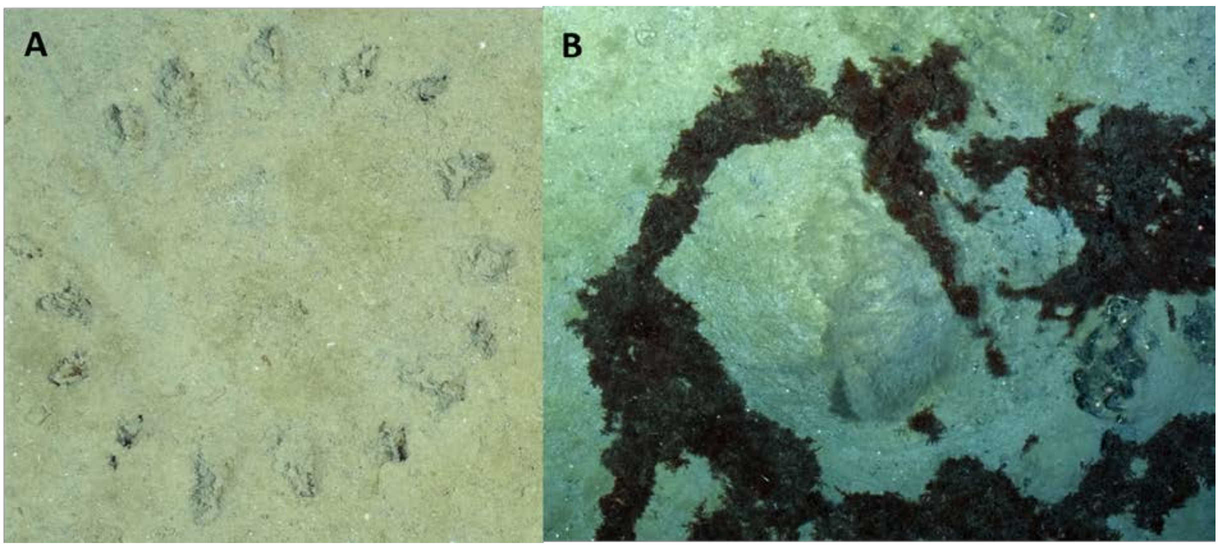


Figure 7.2.5.3 Interesting features observed in the seabed during ROV abyssal surveys. **A)** Biological traces imprinted in the mud (lebensspuren). **B)** Algae falls forming organic mats. (Image: A. Sweetman and E. Simon-Lledó)

7.3 Deep sea biodiversity. Environmental DNA. RocSI (S. Evans)

7.3.1 Personnel involved
Susan Evans with help from the AUV team and the ROV team, Veerle Huvenne and Erik Simon-Lledó

7.3.2 Introduction. Aims
To understand the natural state of marine ecosystems, there is a need to characterise biological baselines in remote environments that are often challenging to sample. The use of emerging technologies to facilitate genetic observations has great potential to improve baseline data, especially in environments like the deep-sea. Environmental DNA (eDNA) analysis has the potential to characterise biological communities with high sensitivity and species-level accuracy without disturbing organisms in the environment, by sequencing DNA signatures from sloughed cells, scales, faeces or other material left behind. During the iMirabilis2 campaign, our work aimed to demonstrate for the first time in-situ, the new high-resolution autonomous sampler, the Robotic Cartridge Sampling Instrument (RoCSI) recently developed at National Oceanography Centre, UK and integrated into the nose of Autosub6000 (Fig. 7.3.2.1).
The RoCSI is designed to filter and preserve predefined volumes of water in-situ collecting genetic material such as eDNA on a 0.22 µm filter. As well as demonstrating the ability of RoCSI to work

autonomously at depth, our work during the cruise was also to collect samples for eDNA analysis using traditional CTD-rosette deployments and water collected during ROV dives to validate and compare to the autonomously collected samples. Owing to the technical difficulties experienced with the Autosub6000 during the expedition, it was not possible to have as many surveys as planned or to get the corresponding multi-beam or image surveys at the same time. However, throughout the campaign, additional opportunistic eDNA samples were successfully collected from the CTD-rosette casts, ROV dives and also from the box corer and the MUC when the opportunity arose. The majority of samples were collected from a transect along the Cadamosto seamount but samples were also collected from from Fogo seamount.

Figure 7.3.2.1 RoCSI inside the nose of Autosub6000. (Image: Susan Evans)

7.3.3 Sampling methodology

RoCSI in Autosub6000

0.22 µm Sterivex™ filter units were assembled into pre-labelled cartridge units by hand as close as possible prior to the deployment of the AUV. These were loaded into a 25 cartridge sampling belt which was loaded into RoCSI using the GUI to advance the magazine. The correct alignment of all the cartridge units was then checked at least twice before deployment. Fresh RNAlater preservative was prepared as close to deployment as possible. Pre-deployment checks were made and RoCSI was pre-programmed using a GUI. After the AUV mission, the samples were removed from RoCSI as quickly as possible, the cartridge units were disassembled, and the Sterivex™ units sealed. All samples were then immediately transferred to the -80C freezer.

CTD-rosette

Throughout the cruise, seawater from a variety of depths (typically 5 m, chlorophyll α maximum, oxygen minimum zone, 100 m + bottom depth, bottom depth) was collected from a total of 12 sampling stations using a CTD-rosette. Following retrieval of the CTD, triplicate seawater samples (~4L) were filtered through 0.2 µm Sterivex™ filters using a peristaltic pump in a laboratory which was kept free of sediment and fish biomass. The eDNA on the filter was immediately preserved using RNAlater preservative and then stored at -80°C onboard.

Water samples collected by ROV LUSO

An individual 12 L Sea-Bird O.T.E sampling bottle (supplied by Marine Facilities, NOC) was mounted onto the side of ROV LUSO by the ROV team (**Figure 7.3.3.1**) by removing 1 of the 4 x 2.5L Garrafas Niskin bottles. During the ROV dives, the sampling bottle was closed manually using the ROV robotic arm to pull the release upon instruction to the ROV pilot. Following the dive, seawater was collected from the bottle into 10L carboys using sterile tubing as soon as the ROV was secured on deck. Where possible, seawater was also collected using the 3 x 2.5 L sampling bottles already mounted on the ROV.

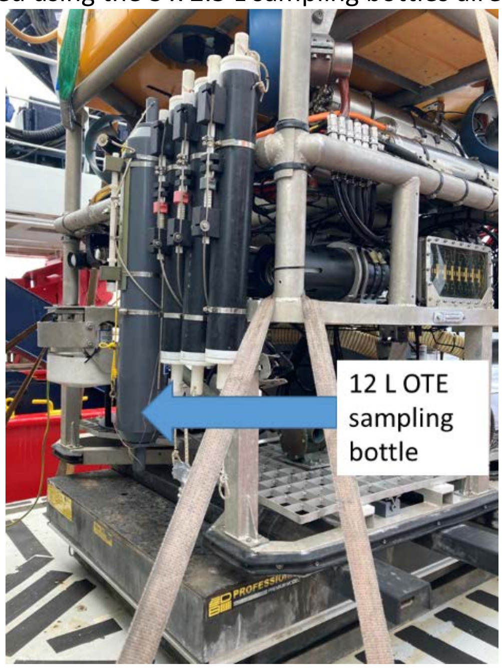


Figure 7.3.3.1 12 L O.T.E sampling bottle mounted on ROV LUSO. (Image: Susan Evans)

Triplicate 4 L samples were then filtered through 0.22 µm Sterivex™ filters using a peristaltic pump in a laboratory which was kept free of sediment and fish biomass. The eDNA on the filter was immediately preserved using RNAlater preservative and then stored at -80°C onboard.

RoCSI on ROV LUSO

Following the completion of video and image transects in seamount areas, the ROV LUSO was reconfigured and RoCSI was removed from the nose of Autosub6000 and mounted onto the ROV frame using jubilee clips where the sampling box is normally positioned (**Fig. 7.3.3.2**). As RoCSI was in a more exposed location in the ROV compared to in the AUV, a reinforced sampling bucket was constructed to protect the cartridge belt. The sampling inlet was positioned away from the downward facing thrusters and at the front of the ROV to ensure the sample was as free from sediment as possible. Details of the ROV surveys which occurred with RoCSI integrated are given in section 7.2.3. For the first survey, RoCSI was powered by a portable pressure tolerant battery pack. For the 2nd survey, RoCSI was powered directly using a 24V supplied from the ROV depth sensor and a 12 V invertor which was potted in a 8 pin SubConn cable. One of the ROV low light video camera’s which is normally positioned on the sample suction cups was re-positioned for this survey so it faced towards the sample and stabilizer pumps allowing visual checks if RoCSI was switched on during the dive.

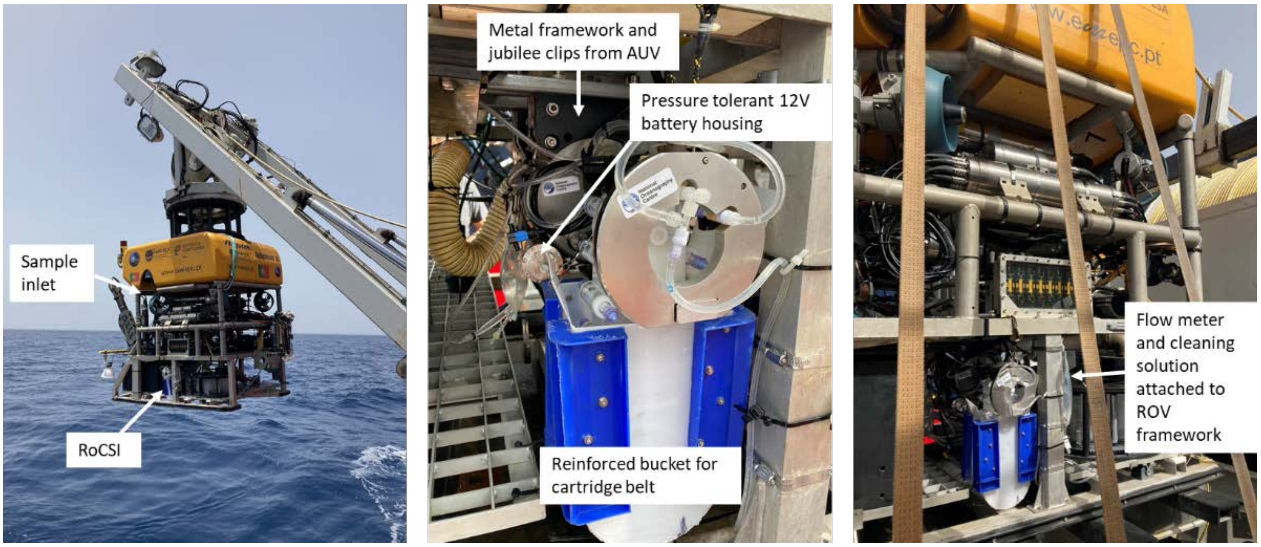


Figure 7.3.3.2 RoCSI mounted on the ROV LUSO. (Images: Susan Evans)

Sediment samples
Sediment samples were collected from cores from the MUC and box corer using a sterilised spoon and carefully transferred to 2 ml cryovials. A 1-2 g sediment sample was taken from the MUC and box cores from the edge of an undisturbed core and then frozen at -80 C. One push core was taken during ROV dives upon instruction to the ROV pilot. This was usually at the end of the ROV dive. When the ROV was back on deck, the push core was stored at 4°C until it could be processed. Once labelled, the whole push core in the core liner was extruded by letting the outside defrost a little, and the content was then put back into the -80 freezer.
Small tissue samples from 28 specimens collected by the ROV were collected and preserved in 98% molecular-grade ethanol for barcoding and to facilitate the genetic reference database used for eDNA metabarcoding.

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

7.3.5 Preliminary results
In total, 152 samples for eDNA analysis were collected from the CTD casts from 12 stations. 32 samples were collected using the ROV from 8 separate ROV dives. 44 samples were collected using RoCSI in the AUV from 3 missions (from 300-450 m, 400-3300 m and 3400 – 500 m respectively) (Table 7.3.5.1). A total of 6 push cores were collected for eDNA analysis during ROV dives, and 9 sediment samples were collected from the MUC and 8 from the box corer. Unfortunately, it was not possible to collect any eDNA

samples using RoCSI on the ROV as there were power supply issues to the device. However, despite this, RoCSI was successfully integrated on the ROV, a process that will help inform future design reviews. The results from both multiple marker and single marker analysis will be used to assess biodiversity at the sample areas. Between sampling areas, the number of OTUs detected and number of unique OTUs for each metabarcoding marker will be compared to give an indication of deep-sea community composition at each sampling area with a focus on eDNA distribution around the Cadamosto seamount. As it was not possible to collect any corresponding image survey data from the AUV missions, the eDNA data collected autonomously will be compared to eDNA data from samples collected using the CTD-rosette casts in as close a proximity as possible. The corresponding metadata collected during the AUV mission (CTD and ADCP) will be used to provide context to the eDNA data.

Table 7.3.5.1 eDNA sample summary

Station	Date	Location	CTD eDNA	ROV water samples	ROV push core	AUV RoCSI
8	05/08/2021	Cadamosto	16			
12	06/08/2021	Fogo		4	1	
15	07/08/2021	Cadamosto	15			
24	09/08/2021	Cadamosto		2	1	
25	10/08/2021	Cadamosto	16			
30	11/08/2021	Cadamosto	16			
31	11/08/2021	Fogo		6	1	
32	12/08/2021	Cabo Verde shelf				24
33	12/08/2021	Fogo	14			
37	13/08/2021	Fogo	12			
38	13/08/2021	Cabo Verde shelf	6			
44	14/08/2021	Cadamosto	15			
45	15/08/2021	Cabo Verde shelf				5
46	15/08/2021	Cadamosto		4		
50	16/08/2021	Cadamosto	15			
51	16/08/2021	Cadamosto	6			
55	17/08/2021	Cadamosto		4	1	
56	18/08/2021	Cabo Verde shelf				15
59	18/08/2021	Cadamosto	6			
61	19/08/2021	Cadamosto	15			
64	19/08/2021	Cadamosto		4	1	
75	21/08/2021	Cadamosto		4		
77	22/08/2021	Brava		4	1	
			152	32	6	44

7.3.6 Datasets to be submitted to PANGEA

Description of eDNA datasets and sampling events

7.4 Hard bottom megabenthos biodiversity and distribution Cadamosto and Nola Seamount off Cabo Verde. ROV Luso (B. Vinha, C. Orejas, V. Huvenne, A. Gori, M. Roberts, K. Barnhill)

7.4.1 Personnel involved

Beatriz Vinha, Covadonga Orejas, Veerle Huvenne, Andrea Gori, Murray Roberts, Kelsey Archer Barnhill, ROV Luso Team (António Calado, Andreia Afonso, Miguel Souto, Renato Bettencourt, Bruno Ramos)

7.4.2 Introduction. Aims

Cabo Verde is a relatively unexplored area in terms of deep-sea benthic megafauna. Prior to iMirabilis2, information on the deep-sea megabenthic communities of Cabo Verde was available from previous research cruises conducted by GEOMAR to the region. Video and images from the JAGO submersible (GEOMAR) and from the Remote Operated Vehicle (ROV) Kiel6000 (GEOMAR) revealed a landscape covered by volcanic rocks with the presence of octocorals, bamboo corals, black corals and sponges (Hansteen et al., 2014). However, as these cruises were not aimed at looking at deep-sea communities, information still remained very scarce.

Using the ROV *Luso* (EMEPC), we conducted *in situ* field work to explore the benthic megafaunal communities occurring on the hard bottom seafloor of Cabo Verde. This was the first assessment fully dedicated to investigate the deep-sea benthic communities of Cabo Verde. Quantitative video analysis will later be conducted in our home laboratories based on methodologies that have been successfully applied in previous publications (e.g., Orejas et al. 2009; Gori et al. 2013; Vad et al. 2017). The main aims of this scientific work are:

1. To describe and characterize, for the first time, the megabenthic communities of Cadamosto seamount and of Fogo and Brava Island slopes;
2. To map the benthic habitat of the investigated areas;
3. To analyse species distribution patterns, population structure and growth of conspicuous species based on the video material and
4. To identify the presence of Vulnerable Marine Ecosystems (VMEs).

7.4.3 Sampling methodology

A total of 10 ROV dives, in which 2 dives were aborted due to technical problems of ROV Luso, were conducted to investigate the hard-bottom deep-sea megabenthic communities of Cabo Verde (Table 7.4.3.1). Three different locations SW of the Cabo Verde archipelago were explored: Fogo and Brava Island slopes and Cadamosto Seamount, SW of Brava Island. Five ROV dives were conducted at Cadamosto seamount (Fig. 7.4.3.1A), while two dives took place at Fogo Island slope (Fig. 7.4.3.1B) and one at Brava Island slope (Fig. 7.4.3.1C). Before each ROV dive, transects in the explored areas were planned based on the bathymetry of the area. Overall, transects covered a bathymetric distribution from 2000 to 1400 m of depth.

Table 7.4.3.1 List of ROV dives aimed for the characterization of the hard bottom deep-sea megabenthic communities of Cabo Verde.

Dive number	Station number	Location	Date	Longitude (Start/End)	Latitude (Start/End)	Depth Range (m)	Notes
Dive 01	12	Fogo	06/08/2021	-24.50325 -24.49396	14.81252 14.81828	2117-1876	
Dive 02	17	Cadamosto	07/08/2021	-24.93248 -24.93213	14.65001 14.65041	1850-1850	Aborted
Dive 03	24	Cadamosto	09/08/2021	-24.931663 -24.91969	14.75160 14.65462	1997-1416	
Dive 04	31	Fogo	11/08/2021	-24.365068 -24.3646	14.67410 14.75963	1939-1705	
Dive 05	46	Cadamosto	15/08/2021	-24.933767 -24.92214	14.67410 14.66901	2004-1682	
Dive 06	55	Cadamosto	17/08/2021	-24.9169	14.635	1952-1771	

				-24.91563	14.64190		
Dive 07	64	Cadamosto	19/08/2021	-24.9053	14.6807	1939-1770	
				-24.90595	14.67501		
Dive 08	74	Cadamosto	21/08/2021	-24.9215	14.6685		Aborted
				-24.9215	14.6685		at 100m
Dive 09	75	Cadamosto	21/08/2021	-24.9215	14.6685	1740-1421	
				-24.91936	14.6600		
Dive 10	77	Brava	22/08/2021	-24.635820	14.7975435	2004-1668	
				-24.64873	14.79757		

The ROV *Luso* is equipped with a HD and 4K video camera, with two laser scaling devices 60cm apart, and a digital stills camera (Canon PowerShot G11). During ROV dives, the digital stills camera was shot automatically every minute and, in particular areas of interest, the camera was manipulated by one of the members of the scientific team for extra photographs.

In ROV dive 09, at Cadamosto seamount, video data was acquired to reconstruct an area in 3D, based on photogrammetry techniques (Table 7.4.3.2). For this purpose, the ROV was kept at a constant speed and the camera view was kept at the same angle in order to ensure image overlap. The area chosen to be reconstructed was an area with dense aggregations of *Enallopsammia rostrata* (Fig. 7.4.3.2). Spatial statistics will be applied on the 3D reconstructions to investigate spatial patterns of the species.

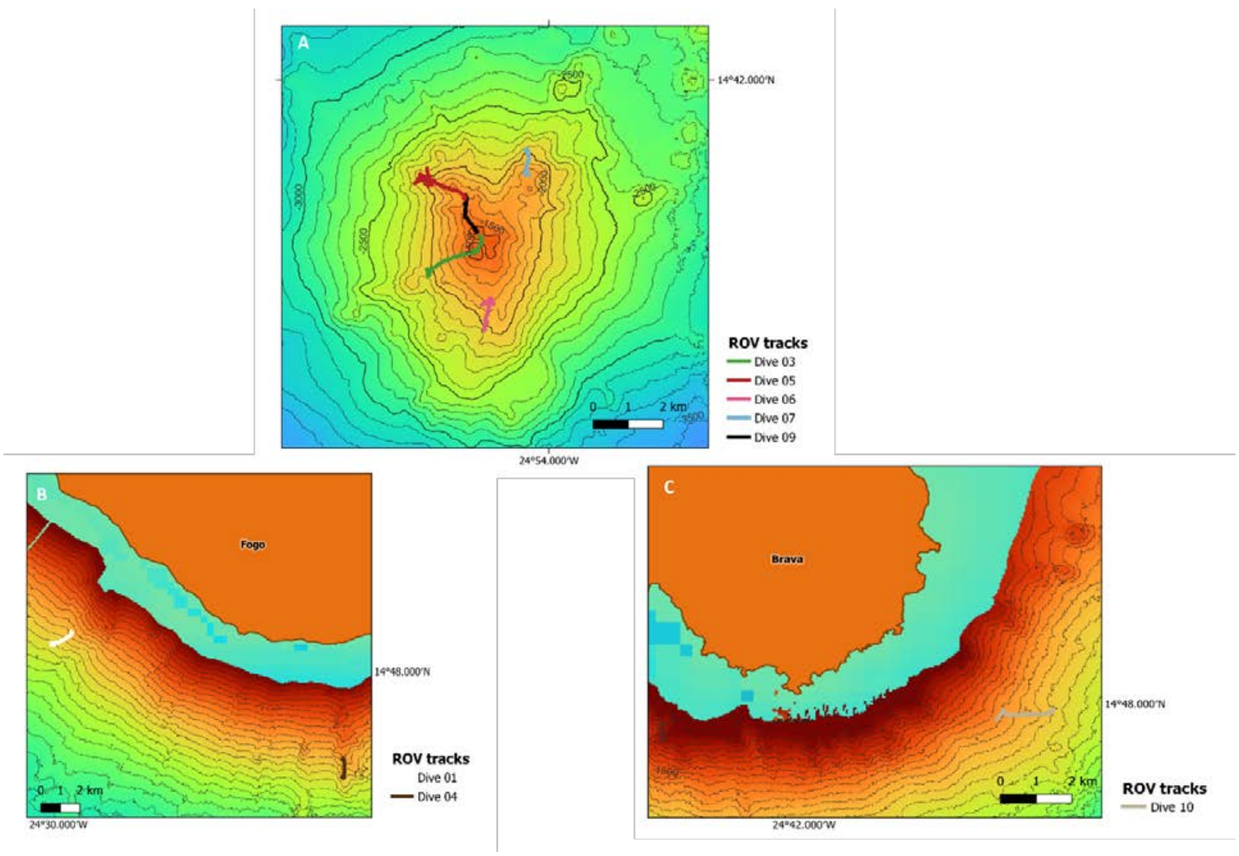


Figure 7.4.3.1 Map with the ROV dive tracks at (A) Cadamosto seamount; (B) Fogo Island and (C) Brava Island slopes.

Table 7.4.3.2 Metadata of 3D photogrammetry video acquisition during ROV dive 09.

Dive number	Date	Start Time Image acquisition	End Time Image acquisition	Start Lat End Lat	Start Lon End Lon
Dive 09	21/08/2021	16:41	16:52	14.663569 14.663434	-24.921825 -24.921964

Figure 7.4.3.2 Snapshots of the video data acquired for 3D photogrammetry in an area with a dense aggregation of *Enallopsammia rostrata.* (Image: Luso/iMirabilis2/iAtlantic project)

Along the video transects, the ROV stopped to collect samples. Specimens belonging to different functional groups were sampled using the ROV manipulators (7-functions arm and suction sampler) both for stable isotopes and fatty acid analysis (see section 7.5), as well as for taxonomy. Water samples were collected for eDNA analysis using the Niskin bottles installed in the ROV (3 bottles of 2.5L and 1 bottle of 12L) and sediment was sampled using the ROV push cores for both eDNA, stable isotopes and fatty acids analysis. In ROV Dive 05, a zooplankton net (200µm) was installed in the ROV suction sampler in an attempt to sample zooplankton in the water column near the bottom. However, this sampling attempt failed has the net came back to the surface empty.

7.4.4 Processing methodology

On board video annotations were done, during each ROV dive, using the Ocean Floor Observation Protocol (OFOP) software. These preliminary annotations have allowed a first characterization of the explored areas, presented in the following section.

7.4.5 Preliminary results

Over 75 hours of ROV video data were acquired for the characterization of the hard bottom megabenthic communities of Cabo Verde. The ROV dives showed a volcanic landscape and a high number of octocoral species in all the three explored locations. In all the locations, coral skeletons on the substrate were also frequently observed. Based on qualitative video annotations, we present, in this section, the preliminary results on the characterization and spatial distribution of the conspicuous megabenthic communities observed during ROV dives.

7.4.5.1. Preliminary characterization and spatial distribution of the deep-sea megabenthic communities along the study areas

The dives conducted in Cadamosto are depicted in figure 7.4.5.1.1. Cadamosto seamount is characterized by young volcanic features, big pillow lavas (Fig. 7.4.5.1.2A) and red hydrothermally-altered rocks (Fig. 7.4.5.1.2B), unveiling the highest species diversity and densities of all the three explored locations with the ROV. In all dives at Cadamosto seamount, it was frequent to see a high abundance of coral skeletons. Through qualitative video analysis on board, some differences between the communities in the northern part and the southern part of the seamount have been observed (Fig. 7.4.5.1.1).

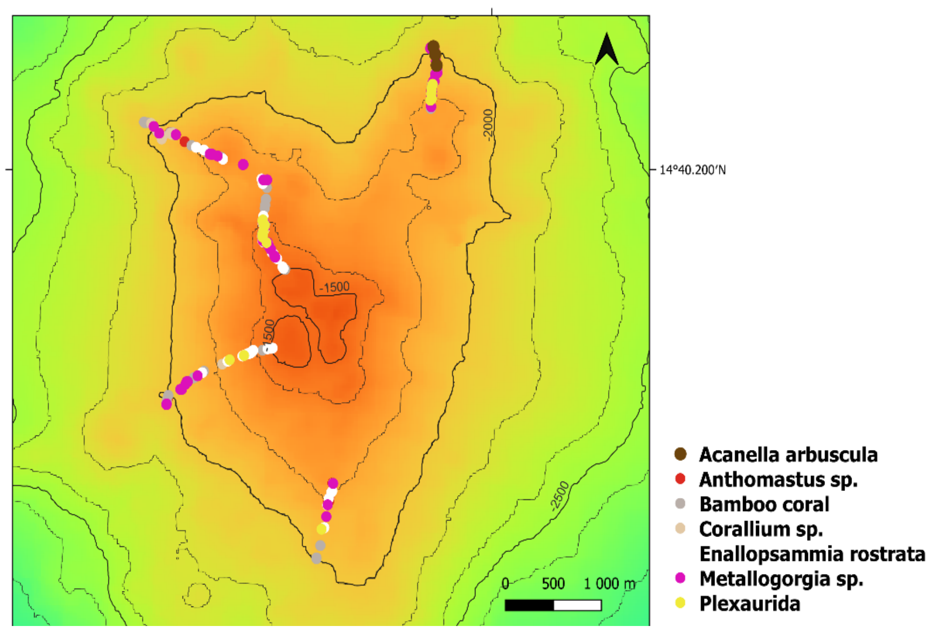


Figure 7.4.5.1.1 Spatial distribution of conspicuous species observed during ROV dives at Cadamosto seamount using the OFOP annotations conducted on board.

At the SW flank of Cadamosto seamount, in dives 03 and 05, different species of cold-water corals (CWC) and sponges were observed, however they presented a scattered distribution along the transects. Both dives were specially characterized by areas with dense aggregations of brittle stars and sea urchins (Fig. 7.4.5.1.2C). Some of the conspicuous CWC species observed during both dives were *Anthomastus* spp., *Metallogorgia* spp., corals from the Pleuxauridae family (Fig. 7.4.5.1.2D), bamboo corals and, in the shallowest depths of the transect at around 1800m depth, some scatter distributed colonies of *Ennallopsammia rostrata* (Fig. 7.4.5.1.2E).

At the NW slope of Cadamosto seamount, during dive 05, at around 1900m depth, some sponge aggregations (Fig. 7.4.5.1.2F) and coral gardens composed by bamboo corals and *Corallium* spp. were observed. Along the transect, *Metallogorgia* spp. and some colonies of *E. rostrata* were seen. Dive 09 started at 1740m depth, near the area where dive 05 finished, and *Plexauridae* spp., *Metallogorgia* spp. and bamboo corals were observed. Additionally, a large coral garden composed by *E. rostrata* was observed at 1600m depth.

The NE side of the seamount was explored during dive 07 and this was the area on Cadamosto seamount with the highest diversity and density of CWC species (Fig. Fig. 7.4.5.1.2G,H). The deepest part of the transect was the only site explored on Cadamosto seamount with the presence of *Acanella arbuscula*. Also, at approximately 2000m depth, some sponge aggregations were observed. During the dive, *Metallogorgia* spp. was seen in high abundances and, at 1850m depth, a coral garden dominated by the species was found. Additionally, different species of black corals and bamboo corals as well as *Plexauridae* spp. family were observed during this dive.

The summit of Cadamosto seamount was explored at the end of both dive 03 and dive 09. In dive 03, the western side of the summit unveiled a landscape dominated by red hydrothermally altered rocks and a high density of a white stick-shaped organism (possibly polychaete tubes or carnivorous sponges) (see Fig. 7.4.5.1.2B). During dive 09, at the NW side of the summit, red hydrothermally altered rocks were observed, however, the presence of the same organisms in the same abundance was not seen.

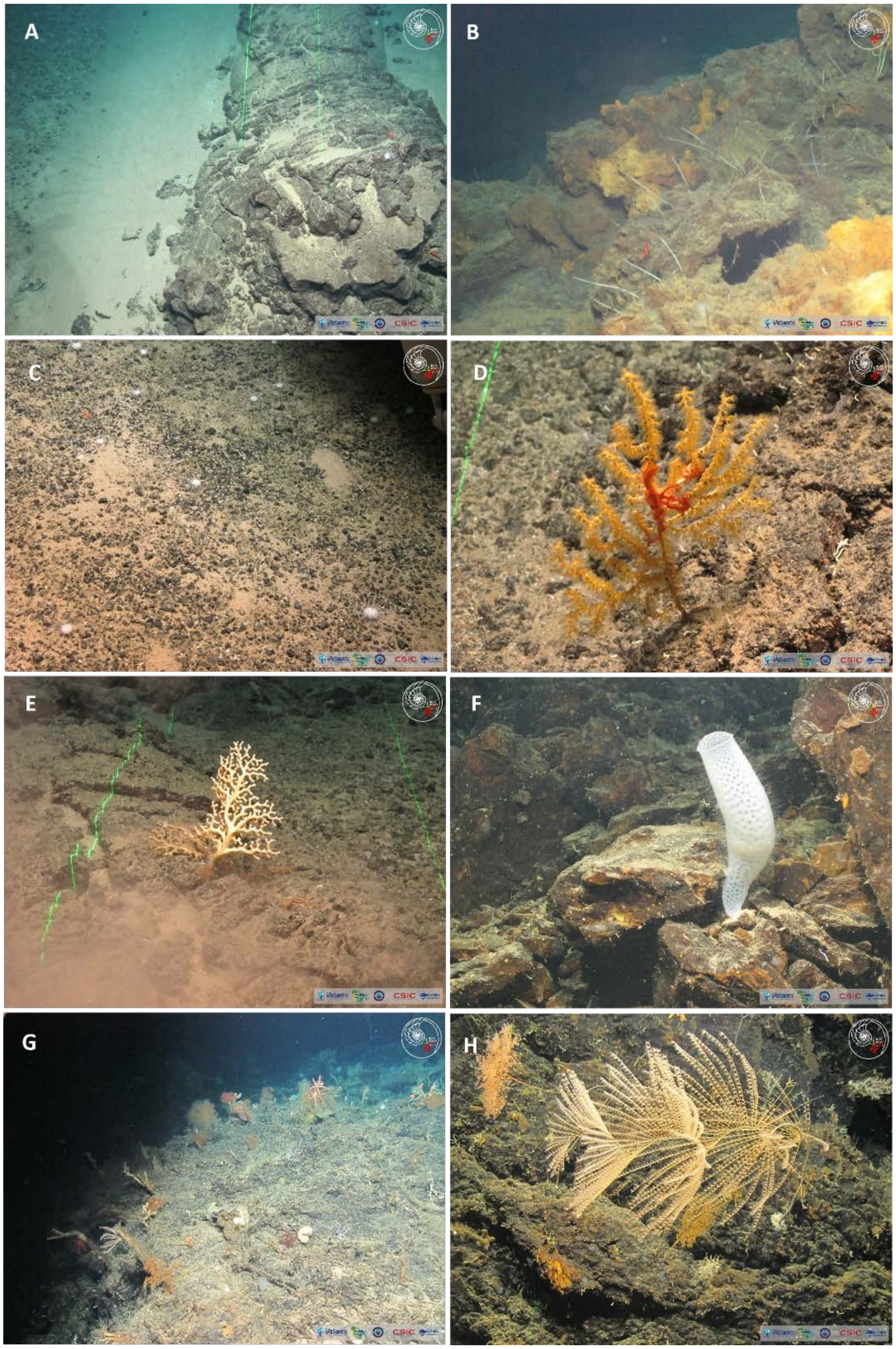


Figure 7.4.5.1.2 Representation of the geological landscape and of some of the species observed on Cadamosto seamount. (A) Typical volcanic features observed during dives at Cadamosto seamount; (B) The summit of Cadamosto seamount with red hydrothermally-altered rocks with the presence of the white stick-shaped organisms (possibly polychaete tubes or carnivorous sponges); (C) High density of sea urchins; (D) *Plexauridae* spp.; (E) *Enallopsammia rostrata;* (F) Venus' Flower Basket sponge (*Euplectella* spp.); (G) Coral Garden composed of different species of octocorals and black corals and (H) *Metallogorgia* spp. and *Iridogorgia* spp. (Image: Luso/iMirabilis2/iAtlantic project).

The two dives conducted along Fogo Island slope revealed the dominance of different species compositions (Fig. 7.4.5.1.3).

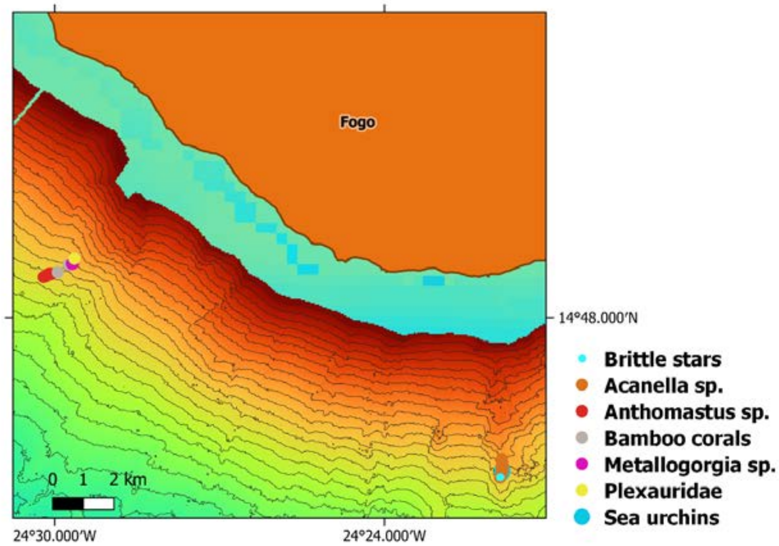


Figure 7.4.5.1.3 Spatial distribution of conspicuous species observed during ROV dives on the Fogo Island slope, using the OFOP annotations conducted on board.

SW of Fogo Island, in the deepest part of the transect conducted during dive 01, an area covered by soft sediment with the presence of spaced distributed colonies of *Anthomastus* spp. (Fig. 7.4.5.1.4A) was observed. As the ROV transited upwards across the island slope, the substrate was dominated by sediment with boulders where colonies of with *Metallogorgia* spp., bamboo corals, and *Plexauridae* spp. (Fig. 7.4.5.1.4B) have settled. Also stylasterids were observed and sampled with the ROV (Fig. 7.4.5.1.4C).

South of Fogo Island (dive 04), from 1950 to 1830 m depth, was the explored location with the highest abundance of *A. arbuscula* (Fig. 7.4.5.1.4D). Within this same depth range, different species of sponges, bamboo corals and black corals as well as *Plexauridae* spp. and *Metallogorgia* spp. were observed. In the shallowest part of the explored area, starting at 1820m depth, the substrate was mainly dominated by soft sediment, with the presence of sea pens and different holothurian species.

Figure 7.4.5.1.4 Benthic communities observed during ROV dives at Fogo Island Slope. (A) *Anthomastus* spp.; (B) Boulder with *Metallogorgia* spp., *Pleuxauridae* spp. and Venus flower basket sponge; (C) Stylasteridae; (D) *Acanella arbuscula*. (Image: Luso/iMirabilsi2/iAtlantic project)

One ROV dive (dive 10) was dedicated to exploring the deep-sea megabenthic communities of Brava Island Slope (Fig. 7.4.5.1.5).

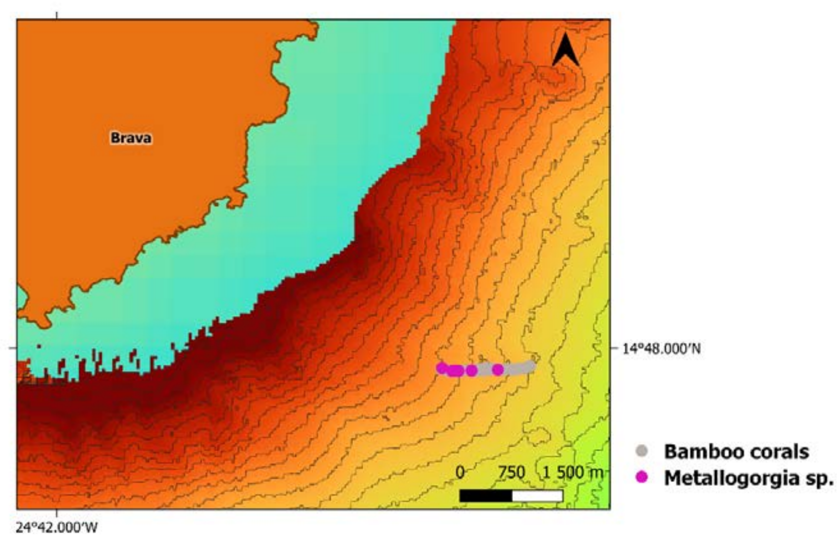


Figure 7.4.5.1.5 Spatial distribution of species observed during ROV dives in Brava Island slope, using the OFOP annotations conducted on board.

This dive was mainly characterized by areas with soft sediment with boulders and, occasionally, areas with large volcanic rocks. When compared to the other two locations (Fogo and Cadamosto), Brava appeared to be less diverse in terms of species composition. Along the transect, the presence of sea pens, brittle stars and sponges was observed. In the shallowest section of the transect, some colonies of *Metallogorgia* spp. were observed. Brava was especially characterized by the presence of different species and large colonies of bamboo corals (some of them >1 m in height) (Fig. 7.4.5.1.6A, C). Overall, all the cold-water coral species observed presented a scattered distribution and no large aggregations were observed in this location.

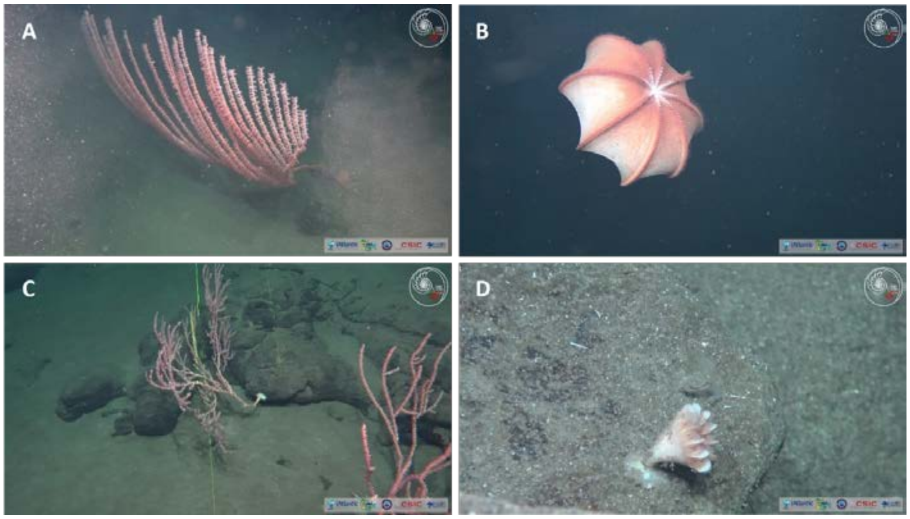


Figure 7.4.5.1.6 Some of the species observed during the ROV dive conducted at Brava Island Slope. (A) *Isidella* spp.; (B) Cirrate Octopus; (C) Bamboo corals; (D) Solitary coral. (Image: Luso/iMirabilis2/iAtlantic project)

In a next step, species will be identified to the lowest possible taxonomic level. The results on species spatial patterns retrieved from the video analysis will be combined with environmental data (terrain and oceanographic) to get insights into the factors driving species distribution.

7.4.5.2. Presence of Potential Vulnerable Marine Ecosystems (VMEs)

During ROV dives, key indicator species of Vulnerable Marine Ecosystems (VMEs) were observed.
The bathymetric distribution (Fig. 7.4.5.2.1) of some of the conspicuous VME Indicator taxa shows that some of the observed species during ROV dives are usually exclusive to certain depths and have only been observed in some of the areas explored with the ROV.
The presence of the scleractinian coral *Enallopsammia rostrata* was only observed at Cadamosto seamount, and usually in the shallowest depths of the transects conducted in the area, starting at 1800 to 1500 m, whereas the higher abundance of *Acanella arbuscula* was observed on the S of Fogo Island (Dive 04) from 1950 to 1830 m. A few colonies of *A. arbuscula* were also observed NE of Cadamosto Seamount (Dive 07) from 1970 to 1910 m depth. The presence of the “Precious coral” *Corallium* sp. was exclusive to the NW of Cadamosto seamount (during dive 05), associated with deeper waters, from 2000 to 1900 m. The soft coral *Antomasthus* spp. was usually observed in the deepest parts of the ROV transects conducted.
Some of the cosmopolitan taxa observed during ROV dives included *Metallogorgia* spp., *Pleuxauridae* spp. and different species of bamboo corals. These taxa were present in all the explored locations with the ROV and in a wide depth range.

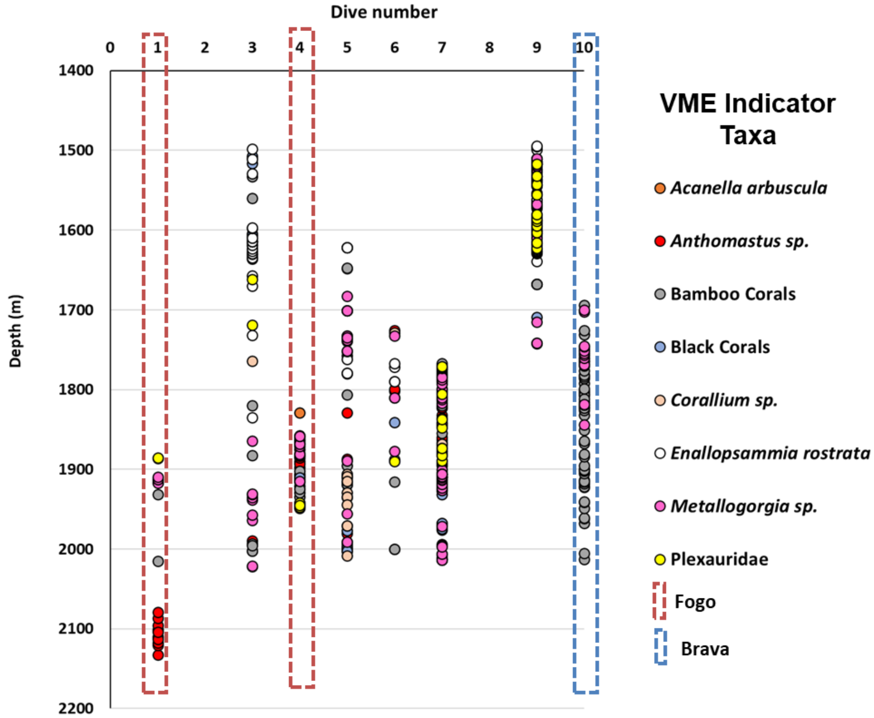


Figure 7.4.5.2.1 Bathymetric distribution of VME indicator taxa observed during ROV dives in Cadamosto, Fogo and Brava. Fogo and Brava dives are indicated with red and blue dotted lines respectively.

Based on qualitative observations during ROV dives, we identified the areas with the densest species aggregations, in order to identify potential VMEs (Fig. 7.4.5.2.2).

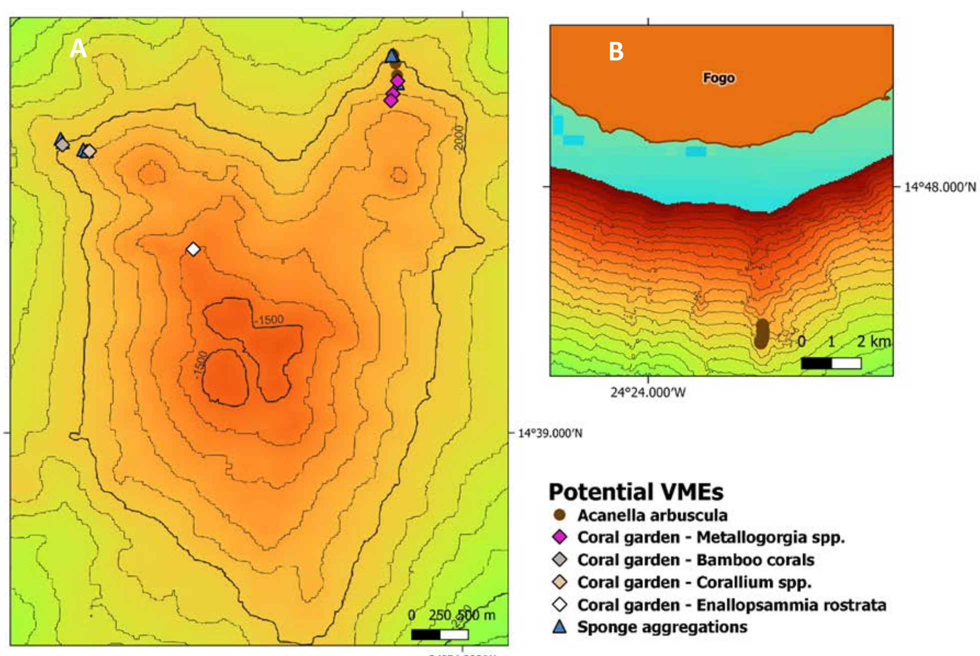


Figure 7.4.5.2.2 Spatial distribution of Potential VMEs observed during ROV dives at (A) Cadamosto seamount and (B) Fogo Island Slope, using the OFOP annotations conducted on board.

North of Cadamosto seamount, different areas are highlighted as potential VMEs: (1) a large coral garden composed by *E. rostrata* (Fig. 7.4.5.2.3 A); (2) dense aggregations of *Corallium* sp. mixed with other VME indicator taxa, such as sponges, *Anthomastus* spp. and bamboo corals (Fig 7.4.5.2.3 B); (3) a bamboo coral garden (Fig 7.4.5.2.3 C); (4) Sponge aggregations (Fig. 7.4.5.2.3 D) and (5) coral gardens dominated by *Metallogorgia* spp. and with the presence of different species of octocorals and black corals (Fig. 7.4.5.2.3E, F). On Fogo Island, from 2000 to 1800 m depth, the presence of *A. arbuscula* can also be identified as a potential VME (see section 7.4.5.1).

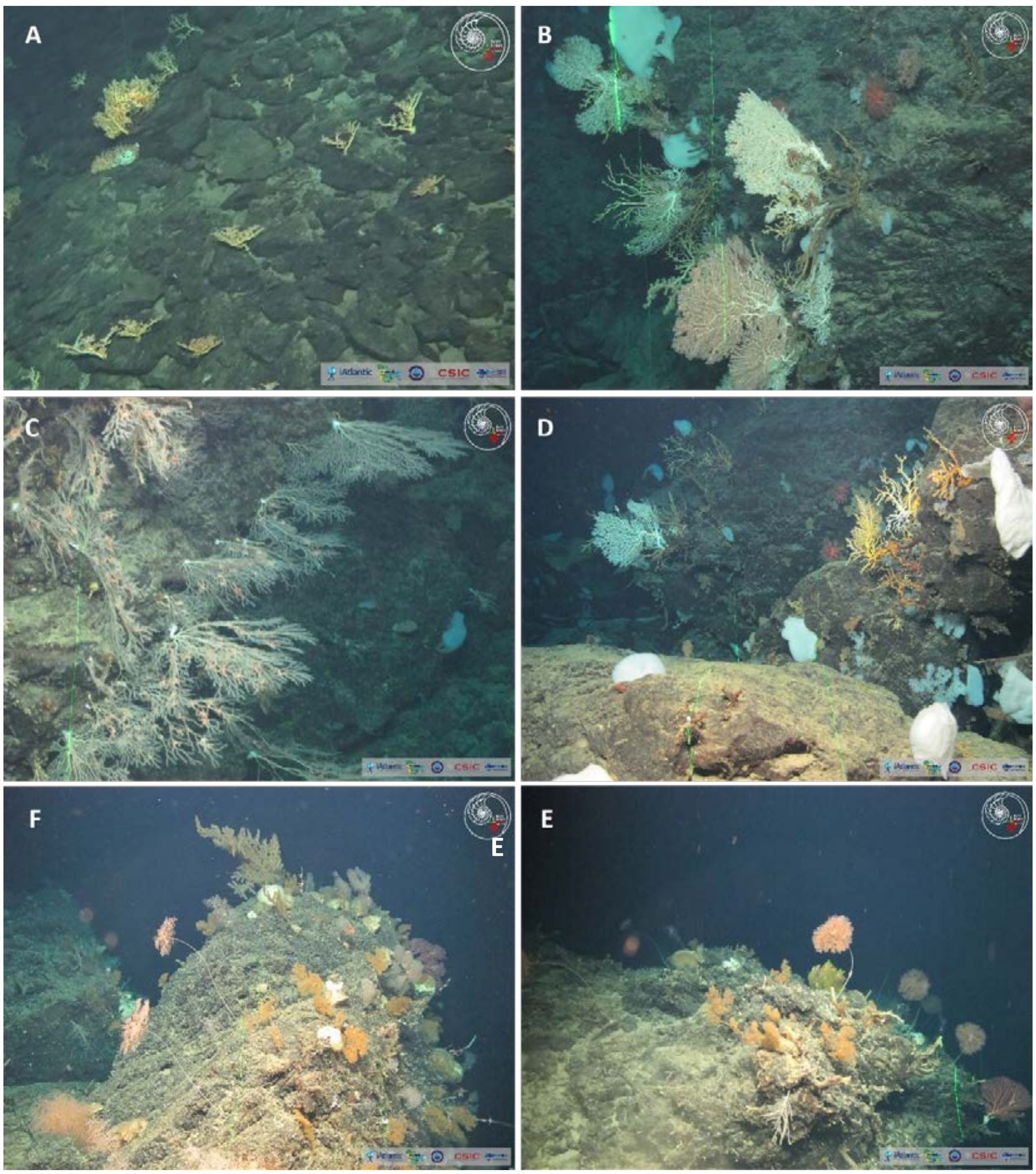


Figure 7.4.5.2.3 Presence of Potential VMEs. (A) Large coral garden composed by *Enallopsammia rostrata*; (B) Aggregation of *Corallium* spp. in association with sponges, *Anthomastus* spp. and bamboo corals; (C) Coral Garden dominated by bamboo corals; (D) Sponge aggregation; (E) and (F) Coral Garden composed by a high density of *Metallogorgia* spp. and different species of black corals and octocorals. (Image: Luso/iMirabilsi2/iAtlantic project)

7.4.6 Datasets to be submitted to PANGEA
Metadata ROV dive stations, OFOP on board annotations, species occurrences and counts.

7.5 Trophic ecology Cadamosto Seamount off Cabo Verde. Stable isotope analyses. ROV Luso (B. Vinha, C. Orejas, A. Gori, T. Amaro, ROV team)

7.5.1 Personnel involved
Beatriz Vinha, Covadonga Orejas, Andrea Gori, António Calado, Andreia Afonso, Bruno Ramos, Renato Bettencourt, Miguel Souto

7.5.2 Introduction. Aims
Understanding trophic interactions between species is of great importance to understand the functionality of a habitat and how it might be affected by any disturbances in the ecosystem. Because of the difficulty to access the deep-sea, applying some of the techniques commonly used in dietary studies can be challenging.
For many decades, the analysis of trophic biomarkers, such as stable isotopes and fatty acids, has been widely used to investigate the trophic ecology of terrestrial and marine ecosystems. Over the past years, these analyses have shown to be an accessible and effective tool to assess food sources, trophic levels and carbon flows in deep-sea ecosystems.
In iMirabilis2, we sampled fragments of the most abundant benthic megafauna functional groups observed during ROV dives as well as their potential food sources, such as Suspended Particulate Organic matter (SPOM), sediment and zooplankton. These samples will be analysed in terms of their stable isotopic ($\delta 13C$ and $\delta 15N$) and fatty acids composition in order to determine the trophic ecology of the deep-sea hard bottom megabenthic habitat of Cabo Verde. Stable isotopes analysis of the collected samples will be done at University of Salento (Italy), whereas the analysis for fatty acids will be conducted in collaboration with the University of Aveiro (Portugal).

7.5.3 Sampling and processing methodology
The most abundant functional groups observed at each ROV dive were collected using the ROV manipulators. Specimen belonging to Cnidaria (Hydrozoa and Anthozoa – Hexacorallia and Octocoral), Porifera, Echinodermata, Cephalopoda, Crustacea and Teleostei were sampled (see Appendix 10.8 for the complete list of samples collected). During ROV dives, sediment was collected using the push cores installed on the ROV. Whenever possible, 3 specimens of each group were collected. Two sub-samples from the same sample were prepared: one sub-sample for stable isotopes analysis and one sub-sample for fatty acids analysis. All samples were stored upon collection at -80ºC.
To analyse the stable isotopes and fatty acids of suspended particulate organic matter (SPOM) in the water column as a potential food source for megabenthos, 1L of water was filtered on 25mm GF/F filters. During 9 CTD rosette deployments, near the areas where ROV samples were collected (Fig. 7.5.3.1), water was sampled using the 12L bottles of the rosette, at 4 different depths (maximum of chlorophyll a, oxygen minimum zone, 100m above bottom and at the bottom) (Table 7.5.3.1). In order to have three replicates per depth, three CTD bottles were sampled at each depth. From each sampled bottle, we filtered water on three GF/F filters: one filter to be analysed for stable isotopes, one filter to be analysed for fatty acids and one filter to be analysed for POC, PON and C:N ratios. At station 50 and 59, at Cadamosto seamount, the GF/F filters will be analysed only for POC, PON and C:N ratios. The results from these analyses will be combined with the spatial distribution of the megabenthic communities of the explored locations. A total of 276L of water was filtered, however, for trophic ecology studies, i.e., samples to be analysed for stable isotopes and fatty acids, a total of 168L of water was sampled. All filters were stored on board at -80ºC.

Table 7.5.3.1 Location and depth of the sampled water filtered on GF/F filters (1L of water filtered) and the analysis that will be conducted on each filter. For each one of the analyses, there are 3 replicates of GF/F filters per depth.

Location	Station number	Depth	Analysis to be conducted
Cadamosto	18	2008	Stable Isotopes, Fatty Acids, POC, PON, C:N Ratio
		1900	
		340	
		60	
	25	1403	Stable Isotopes, Fatty Acids, POC, PON, C:N Ratio
		1301	
		445	
		50	
	44	2221	Stable Isotopes, Fatty Acids, POC, PON, C:N Ratio
		2100	
		435	
		50	
	50	2082	POC, PON, C:N Ratio
		1982	
		410	
		65	
	59	2915	POC, PON, C:N Ratio
		2815	
		432	
		45	
Fogo	33	1959	Stable Isotopes, Fatty Acids, POC, PON, C:N Ratio
		1859	
		400	
		45	
	34	2124	Stable Isotopes, Fatty Acids, POC, PON, C:N Ratio
		2024	
		360	
		50	
	37	1037	Stable Isotopes, Fatty Acids, POC, PON, C:N Ratio
		937	
		340	
		45	
Brava	91	1982	Stable Isotopes, Fatty Acids, POC, PON, C:N Ratio
		1882	
		370	
		60	

In order to sample zooplankton as a potential food source, a WP2 net (200 μm) was deployed vertically at 40 m/minute until approximately 100 m above the bottom, and then recovered at the same speed. Plankton was collected in a bucket and subsequently subdivided as follows:

- Shrimps were individually fixed for stable isotope and fatty acid analyses at -80ºC.
- Fish were individually fixed for stable isotopes and fatty acid analyses at -80ºC.
- All the remaining zooplankton (with abundant gelatinous component) was fixed for stable isotopes and fatty acid analyses at -80ºC, as well as in 10% formalin for taxonomical analyses.

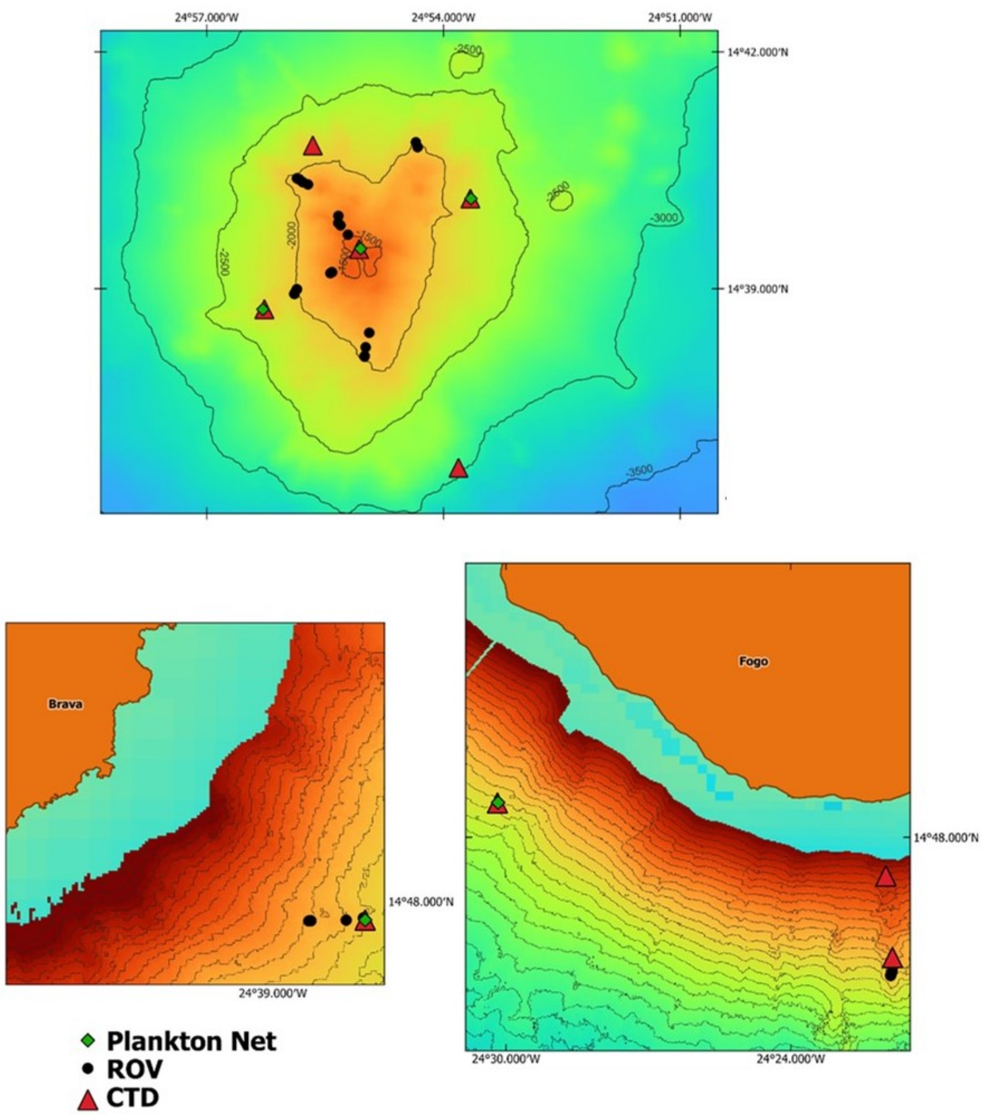


Figure 7.5.3.1 Spatial distribution of the sampling conducted to investigate the trophic ecology of the deep-sea megabenthic communities at (A) Cadamosto seamount, (B) Brava and (C) Fogo Islands.

7.5.4 Preliminary results

A summary of the samples collected for the investigation of the trophic ecology of the study area is provided in Table 7.5.4.1. Samples will later be analysed in our home laboratories for fatty acids and stable isotopes ($\delta^{15}N$ and $\delta^{13}C$) composition.

Table 7.5.4.1 Number of samples collected with each sampling gear for the trophic ecology of Cadamosto seamount, Fogo and Brava islands.

Sampling gear	Number of deployments/Dives with sample collection	Number of Samples
ROV	7	59
CTD Rosette	9	276 GF/F filters (1L/filter) *Only 168 GF/F filters will be analysed for SI and FA*
WP2 Plankton Net (200 μm)	5	19

7.5.5 Datasets to be submitted to PANGEA

Metadata stations where samples have been collected

7.6 Trophic ecology Cadamosto Seamount off Cabo Verde. *Ex situ* aquaria experiments. (A. Gori, M. Roberts, K. Barnhill, C. Orejas & ROV team)

7.6.1 Personnel involved

Andrea Gori, Murray Roberts, Kelsey Archer Barnhill, Covadonga Orejas & ROV team

7.6.2 Introduction. Aims

The aquaria experiments were aimed at comparing the capability of representative cold-water coral species from Cadamosto seamount to capture food particles under different current flow speeds. Interspecific differences in feeding capability could help in understanding the contrasted distribution of species at the seamount, possibly driven by exposure to the main current flow in the area.

7.6.3 Sampling methodology

A 300 L aquarium provided with a biological filter and a chiller (TK-2000) was installed in the thermally regulated laboratory (Fig. 7.6.3.1a). The aquarium was filled (100 L) with water and maintained at 5ºC. A pump inside the aquarium provided water flow. A water bath was settled with a chiller, containing 3 flume experimental aquaria, with a motor propeller each (Fig. 7.6.3.1b). Flow velocity in each aquarium was calibrated using a flow meter AEM1-D, ALEC Electronics (Fig. 7.6.3.1c).

Cold-water coral specimens were collected by the ROV Luso and placed into the sampling box in the first dives, and subsequently, in all the others dives, specimens were collected by the ROV suction pump and stored in its sampling cylinders until ROV recovery onboard. After ROV arrival onboard, coral specimens were quickly transported to the thermally regulated laboratory. Corals were transported using a bucket filled with cold seawater in the first dives, whereas subsequently the sampling cylinders were removed from the ROV and directly used to transport corals to the thermally regulated laboratory. Once in the laboratory, corals were placed in the aquarium and observed during the following days to assess their state:

Lepidis (2 branches): produced mucus for 2 days; then showed some signs of recovery and opened some of the polyps; however, after 5 days polyps started to die; and after 8 days there were no more polyps.

Enallopsammia (8 branches): produced a lot of mucus for 3 days; then started to lose entire polyp tissue; all branches were dead after 7 days.

Plexauridae (9 branches): no mucus production; polyps were closed during several days; from day 6 it started to lose polyps (found on the bottom).

Corallium (5 branches): no mucus production; most of the polyps were closed during several days, a few were possibly starting to open; however, from day 6 they started to lose polyps (found on the bottom).

Anthomastus (1 colony): mucus production for 1 day; then stayed closed during all the following days; after 7 days without opening, it was fixed in ethanol for taxonomy.
Freshly hatched *Artemia salina* nauplii (Fig. 7.6.3.1d) were delivered 3 times during the entire period, to try stimulating corals to open.

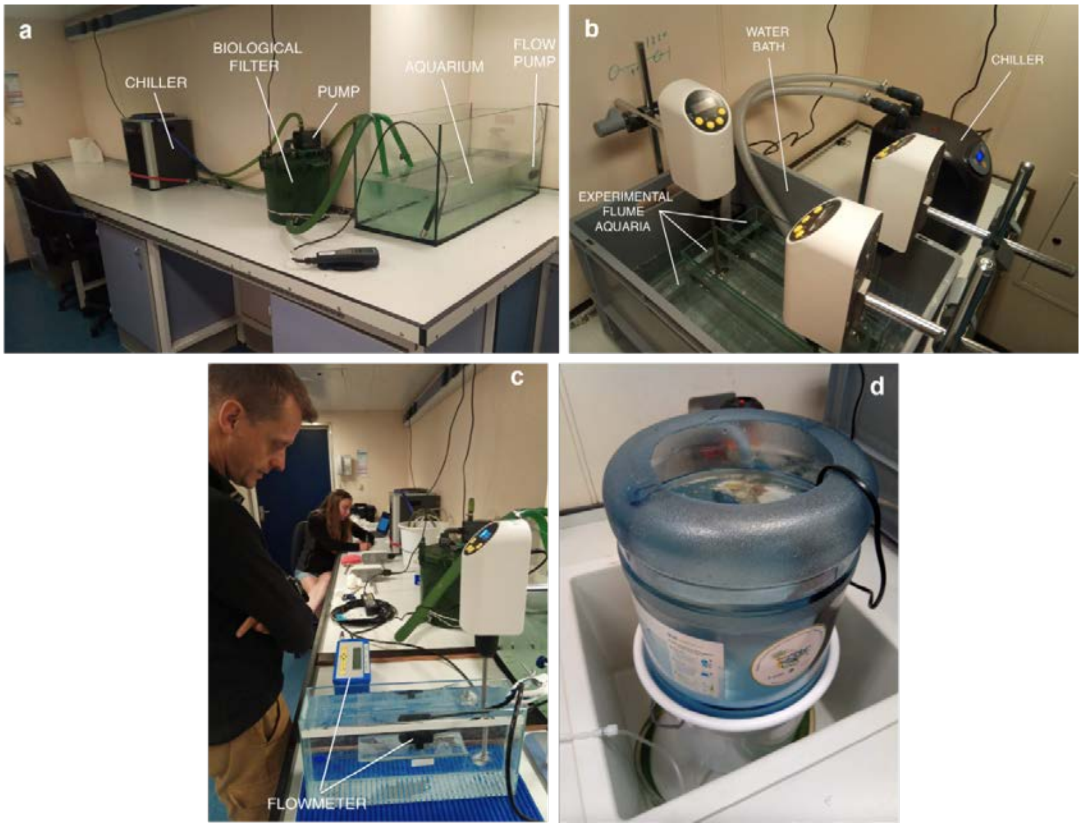


Figure 7.6.3.1 a)The aquarium for the maintenance of corals onboard, b) Water bath with three experimental flume aquaria, c) Calibration of water flow in one of the experimental flume aquaria, d) Tank for the hatching of the *Artemia salina* nauplii. (Images: Andrea Gori)

7.6.4 Processing methodology

Due to the impossibility to maintain living corals in the aquarium, no feeding experiment could be run onboard.

7.6.5 Preliminary results

No results obtained.

7.6.6 Datasets to be submitted to PANGEA

No results obtained.

7.7 Functional ecology of soft bottom deep-sea benthos off Cabo Verde. *In situ* seafloor incubation experiments (D. de Jonge, A. Sweetman, Alicia Smith, M. Roberts, A Mósquera-Giménez)

7.7.1 Personnel involved

Prof. Andrew K. Sweetman (HWU), Dr. Angelo Bernadino (on-shore participant, UFES), Daniëlle S.W. de Jonge (HWU), Alycia J. Smith (HWU), Daniela Yepes-Gaurisas (on-shore participant, UFES), Ángela Mosquera Giménez (on-board support, IEO), Murray Roberts (on-board support, UEDIN), Andrea Gori (on-board support, UB).

7.7.2 Introduction. Aims

Climate change is predicted to change environmental conditions at the seafloor including changes in oxygen, pH, temperature, and POC influx quantity and quality (Sweetman et al. 2017). Studying changes in ecosystem functioning over natural gradients of these environmental conditions can help predict how functioning of abyssal soft sediments may be altered in future climate scenarios (i.e. space-for-time substitution experiments). Alteration of abyssal soft sediment functioning may impact ecosystem services provided by these systems, like nutrient recycling and carbon sequestration (Thurber et al. 2014).

The Cabo Verde Abyssal Basin is generally considered an oligotrophic region, with seafloor POC fluxes of <0.5 g POC m^{-2} y^{-1} at depths below 4000 m (Khripounoff et al. 1998). Therefore, comparing baseline ecosystem functioning of Cabo Verde soft sediments to datasets from more eutrophic Atlantic abyssal regions, like the Porcupine Abyssal Plain (PAP), can provide a natural gradient of POC flux to observe how declining POC flux with climate change may influence benthic environments.

Baseline ecosystem functioning of soft sediments at the Cabo Verde Abyssal Basin was studied using the Benthic Respirometer Lander, which can measure seafloor respiration, CO_2 production, nutrient fluxes, and C flow through the benthic food web.

7.7.3 Sampling methodology

In total the Benthic Respirometer Lander was deployed five times at ~4200 m depth (Table 7.7.3.3). We undertook 4 isotope labelling experiments and 11 experiments that measured background respiration, stable isotope values, and sediment characteristics. For each deployment all three functional chambers were prepared to be injected with isotopically labelled organic matter: freeze-dried algae *Phaeodactylum tricornutum*. The algae were axenically cultured in F/2 algal medium in artificial seawater with 25% $NaH^{13}CO_3$ and 25% $Na^{15}NO_3$ in the lab in the months preceding the expedition. The cells were harvested over a 0.45 µm cellulose acetate filter, washed three times with sterile isotonic solution, centrifuged at 400 *g* for 15 min to obtain an algal pellet, freeze-dried and homogenized with pestle and mortar. Analysis at the Stable Isotope Facility at UC Davis showed the material had a C content of 27%, N content of 3%, C:N ratio of 9.1, and was labelled with 12 at-% ^{13}C and 22 at-% ^{15}N. Pre-weighed batches of 30.4 mg freeze-dried algae were hydrated in filtered seawater and added to the chamber injectors filled with filtered seawater (Fig. 7.7.3.1) right before each lander deployment. This injection of algae results in the addition of 8.37 mg C over the 484 cm^2 chamber surface, i.e. 0.17 g C m^{-2}, which corresponds to about 25% of the annual influx. Additionally, 1 g of Sodium Bromide was added to the injector for later water volume determination inside the chamber.

The lander computer was pre-programmed to start at 22:40 h each time and the lander was deployed well in advance to ensure it was at the seafloor when the program commenced. At the seafloor, the incubation chambers were pushed down 27.2 cm over 1 hour and 20 minutes, thereby sealing off a 22x22 cm patch of sediment of about 10-15 cm depth and 10-15 cm of overlying water. Once the chambers were down (T= 0 h), the Aanderaa oxygen optodes were powered on, the stirrers started, and a control water sample was taken (T= 0.33 h). After 40 minutes, the labelled algae were injected and allowed to settle for 1 hour with the stirrers off. Once settled, the stirrers were turned back on to maintain a diffusive boundary layer inside the chamber, and six more water samples were taken during the incubation after injection at T= 2 h, T= 10 h, T= 19 h, T= 28, T= 37 h, and T= 46 h.

Figure 7.7.3.1 Addition of ^{13}C and ^{15}N isotopically labelled substrate (freeze-dried axenic algae *Phaeodactylum tricornutum*) to the particle injector of the benthic respirometer lander. (Image: Murray Roberts, University of Edinburgh).

At the end of each deployment, the chambers were closed, sealed and retracted at midnight, which was exactly 48 hours after the chambers penetrated the sediment. The landers were recovered on deck at the first daylight around 6:30h. First, it was determined which chambers had correct injection of algae and which chambers had no injection and could be used for background respiration and stable isotope values (Table 7.7.3.1). Afterwards, the syringes with water samples were dismounted and stored in the fridge until processing, and the water and sediment within the sealed chamber were processed.

Table 7.7.3.1. List of Benthic Respirometer Deployments

StationID AKS	**StationID** iMirabilis	**Lat, Lon** (DD)	**Depth** (m)	**Deployment** **(**UTC+0)	**Recovery** (UTC+0)	**Injection**
AKS295	9	14.7190, -25.2021	4168	05/08/2021 19:44	08/08/2021 06:58	Ch1: Algae Ch2+3: Background
AKS300	28	14.7119, -25.1919	4178	10/08/2021 17:24	13/08/2021 06:19	Ch1: Algae Ch2+3: Background
AKS302	43	14.7219, -25.1755	4197	14/08/2021 16:25	17/08/2021 07:10	Ch1: Algae Ch2+3: Background
AKS306	58	14.7100, -25.1483	4215	18/08/2021 08:36	21/08/2021 07:00	Ch1+2+3: Background
AKS309	76	14.7323, -25.1268	4208	21/08/2021 22:35	24/08/2021 08:49	Ch1: Algae Ch2+3: Background

7.7.4 Processing methodology

The water samples from the syringes were subsampled for DIC, O_2, nutrient, and bromide concentration analysis.

A 12 ml subsample was transferred to an exetainer through a 0.45 µm filter and fixed with 10 µl 6% $HgCl_2$ solution for DIC analysis. DIC samples will be analyzed later in an onshore lab for CO_2 concentration in the chambers over time.

Another 12 ml subsample was transferred to an exetainer with a glass bead, and the oxygen in the water was precipitated through addition of 150 µl Winkler A solution (600 g/L $MnCl_2$) and 150 µl Winkler B solution (320 g/L NaOH and 600 g/L NaI). Micro-Winkler titrations with a micro-burette to determine oxygen concentration in the chamber water over time were done shipboard within 12 hours of sample fixation. The oxygen precipitate was acidified with 300 µl 50% H_2SO_4 and two 5 ml aliquots were titrated with $Na_2S_2O_3$ using a few drops of 10 g/L starch solution as indicator. Oxygen concentration in each syringe water sample was the mean of the two titrations, calculated as:

$O_2(\mu M) = (A \times B \div 39.2) \times 2$, where A is the amount of $Na_2S_2O_3$ added in µl and B is the $Na_2S_2O_3$ concentration in mM (close to 10 mM) as determined in a $Na_2S_2O_3$ standardization on the same day.

A 20 ml subsample of the syringe water sample was transferred to an acid washed scintillation vial and stored at -80°C for later analysis of nutrient concentrations over time in the chamber in an onshore lab.

Finally, a 2 ml subsample of water from two syringes (control sample and one after injection) was taken for later onshore analysis of bromide concentration. Bromide concentration can be used to calculate the original volume of water in the chamber we injected 1 g of NaBr into.

The recovered overlying water and sediment within the chamber was processed on deck. The overlying water was siphoned off over a 32 µm sieve, the sieve contents were added to the sediment surface macrofauna sample, and the water volume was measured. The sediment surface was photographed, and four push-cores (inner diameter 28 mm) were pushed in at the edge of the chamber. The rest of the sediment was collected from the chamber at 0-2 cm and 2-5 cm horizons into separate clean buckets and homogenized with a spackle knife (from 5 chambers the 5-10 cm horizon was also collected: 2 chambers with injection, 3 background chambers).

One push-core was sliced into 8 horizons (0-0.5, 0.5-1.0, 1.0-1.5, 1.5-2.0, 2-3, 3-5, 5-7, 7-10 cm) stored in small sample bags at -20°C for later TOC analysis in an onshore laboratory.

Three push-cores were sliced into 3 horizons (0-2 and 2-5 cm, only 5-10 cm for 6 chambers), which were combined into one 250 ml HDPE bottle with 4% formaldehyde previously buffered with sodium tetraborate decahydrate in filtered (5 µm) seawater for meiofauna analysis. Meiofauna will be sorted into major faunal groups and analyzed for stable isotopes in an onshore laboratory.

From the homogenized sediment horizons, a 10 ml sediment sample was transferred to a sterile 15 ml Falcon tube using a sterilized utensil and stored at -80°C for later genetic analysis of microbial OTUs in an onshore laboratory. Additionally, a 40 ml sediment sample was transferred to a sterile 50 ml Falcon tube, flash frozen at -80°C and stored at -20°C, for later analysis of phospholipid derived fatty acid (PLFA) analysis in an onshore laboratory.

The rest of the sediment was sieved over a 300 µm mesh with filtered seawater for macrofauna analysis. The sieve contents were collected in a 500 ml HDPE bottle with 4% formaldehyde previously buffered with sodium tetraborate decahydrate in filtered (5 µm) seawater. In an onshore lab the macrofauna will be sorted into faunal groups and analyzed for stable isotopes.

Oxygen optode data was read from the data logger at the end of the expedition. Optode calibration will be done back at the onshore lab right after the expedition to obtain new calibration coefficients. These new calibration coefficients take into account any foil drift and will be used to convert the raw optode data to oxygen concentration readings from within the chamber.

From the last two deployments, a known volume of sediment (~35 ml) from 0-2, 2-5, and 5-10 cm horizons was collected from chamber 2 and 3 (without injection) stored frozen in a 15 ml Falcon tube,

for later sediment density and grain size analysis. From the last deployment, extra push-cores were sliced into 0-0.5, 0.5-1.0, 1.0-1.5, 1.5-2.0, 2-3, and 3-5 sediment horizons for later phytopigment (stored in aluminium foil) and total hydrolysable amino acids (THAA) analysis.
Opportunistically, bottom water was sampled at 10 m.a.b. with the CTD (technical details see section 6.1 CTD-Rosette (A. Mosquera-Giménez, P. Vélez, I. Mouzo)) in the region of Benthic Respirometer Lander deployments (station 78). The bottom water was filtered over 0.7 µm glass fiber filters (Scharlau, Ø=25 mm) using 24 kPa under-pressure. One liter of water per filter from different CTD bottles (Table 7.7.4.1) was filtered for later POC/PON, phytopigment, and THAA analysis. The water was kept cool and dark, and the filtration system was covered in aluminium foil to avoid photo-degradation of any phytopigments. The filters were stored at -80°C in cryovials. Additionally, three filters were used with milliQ and stored the same way to be used as blanks to correct for any contamination on the filters. We initially tried to ash filters at 550°C for 30 minutes, but the filters melted and there was no time to ash another batch. We had to estimate of the volume of water to filter to obtain enough material, deciding on a total of 3L for POC/PON, 18L for phytopigments, and 6L for THAA being filtered over 14 hours. Later in the lab, we will test how much material is on the filters to decide how to combine multiple filters to reach analytical thresholds.
The analysis of C:N ratios, phytopigment concentration, and THAA in the near-bottom suspended particulate matter (SPM) and surface sediments can provide insight into the quality of POM reaching the seafloor where we conducted our *in situ* incubations.

Table 7.7.4.1 Overview of filters and volume of bottom water processed from different CTD Niskin bottles for various chemical analyses on suspended organic matter.

Analysis	**CTD Niskin #**						**Total (L)**
	1	**2**	**3**	**4**	**5**	**6**	
POC/PON, C:N, stable isotope	1x 1L	1x 1L			1x 1L		3
Phytopigments	3x 1L	3x 1L	3x 1 L	3x 1 L	3x 1 L	3x 1 L	18
THAA	1x 1 L	1x 1 L	1x 1 L	1x 1 L	1x 1 L	1x 1 L	6

7.7.5 Preliminary results

The obtained sediments were light-brown in color, contained many calcite foraminifera tests, often displayed bioturbation activity in the form of small burrowing holes, and occasionally polychaete tubes and ophiuroids were retrieved (**Fig. 7.7.5.1**). One deployment (AKS309, Ch1) a small jelly and crustacean were retrieved from the overlying water and surface sediment respectively. No other fauna visible by the naked eye was found on the 300 µm sieve. In various chambers small leaf-shaped algal-like material was found, which could be fragments of macroalgae.

Figure 7.7.5.1 Image of representative sediment surface after removal of overlying water (AKS300, Chamber 1). Note the many white calcite foraminifera tests, burrowing holes, and the ophiuroid in the lower-right corner. Chamber surface is 22x22 cm. Photo by Alycia Smith (HWU).

Micro-Winkler titrations to determine the oxygen concentration in the various syringe water samples, showed a bottom water concentration (control water sample at T= 0.33 h) of 217.8±7.8 (s.e.) µmol l^{-1}. The oxygen concentration at T= 2 was generally slightly higher than the background bottom water concentration as this water sample was taken shortly after injection of our labelled material hydrated in oxygenated surface seawater. Oxygen concentration decreased linearly over the course of the incubation and, when corrected for the volume of overlying water, resulted in an experimental average SCOC rate of 0.80 ± 0.14 (s.e., range 0.5 to 1.16) mmol O_2 m^{-2} d^{-1}.

Table 7.7.5.1 Preliminary SCOC rates (mmol O2 m^{-2} d^{-1}) based on regression of the oxygen concentration in the chamber during the incubation and corrected for the measured volume over overlying water.

Treatment	**Linear regression**	**Water volume (L)**	**SCOC (mmol O_2 m^{-2} d^{-1})**
Algae injection			
AKS295, Ch1	$[O_2]_{\mu M} = -0.3207 \times t_h + 212.78, R^2 = 0.68$	5.2	0.83
AKS300, Ch1	$[O_2]_{\mu M} = -0.5205 \times t_h + 222.77, R^2 = 0.78$	4.5	1.16
AKS302, Ch1	$[O_2]_{\mu M} = -0.1797 \times t_h + 192.18, R^2 = 0.62$	5.1	0.50
AKS309, Ch1	$[O_2]_{\mu M} = -0.286 \times t_h + 219.31, R^2 = 0.81$	5.0	0.71
		mean±s.e.	**0.80±0.14**

Background SCOC determined through Winkler was 2.0 mmol O_2 m^{-2} d^{-1} (AKS306, Ch1), however, this value should be viewed with caution. There was no overlying water in this particular chamber when processed, and the water volume used to calculate the flux (9.1 L) is likely an overestimate as water and sediment may have drained from the chamber upon recovery. Using a volume of 5 L, which is the approximate volume of water retrieved from Ch1 in other deployments, the background SCOC is 1.1 mmol O_2 m^{-2} d^{-1} which lies more in the observed range of experimental SCOC. Optode data will be calibrated and processed in the lab, and compared against Winkler data to check for internal consistency of data.

Previous studies in the Cabo Verde Abyssal Basin were located at 21.1° N, 31.2°W. At this site seafloor POC flux was 1.43 mg C m^{-2} d^{-1} at 4300 water depth (Khripounoff et al., 1998), and oxygen flux at this site based on porewater oxygen profiles is 0.55 mmol O_2 m^{-2} d^{-1} (Relexans et al. 1996). The lower range of our measured SCOC rates correspond to this value (Table 7.7.5.1). A similar experiment at the Porcupine Abyssal Plain (PAP) at 4800 water depth resulted in a SCOC of 0.75 ± 0.05 (s.e.) mmol O_2 m^{-2} d^{-1} after 60 hours, 0.78 ± 0.06 (s.e.) mmol O_2 m^{-2} d^{-1} after 8 days, and 0.98 ± 0.10 (s.e.) mmol O_2 m^{-2} d^{-1} after 23 days of incubation with labelled freeze-dried algae (Witte et al. 2003). Therefore, the SCOC rate of 0.80 mmol O_2 m^{-2} d^{-1} obtained for this region of the Cabo Verde Abyssal Basin at 4200 m after 48 hours is similar and even slightly greater than the SCOC rate after 60 hours at PAP.
As our experimental SCOC rates are comparatively similar to experimental SCOC rates at PAP, this particular area of the Cabo Verde abyssal basin might not be representative of an oligotrophic system. The previously studied site at 21.1° N, 31.2°W lies north of the Cabo Verde Frontal Zone (CVFZ) in an oceanic gyre, whereas our study site at 14.7° N, 25.2 °W lies south of the CVFZ relatively close to the islands, and might receive lateral transport of POM from the westward North Equatorial Current and Guinea Dome (Peña-Izquierdo et al. 2012).

7.7.6 Datasets to be submitted to PANGEA

1. Deployment metadata (station info, injected material, overlying water volumes, sediment surface pictures).
2. DIC flux data.
3. SCOC flux data.
4. Nutrient flux data
5. Bacterial biomass and C-uptake data
6. Meiofauna identification, biomass and C-uptake data.
7. Macrofauna identification, biomass and C-uptake data.
8. Sediment density and grain size per site.

7.8 Functional ecology of soft bottom deep-sea benthos off Cabo Verde. Scavenging activity. (A. Sweetman, D. de Jonge, A. Smith)

7.8.1 Personnel involved

Prof. Andrew K. Sweetman (HWU), Daniëlle S.W. de Jonge (HWU), Alycia J. Smith (HWU), Dominique Anderson (on-shore support, HWU).

7.8.2 Introduction. Aims

Benthic and demersal predators and scavengers consume and redistribute organic material, thereby contributing to nutrient cycling and energy flow in deep-sea ecosystems (Trueman et al. 2014). Abyssal scavengers mostly comprise of fish, shrimp, and amphipods, which scavenge on food-falls. In fish, scavenging is an important but facultative feeding mode, where carrion can make up to 50% of their diet by biomass (Drazen and Sutton 2017). Baited experiments help attract these scarcely distributed organisms and allow researchers to study their feeding behaviour and interactions. Additionally, arrival time to the bait can help estimate scavenger abundance in an area using swimming speed and bottom current speed and direction (Priede and Merrett 1996).
Baited-Camera Lander deployments were used to study Cabo Verde scavenger diversity, abundance, and scavenging rates. Additionally, we compared these metrics for two different bait types: fish (Atlantic Mackerel, *Scomber scombrus*) and squid (Patagonian squid, *Loligo gahi*). Squid stocks have been increasing over the past decades due to changing ocean conditions, whereas fish stocks have been falling (Doubleday et al., 2016): a trend that is predicted to continue with future climate change due to

squid's capability to cope with lower oxygen levels and accelerated life cycles at higher temperatures. Our experiment can help elucidate how abyssal benthic scavengers may react to changing food fall composition.
Additionally, Baited Trap Lander deployments provided reference specimens for the organisms observed on camera. Reference specimens will be used to aid taxonomic identification and tissue samples for stable isotopes were taken to study the trophic position of Cabo Verde's abyssal scavengers. Opportunistically, pelagic organisms collected with plankton nets will be analyzed for stable isotopes to aid the coupling of benthic scavenging to potential pelagic food-falls.

7.8.3 Sampling methodology

The Baited Camera Lander was deployed eight times in total, four times with Atlantic Mackerel and four times with squid (Table 7.8.3.1). Care was taken to spatially separate the deployments to avoid targeting the same scavenging community. The bait was defrosted and weighed, aiming for a consistent bait weight of about 3.1-3.4 kg. The bait was then attached to the bait plate (fish with tie rips through the eye sockets and around the tail fins, squid with a rope mesh) always while wearing gloves to avoid contaminating the bait with e.g. sunscreen that would influence the bait odour. At the seafloor the camera took a picture every 2.5 min. The lander was released from the seafloor after approximately 24 hours, depending on other activities on the vessel and availability of daylight for the recovery. The left-over bait was photographed, reweighed, and the images downloaded and backed-up for later annotation.

Table 7.8.3.1 Baited Camera Lander deployments.

StationID AKS	**StationID** iMirabilis	**Lat, Lon** DD	**Depth** m	**Deployed** UTC	**Recovered** UTC	**Bait** Type and weight
AKS296	11	14.7263, -25.1993	4163	05/08/2021 22:49	07/08/2021 2:30	*Scomber scombrus* 3.252 kg
AKS298	19	14.7278, -25.1901	4170	08/08/2021 4:55	09/08/2021 10:30	*Loligo gahi* 3.194 kg
AKS299	26	14.7193, -25.2093	4170	10/08/2021 7:44	11/08/2021 12:10	*Scomber scombrus* 3.434 kg
AKS301	36	14.7068, -25.1699	4187	13/08/2021 5:40	14/08/2021 18:56	*Loligo gahi* 3.120 kg
AKS303	47	14.7292, -25.1817	4225	16/08/2021 0:41	17/08/2021 8:50	*Scomber scombrus* 3.467 kg
AKS305	57	14.7443, -25.1432	4192	18/08/2021 7:23	19/08/2021 12:09	*Loligo gahi* 3.220 kg
AKS308	73	14.6760, -25.1540	4341	21/08/2021 7:55	22/08/2021 20:15	*Loligo gahi* 3.360 kg
AKS311	79	14.6968, -25.1212	4255	23/08/2021 0:21	24/08/2021 6:05	*Scomber scombrus* 3.360 kg

The Baited Trap Lander was deployed three times (Table 7.8.3.2) and used to retrieve reference specimens (i.e. not used quantitatively). Atlantic mackerel was mounted on the lander on inside- and outside fishhooks, the inside mesh of the lander, and inside amphipod traps. The lander was kept at the seafloor for about 48 hours before recovery. When on deck, the specimens in the trap were removed as quickly as possible and put in a cool box with ice. The cool box was placed in a refrigerated space for storage until the specimens were dissected individually.

Table7.8.3.2 Deployments of Baited Trap Lander.

StationID	StationID	Lat, Lon	Depth	Deployment	Recovery
AKS	iMirabilis	DD	m	UTC	UTC
AKS297	13	14.7108, -25.2061	4175	06/08/2021 22:50	09/08/2021 6:45
AKS304	48	14.6922, -25.1792	4247	16/08/2021 1:37	18/08/2021 10:45
AKS307	63	14.6986, -25.1091	4188	19/08/2021 13:20	22/08/2021 1:00

Additionally, some pelagic specimens were sampled using a plankton net (Table 7.8.3.3, technical details see section 6.6) and stored at -80°C for stable isotope analysis. The net started sampling from a certain distance above the seafloor up to the surface at 40 m/min.

Table 7.8.3.3 Deployments of the Plankton Net with samples for the scavenging study.

StationID	Lat, Lon	Depth (seafloor)	Depth (net)	Deployment
iMirabilis2	DD	m	m	UTC
67	14.6584, -24.9173	1421	1400	20/08/2021 11:08
89	14.8122, -24.5028	2146	2000	26/08/2021 3:35
90	14.7972, -24.6359	1973	1870	26/08/2021 6:32

7.8.4 Processing methodology

The images from the Baited Camera Lander were reviewed on the vessel to review the scavenging rate and for initial taxonomic identifications. The difference in bait weight during the deployment was divided by the time taken for all the bait to be removed (in the case of squid) or the amount of time the lander was at the seafloor (in the case of mackerel) to obtain a scavenging rate (kg d^{-1}).

Onshore, the images will be annotated fully using a large screen in a room with appropriate lighting, and potentially some image processing for light and color corrections. We will annotate the number of individuals per image, their time of first arrival, and observe succession patterns on the bait.

Fish from the Baited Trap Lander were weighed using a light but sturdy bag and a luggage scale. They were photographed from above while facing left with a visible sample label and measuring tape. Pre-Anal Fin Length (PAFL) and Total Length (TL) were noted. A muscle sample was taken for stable isotopes analysis (stored at -80°C), and the head was sampled for later age determination through the otoliths and as a further identification aid (stored at -20°C). If possible, the sex was determined by reviewing the gonads. Opportunistically, ecotoxicology samples were taken to compare to a similar dataset from Pacific benthic scavengers. A blood and gill sample were stored in DMSO at -80°C for DNA damage analysis, a liver sample was stored in RNAlater at -80°C for transcriptomics, a liver sample was fixed in 10% neutrally buffered formalin for patho-histology, and a liver and gill sample were frozen at -80°C for metals analysis.

Amphipods were photographed facing left with a sample label and scale bar either with a normal camera or digital microscope depending on the size. Amphipods were roughly grouped by morphotype and partly stored at -80°C for stable isotope analysis, and partly fixed in 10% neutrally buffered formalin for taxonomic identification. Again, opportunistic ecotoxicology samples were taken for comparision to a similar dataset from the abyssal Pacific. Per deployment, nine amphipods of various sizes were stored in RNAlater for transcriptomics, nine were stored in 10% neutrally buffered formalin for pathohistology, nine were stored frozen at -20°C for metals analysis, and five were stored in DMSO for DNA damage analysis.

All tissue samples, including the samples from the plankton net, will be processed in an onshore laboratory.

7.8.5 Preliminary results

The Baited Camera Lander attracted a variety of different scavengers (Fig. 7.8.5.1) including *Coryphaenoides* spp., *Barathrites iris*, *Bassozetus* spp., synaphobranchid eels, *Cerataspis* spp., and various shrimp and amphipods. Occasionally, other organisms which are not necessarily scavengers were observed, including a *Crossota* spp. jellyfish, *Peniagone* spp. holothurian, a seapen, and a gastropod. Additionally, macro-algal material was observed in some deployments. Some fish had distinct scars and parasite patterns, potentially allowing us to identify the same individual in multiple images. The fish obtained in the Baited Trap Lander were *Coryphaenoides* spp. and *Barathrites iris*, which were the most abundant in the camera images. The *Coryphaenoides* spp had an average weight of 2.2$\pm$0.1 (s.e., n= 21) kg, and *Barathrites iris* had an average weight of 3.6$\pm$0.5 (s.e., n= 6) kg. This average weight includes fish that showed signs that they had been partially consumed and is thus an underestimation. The average PAFL of *Coryphaenoides* spp. and *Barathrites iris*, was 26.5 $\pm$0.6 (s.e., n= 17) cm and 31.8$\pm$1.3 (s.e., n= 6) cm, respectively.

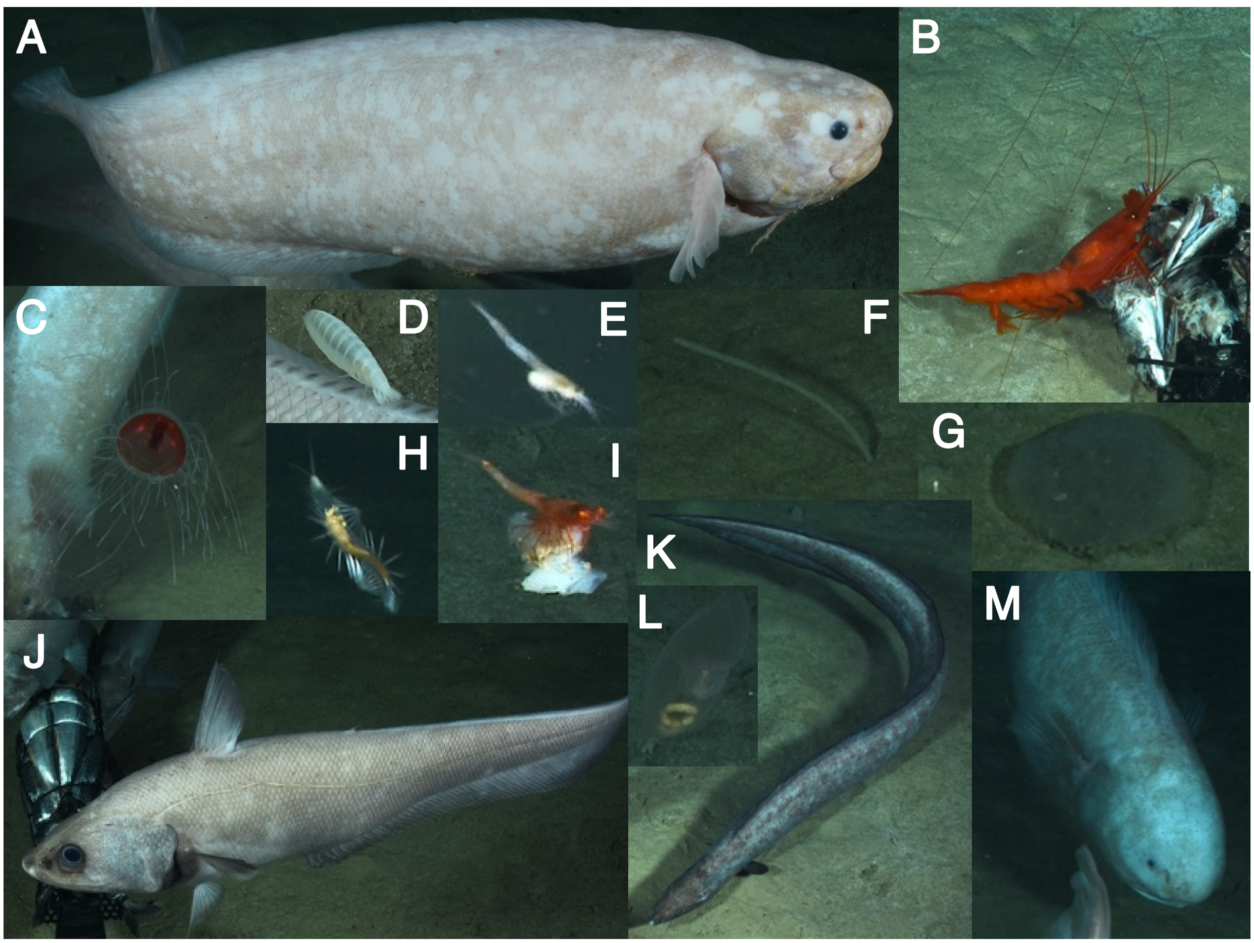


Figure 7.8.5.1 Selection of morphotypes observed with the Baited Camera Lander. A) *Barathrites iris* – Cusk eel, B) *Cerataspis* spp., C) *Crossota* spp., D) Amphipod, E) Amphipod?, F) Sea pen, G) unknown (tunicate? sponge?) H) Polychaete, I) Mysidae, J) *Coryphaenoides* spp. – Rattail, K) Synaphobranchid eel, L) *Peniagone* spp., M) *Bassozetus* spp. (Image: A Sweetmann, HWU).

Preliminary data reveal significantly higher scavenging rates on squid compared to fish (Welch t-test, p= 0.02, df= 3.01). After deployments with Atlantic Mackerel there was always tissue left on the bait plate (besides bones also soft tissue), resulting in an average scavenging rate of 2.8$\pm$0.2 (s.e.) kg d^{-1}. In contrast, no squid was left on the bait plate, and the camera images revealed complete removal of all squid within 5 hours of reaching the seafloor, resulting in an average scavenging rate of 25.4±4.9 (s.e.) kg d^{-1}. These results might indicate that a shift to cephalopod dominated pelagic communities, and consequently food falls, under climate change might impact abyssal scavenging communities, by favouring faster swimming organisms. Additionally, the fast rate of removal of squid shows that any squid food falls will be consumed so fast, that it is difficult for scientist to observe any natural squid food falls. Hence, the importance of squid food falls might be currently underestimated.

7.8.6 Datasets to be submitted to PANGEA

Baited Camera Lander:

1. Deployment metadata (location, depth, bait type, bait weight, etc.).
2. Raw images.
3. Image annotations.

Baited Trap Lander:

4. Fish taxa list, weight, length, sex.
5. Amphipod taxa list, length.
6. Stable isotopes for reference specimens, fish and amphipods.

7.9 Functional ecology of soft bottom deep-sea benthos off Cabo Verde. *Ex situ* sediment incubations (A. Sweetmann, D de Jonge, A, Smith, V Huvenne)

7.9.1 Personnel involved

Prof. Andrew K. Sweetman (HWU), Dr. Angelo Bernadino (on-shore participant, UFES), Danielle S.W. de Jonge (HWU), Alycia J. Smith (HWU), Daniela Yepes-Gaurisas (on-shore participant, UFES), Veerle Huvenne (on board support) Covadonga Orejas (on board support).

7.9.2 Introduction. Aims

Climate change is predicted to alter environmental conditions at the seafloor, including changes in oxygen concentration, pH, temperature, and POC flux quantity and quality (Sweetman et al. 2017). To understand how future deep soft-sediments might react to such changes an ex situ sediment incubation experiment was conducted. The experiment was designed to test for the effect of bottom-water warming and reduced quality of POC export on ecosystem functioning of deep-sea soft sediment communities. Four treatments were defined:

1) a baseline treatment with current-day temperatures and a normal quality POC pulse,
2) a single stressor treatment with increased temperatures and a normal quality POC pulse,
3) a single stressor treatment with current-day temperatures and reduced quality POC pulse, and
4) a dual stressor treatment with both increased temperatures and reduced quality POC pulse.

Each treatment was applied to four sediment cores during shipboard incubations. To avoid pressure artefacts of *ex situ* incubations of deep sediments, cores were sampled from approx.. 870 m depth with a multi-corer. Ecosystem functioning under the different treatments was measured as sediment community oxygen consumption (SCOC) rates, and as carbon (C) uptake and remineralization. SCOC rates were measured at different time intervals during the incubation using FireSting oxygen optodes. C uptake and remineralization rates for bacteria, meiofauna, and macrofauna groups will be determined from final water and sediment samples after a $^{13}C/^{15}N$ stable isotope tracer experiment.

7.9.3 Sampling methodology

Core sampling

Slope sediments were collected with a 'KC Denmark' multi-corer (MUC), which sampled 6 cores (inner diameter 9.5 cm) per deployment (see section 6.8 Multicorer (MUC) (V. Huvenne, P. Rodríguez, I. Casal, M. Sánchez)). The cores were collected from 874-876 m depth between the islands Santiago and Maio at 15.3165° N, 23.3691° W (Table 7.9.3.1). A CTD profile at the site showed a bottom water (10 m.a.b.) temperature of 6.83°C with an oxygen concentration of 2.48 mL L^{-1} (109 µmol L^{-1}). Initially, it was planned to collect cores at 500 m, but this fell right within the oxygen minimum zone.
From every MUC deployment, four cores with clear overlying water were randomly chosen and divided among the four treatments (total n= 16). The core top water was siphoned off into a clean container, and 15-18 cm of sediment was extruded for transfer to an incubation core (inner diameter 10 cm) that was sealed and taped at the bottom. Once transferred, the top water was trickled back into the incubation core while minimizing sediment disturbance and ensuring water penetration along the full length of the core. If necessary, the overlying water was topped off with filtered (5 µm) seawater that was at the experimental temperature. Additionally, from two MUC deployments (AKS292, AKS293) a fifth core was taken and processed directly for duplicate background stable isotopes samples (see 'Processing methodology').

Table 7.9.3.1 Multi-coring stations for ex situ sediment incubations. 'Date and Time' shows the moment the cores arrived on deck.

Station ID AKS	**Station ID** iMirabilis2	**Date and Time (UTC)**	**Depth (m)**	**Core# in experiment**
AKS291	3	04/08/2021 03:33	874	1, 5, 9, 13
AKS292	4	04/08/2021 05:06	876	2, 6, 10, 14
AKS293	5	04/08/2021 06:07	876	3, 7, 11, 15
AKS294	6	04/08/2021 07:18	876	4, 8, 12, 16

The incubation cores were placed in buckets with filtered seawater, already at the experimental temperature, located in two LMS cooled incubators (series 3, model 300W, 290 L). The moment of placement in the incubator is considered T0 (0 hours). An air stone connected to an aquarium pump was placed in the top 10 cm of water in each core to oxygenate the water (Fig. 7.9.3.1).

Figure 7.9.3.1 Picture of the experimental set-up. Eight cores per LMS incubator (model 300W) placed in buckets with filtered seawater, each with an air stone in the top 10 cm connected with tubing to an aquarium pump to oxygenate the top water. Note this picture was taken right after collection when the sediment in the top water had not completely yet settled. (Image: Daniëlle de Jonge, HWU).

Experimental settings

The current-day temperature of the incubations was set to 6.5°C, based on the bottom water temperature as measured with the CTD. The increased water temperature treatment was set at +2°C above the determined current-day temperature, i.e. 8.5°C. This temperature increase falls within global projections of seafloor temperature rise under RCP 8.5 (Sweetman et al. 2017) and was practically maintainable by the LMS incubators (model 300W, 0.5°C temperature intervals with ±0.1°C fluctuations) operating in a hot environment (air temperatures up to 33°C).

The algae used in the experiment were cultured as described in 7.7.3 Sampling methodology. This culture is used in the experiment as 'fresh' or 'untreated' algae. To artificially reduce the quality of the algae to mimic reduced quality of POM influx, part of the untreated culture was artificially degraded in the lab before the expedition. Artificial degradation was achieved by removing low molecular weight compounds (LMWCs) through dialysis over a membrane with a MWCO of 1 kDa (PUR-A-LYZER Mega 1000 Dialysis kit, Sigma-Aldrich) following a procedure adjusted from Aspetsberger et al. (2007). In short, 300 mg of freeze-dried algae was hydrated in 10 ml of filtered (0.22 µm) artificial seawater in dialysis tubing. The dialysis tube was placed in a beaker with 1 L of autoclaved artificial seawater, i.e. the dialysis solution, resulting in a dialysis ratio of 1:100 (Fig. 7.9.3.2). To avoid bacterial growth and unintended algae degradation, dialysis took place in a dark and cold (7°C) climate room. To optimize diffusion, the dialysis solution was mixed using a magnetic stirrer and replaced with fresh dialysis solution every 2 hours. The total dialysis procedure was 6 hours. After dialysis, the hydrated algae were transferred to a sterile 50 ml Falcon tube, centrifuged at 2500 *g* for 40 minutes, and the supernatant carefully decanted. The dialyzed algae were again frozen at -80°C at least overnight, freeze-dried for at least 48 hours, and homogenized with pestle and mortar.

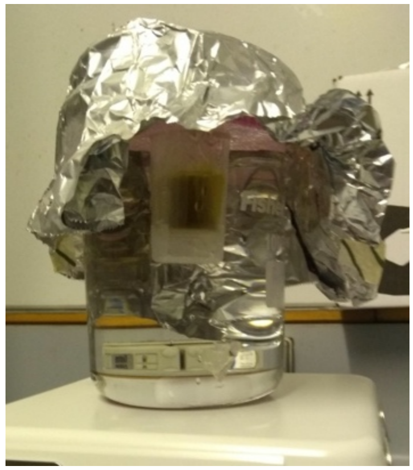


Figure 7.9.3.2 Dialysis set-up. The dialysis tubing of 1 kDa MWCO holds 10 ml of filtered (0.22 µm) artificial seawater with 300 mg freeze-dried algae, and is placed in 1L of artificial seawater (dialysis ration 1:100). The set-up is covered by aluminium foil, and is located in a dark and cold climate room. The dialysis solution is changed three times at 2 hour intervals. (Image: Daniëlle de Jonge, HWU).

Carbon and nitrogen content, C:N ratio, and $^{13}C/^{15}N$ labelling of the normal and dialyzed algae cultures were determined at the Stable Isotope Facility at UC Davis. As expected from the results of Aspetsberger et al. (2007), the bulk chemical characteristics did not differ significantly between the untreated and dialyzed algae in carbon content (27±6.7 vs. 25±16 %DW, s.e.), nitrogen content (3.0±0.6 vs. 2.5±0.9 %DW, s.e.), and C:N ratio (9.1±2.2 vs. 7.9±1.8 s.e.). Later chemical characterization (e.g. pigments, THAA, and PLFA analysis) will be done in order to quantify the lability of the two algae cultures, i.e. the dialysis effect, and any potential bacterial contamination.
Each core received 12.5 mg of freeze-dried algae (either untreated or dialyzed), corresponding to 0.44 g C m^{-2} which is roughly 10% of the annual flux (Relexans et al., 1996; Galéron et al., 2000; Fiedler et al., 2016; Turnewitsch et al., 2016).

Incubations
A schematic overview of the 9-day experiment timeline can be found in figute 7.9.3.3. In total, two background and two experimental SCOC rates were obtained per core. Incubated cores were treated as equally as possible in combination with other experiments being conducted on the vessel. Additionally, eight oxygen optodes were available for 16 cores, so we had to alternate SCOC measurements between each sets of eight cores. Although these limitations have caused variations in the timing of SCOC measurements relative to T0 (standard deviation up to 15 hours), these variations are spread equally among treatments, and the timings of measurements and sample processing in relation to the stable isotope tracer experiment are consistent (maximum standard deviation is 1 hour).

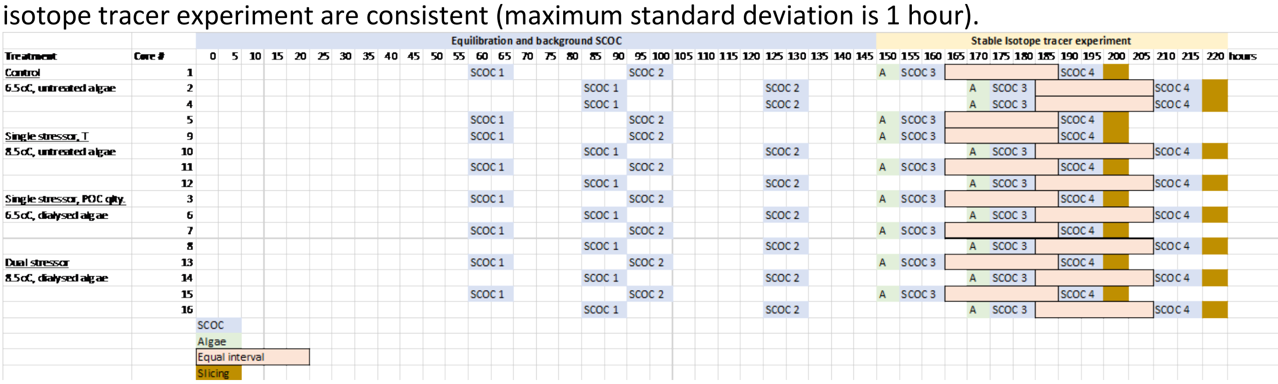


Figure 7.9.3.3 Schematic timeline of the experiment.

The cores were allowed to equilibrate for 147 to 173 hours before the stable isotope pulse chase experiment was started. Every 24 hours all cores were topped off with fresh filtered seawater set to the experimental temperature to partly flush built-up metabolites from the overlying water. Cores were allowed to overflow into the water bath which maintained the independence of replicates. During this equilibration period two measuring intervals of background oxygen consumption were done by placing sealing core lids with stirrers and FireSting oxygen optodes, avoiding any air bubbles being trapped inside. The temperature of the cores was assumed to be equal to the temperature of the surrounding water bath, as measured with an external thermometer connected to the FireSting logger to compensate the raw oxygen optode data. Oxygen optodes measured the change in oxygen concentration in the cores for 8 to 9 hours. After the sealed measuring interval, the core lids were removed, and the air stone returned to re-oxygenate the overlying water.

After the equilibration period, isotopically labelled freeze-dried algae (either the untreated or dialyzed culture) were added to the cores. Pre-weighed batches of algae were hydrated in filtered seawater set to the experimental temperature, transferred to a 60 ml syringe, and gently injected to the topwater while gently stirring. The algae were allowed to settle for 1.5 hours without the air stone in the core, before starting another SCOC measurement.

During the stable isotope tracer experiment, a 20 ml water sample was taken using a 60 ml syringe right before placing and right after removing the core lid for SCOC measurements. Any air bubbles were removed, and the syringes were stored sealed in the fridge until they could be processed. Water from the syringe was transferred to a 12 ml exetainer through a 45 µm cellulose acetate filter, and 10 µl of 6% HgCl was added to preserve the sample for DIC analysis. Concentration and stable isotope labelling of DIC at the start and end of each SCOC measurement interval will be determined later in an onshore laboratory. Two DIC water samples were collected from cores before the algae addition (one from the current-day temperature and one from the increased temperature treatment) for background DIC stable isotope samples.

Core slicing

At the end of the experiment (48-52 hours after the addition of labelled algae), the incubated cores were sliced and stored for further analysis. The height from the top of the bottom seal (resolution ±0.5 cm) to the sediment was measured and the volume of overlying water (resolution ±0.005 L) was calculated. The overlying water was sieved over a 32 µm mesh and the sieve contents were combined with the meiofauna surface sediment sample. The core was extruded and sliced into 0-2 cm and 2-5 cm sediment horizons (Fig. 7.9.3.4). A quarter of each slice was transferred to a 50 ml Falcon tube and stored at -80^{o}C for PLFA analysis. Another quarter of the slice was transferred to a 250 ml HDPE bottle and fixed in 10% formalin for meiofauna analysis. The leftover sediment, half the slice, was transferred to a 500 ml HDPE bottle and fixed in 10% formalin for macrofauna analysis.

Figure 7.9.3.4 Example of core slicing. Core 6 was sliced into 0-2 cm (left) and 2-5 cm (right) horizons, each divided into a quarter for PLFA, a quarter for meiofauna, and half for macrofauna analysis. (Image: Danielle de Jonge).

7.9.4 Processing methodology

To obtain SCOC rates, a linear regression was performed on the last 2-3 hours of oxygen optode data from each SCOC measuring interval, when the temperature and change in oxygen concentration was relatively stable. The change in oxygen concentration (µmol O_2 L^{-1} h^{-1}) was converted to SCOC rates (mmol O_2 m^{-2} d^{-1}) using the volume of overlying water and the surface area of the core.
DIC samples will be analysed later in an onshore lab for CO_2 concentration and delta ^{13}C values in the cores at the start and end of the two SCOC measuring intervals during the stable isotope tracer experiment.
Samples stored for PLFA analysis will be processed in an onshore laboratory. Bacterial markers will be isolated and analysed for stable isotope tracers.
Meiofauna sediment samples will be processed at Heriot-Watt University (UK). The sediment will be washed over a 32 µm sieve, and the meiofauna extracted using Ludox density separation. Meiofauna will be grouped according to taxonomy, counted, and prepared for C content and stable isotope analysis.
Macrofauna sediment samples will be processed at Universidade Federal do Espírito Santo (Brazil). The sediment will be sieved over a 300 µm sieve, and macrofauna grouped according to taxonomy, counted, and prepared for C content and stable isotope analysis.

7.9.5 Preliminary results

The stable isotope tracer experiment shows that warming the water by +2°C significantly increases the SCOC rates by almost doubling it (two-factor ANOVA, $p<0.0001$), but no significant effect of POM quality or interaction between the two factors is observed (two-factor ANOVA, $p>0.5$) (Fig. 7.9.5.1). Although POM quality does not have a significant effect, the observed difference in SCOC between fresh and degraded POM at 6.5°C is smaller than the observed difference in SCOC for fresh and degraded algae at 8.5°C. This result might indicate that, although temperature is likely to be the main driver of changing ecosystem functioning, the effects of reduced POM quality might be more apparent at higher temperatures.

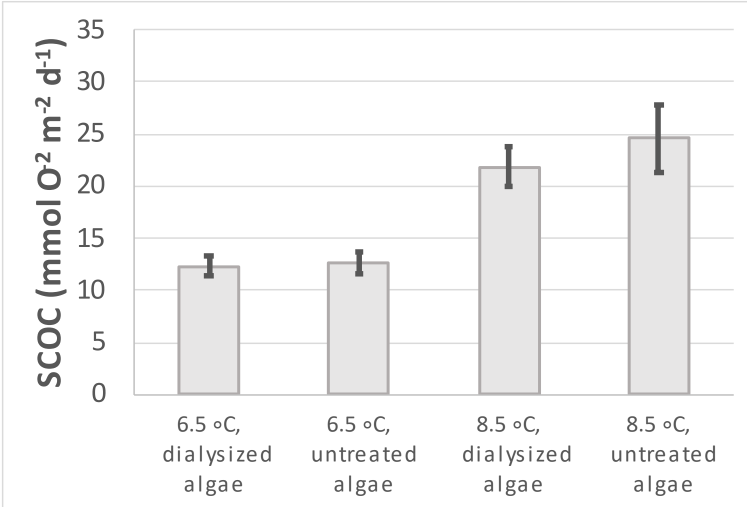


Figure 7.9.5.1 Mean SCOC rates (mmol O_2 m^{-2} d^{-1}) for the four treatments (per treatment n = 4),between T10 and T45. Error bars represent standard error.

7.9.6 Datasets to be submitted to PANGEA

1. SCOC data
2. DIC fluxes
3. Bacterial biomass and C-uptake
4. Meiofauna taxa, biomass and C-uptake data.
5. Macrofauna taxa, biomass and C-uptake data
6. Algae chemical characteristics.

7.10 Paleoceanography (V. Huvenne, C.Orejas, J. Raddatz, I. Pérez)

7.10.1 Personnel involved

The science team involved in the coring operations for paleoceanography included Veerle Huvenne and Erik Simon Lledo, assisted by Susan Evans, Andrea Gori, Kelsey Archer Barnhill, Beatriz Vinha and Cova Orejas.

The team looking after the collection of fossil corals for paleoceanographic research included Cova Orejas, Andrea Gori, Veerle Huvenne and Beatriz Vinha.

Team on shore: D. Thornalley (U Oxford), I Pérez (IEO), J Raddatz (U Frankfurt)

7.10.2 Introduction. Aims

As part of iAtlantic WP3 (time series studies and tipping points), the project is generating paleoceanographic data on decadal-millennial ocean and ecosystem changes at several of the case study sites. This complements the study of the modern physical oceanography of the Atlantic, as carried out in WP1. Collecting suitable cores and coral skeletons that contain records of past oceanographic conditions from the waters offshore Cabo Verde, allows us to broaden the scope for this work.

In addition to the study of the fossilised foraminifera, it is also important to study their present-day occurrence. Foraminifera are found at all depths and in all marine environments. Understanding the ecological preferences of benthic foraminifera is a valuable insight for the studies that infer ecological conditions and environmental change from sub-recent or fossil foraminifera tests. Sampling live foraminifera in their present-day environmental conditions therefore provides valuable data for future paleoceanographic studies.

Core locations were chosen based on two criteria: on the one hand we collected a number of deep cores at locations where colleagues from GEOMAR previously collected gravity cores during the expedition M80 on board Meteor. The rationale behind these multicore samples is that multicores are better at preserving the sediment-water interface, and hence the iMirabilis2 cores will complement the Geomar gravity cores, which provide a longer-term record.
Secondly, a series of core locations were chosen on and around Cadamosto Seamount, to provide samples of different depths. The shallower the sample locations, the coarser the sediments, and preference was given to the Boxcore for those. Still, it proved rather difficult to find the pockets of sediment that could provide a good paleoceanographic record.
Cold-water corals represent a promising new development in the study of ocean climate. In particular, they have the following unique characteristics compared to other sedimentary archives: 1) they are common in almost all oceans, 2) they live in the deep ocean, far from sunlight between depth, 3) they integrate the isotopic and element composition of the surrounding seawater, 4) they can live for decades to millennia, and 5) their skeletons can be accurately dated using radioactive isotope decay. For this porpuse cold-water coral samples of *Enallopsammia rostrata* and *Corallium tricolor* have been ROV collected at Capo Verde.

7.10.3 Sampling methodology

Seabed sediment samples were collected by Boxcore, Multicore and ROV pushcore. For the operational procedures and successes, see section 6.8.
(Sub-)Fossil coral skeletons were collected by ROV: see sample list in section 10.4

7.10.4 Processing methodology

Multicore cores were processed according to the following protocol:
- The largest core was chosen for slicing: The core was placed on the extruder and photographed, after which the overstanding water was removed very carefully by sliding the core tube down until 0.5 cm above the sediment surface (taking care not to cause resuspension of the sediment). A photograph of the sediment surface was taken at that point, before the last water was allowed to slowly drain away. After this, the core was sliced in 1 cm intervals down to 15 cm, and in 5 cm intervals below that. The core slices were put in labelled zip-lock bags and stored in the 4°C cold room.
- The shortest two cores were chosen for the sampling of live benthic fauna: again the cores were placed on the extruder, photographed, and the overstanding water was drained off. A photograph of the sediment surface was also taken. Then the top 1 cm of the core was sliced off and transferred into a plastic jar, which already contained 80 ml of ethanol with Rose Bengal (concentration of ca. 2g Rose Bengal powder in 1 l of 70% ethanol). The jars were gently shaken until all sediment was suspended, and then were stored with the sliced cores in the 4°C cold room.
- Any left-over cores were sub-cored using 7 cm diameter PVC drainpipe. Again the cores were placed on the extruder, and photographs were taken. This time the overstanding water was carefully syphoned with a sterile tube, before the sediment surface photograph was taken. The core liner was then pushed down until a small sample of sediment (<1cc) could be taken for eDNA analysis. Those samples were taken from the outer edge of the core, using the handle of a sterilised teaspoon, and were stored in small sample vials in the -80°C freezer. After this procedure, a sufficiently long section of drainpipe was pushed down the centre of the core, until the bottom. The multicore liner and the excess sediment were removed, and the subcore was capped at the bottom, labelled, cut to the correct length using a pipe cutter, and capped at the top. Where necessary, small polystyrene disks were placed on top of the core before capping, to avoid empty spaces in the capped liner. Throughout the cruise, we kept the convention to tape the bottom of the cores with black tape and the top with yellow tape, to make it easy to distinguish the orientation of the cores.

- For multicore 8, two of the core tubes were used for macrofauna analysis. They were sliced 0-2cm and 2-5cm and stored in 500 ml HDPE bottles with 4% borax-buffered formaldehyde. Sediment will be sieved over a 300 µm sieve at UFES for analysed for macrofauna.

Boxcore processing followed similar procedures. When a successful boxcore came on deck, two multicore tubes, and one section of drainpipe were pushed into the sediment sample. Typically all the overstanding water had already drained off during the core recovery operation. The core box and excess sediment were then removed, and the content of one multicore tube was sliced, while the other one was sampled for live foraminifera (i.e. the top slice was stored in Rose Bengal). The drain pipe was capped and treated like a multicore subcore. We followed the same procedures as described above for the multicores.
One of the boxcores came back with a sample that was too small to subcore, hence only a small scoop of the top sediment was stored in a ziplock bag.

On one occasion, an ROV pushcore was taken for paleoceanographic study (flank of Brava, sample number 2). The pushcore was sliced in 1 cm intervals, using an impromptu core extruder made of Schweppes cans. The core diametre was 6.8 cm.

Sample processing of recent and fossil corals
Alive collected and fossil coral sample of *Enallopsammia rostrata* and *Corallium tricolor* have been dried and will be archived at the Institute for Geoscience, Goethe University Frankfurt (Figs. 7.10.4.1, 7.10.4.2, 7.10.4.3). All samples will be prepared for further geochemical analyses such as LA-(MC)-ICP-MS) and further radiometric dating.

Figure 7.10.4.1 Samples of *Enallopsammia rostrata* collected in station 24, ROV Dive 3 (see section 10.1 for station details).

Figure 7.10.4.2 Samples of *Enallopsammia rostrata* collected in station 55, ROV Dive 6 (see section 10.1 for station details).

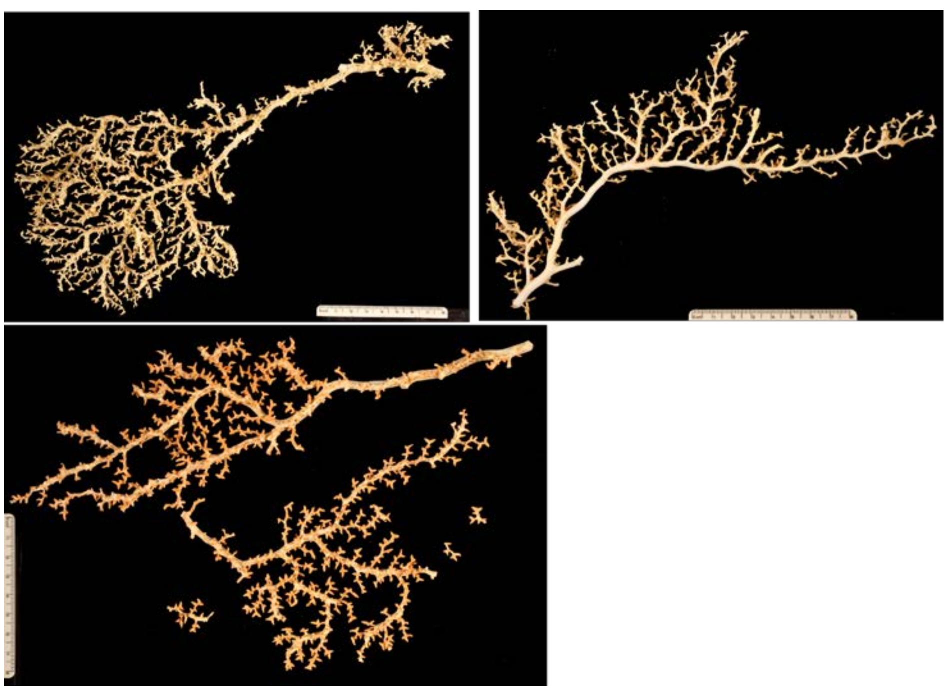


Figure 7.10.4.3 Samples of *Corallium tricolor* collected in station 46, ROV Dive 5 (see section 10.1 for station details).

7.10.5 Preliminary results

Given that the sampling for paleoceanography was carried out for colleagues who could not participate in the expedition, no further analysis was carried out. Core photographs of the multicores are compiled in figure 7.10.5.1.

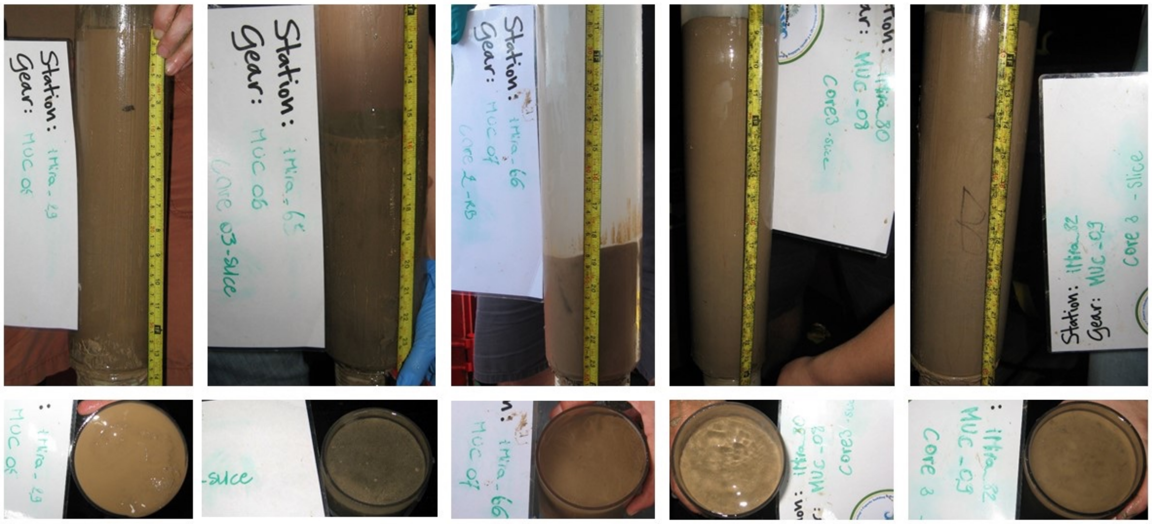


Figure 7.10.5.1 Example cores of the 5 multicores taken for paleoceanography (Images: Veerle Huvenne, Erik Simon-Lledó, Kelsey A. Barnhill, Bea Vinha).

7.10.6 Datasets to be submitted to PANGEA

The palaeoceanographic dataset will include core descriptions, X-ray fluorescence scanning data, foraminifera counts and geochemical analyses of their tests (stable oxygen and carbon isotopes and Mg/Ca ratios).

7.11 Seabird ecology (J.C. Abella, H. Dinis, N. Barbosa, J. González-Solís)

7.11.1 Personnel involved

On board: Herculano Dinis, Nadito Barbosa & Joan Carles Abella
Onshore: Jacob Gonzalez-Solís

7.11.2 Introduction. Aims

The aims of the expedition were mainly two:
-Our work along the trip from Vigo to Gran Canaria on the ship was focused on conducting a census of oceanic birds, mainly petrels and shearwaters.
-Training of the ornithologist team mates from Cabo Verde with distance sampling methodology.
Further we aimed to collect data on seabirds along the transect from Vigo to theCanaries. This is an area where ships normally do not fish and/ or trade.

7.11.3 Processing methodology

For each survey we collected data from line transects and from birds/items spotted (Fig. 7.11.3.1).
Data collected from line transect were: Census_id, start with 1, identifing each survey unit; Date and local time; Observer; 90/180; which side we are watching, one or both sides of the vessels; Weather: sea condition and wind direction and condition; % cloudy, rain; Visibility, good-regular-bad; Speed Vessel (Knots); Line transect (km) and area surveyed (km^2); Direction (º); Lat & Long coordinates.
Data from bird/item spotted: time of item spotted; snapshot (spotted in the snapshot or out); item type (bird, mammal, reptile, fish, ship, rubbish,...); item (item identify or brief description); quantity (number of same item, if there are age or sex differences then will be a new line item); age (calendar age: first

calendar year, second calendar, until we can distinguish); activity (flying or not); item direction (like wind direction, when we saw then we put in observations field); distance (which bandwidth see methods); in/out of bandwidth (observation was in or out from bandwidth); behaviour (only when they are eating: with fisheries, kleptoparasitism,..); observation code (only when there are two or more rows belonging to the same observation in order to identify among them): other observations (as number of pictures,..).

CAMPAÑA: iMirabilis 2 BARCO: Sarmiento de Gamboa RECORRIDO: Vigo (23/07/2021) --> Gran Canaria (30/07/2021) EQUIPO: J.CAbella; H.Dinis; N.Barbosa ANCHO BANDA: 300m CENSO TOTAL EN TRAMOS DE 10MIN

N_CENS	FECHA	HORA	OBSERVADOR	90/180	B/E	ESTADO MAR	BEAUFORT	DIRECCION VIENTO	COBERTURA NUBES (%)	LLUVIA (0/1)	VISIBILIDAD	VELOCIDAD (NUDOS)	RECORRIDO (km)	AREA P
63	24/07/2021	17:35	JCA	90	B	1	1	W	60	0	100	11		
64	24/07/2021	17:47	Nadito	90	E	1	1	W	20	0	100	11		
65	24/07/2021	17:47	JCA	90	B	1	1	W	65	0	100	11		
66	24/07/2021	18:00	Nadito	90	E	1	1	W	15	0	100	11		
67	24/07/2021	18:00	JCA	90	B	1	1	W	55	0	100	11		
68	24/07/2021	18:13	Nadito	90	E	1	1	W	10	0	100	11		
69	24/07/2021	18:13	JCA	90	B	1	1	W	60	0	100	11		
70	24/07/2021	18:24	Nadito	90	E	1	1	W	80	0	100	11		

N_CENS	HORA	SNAPSHOT	TIPO_ITEM	ITEM	CANTIDAD	EDAD	ACTIVIDAD	SENTIDO_V	DISTANCIA	DENTRO/FUERA	ID FOTO	COMP	CODIGO OBSERVACION	OBSERVACIONES
99999	12:10	0	AVES	CALBOR	2	Adulto	1		B	1		3	1	
92		1	AVES	CALBOR	1	Adulto	2		C	1		5		
93	22:23	1	AVES	CALBOR	1	Adulto	2		AD	1	1582-1628	5	1	mismo que 92????
93	22:23	1	AVES	?CALBOR	1	Adulto	2		AD	1	?	5	1	
93	22:29	0	CET	delfines	5				AD	1	1675-1701			nadando
94	11:30	0	CET	BALLENA	1	Adulto	respirando		E	0				nadando

Figure 7.11.3.1 above: Data collected for each line transect survey; below: Data from bird/item spotted

Using dynamic table & function graphics as quality control
After the bandwidth count we were able to reproduce a figure like the one depicted in Fig. 7.11.3.2, where each colour represents the same bandwidth colour code (see under sampling methods). The birds per bandwidth help to calculate bird densities and the resulting probability function was the quality control of the fieldwork (testing will be done later, but at first sight if the plot fits with a theoretical distribution where far is more difficult to detect birds than close then we can accept our fieldwork as ok, see Tasquer et al 1984).

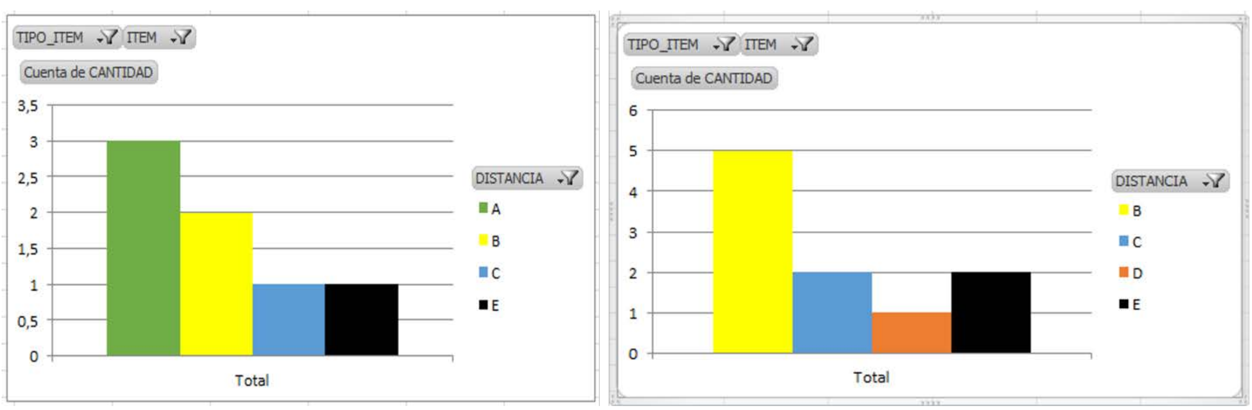


Figure 7.11.3.2 left: In this case for Bulwer's Petrel, the second bird most commonly spotted; right: Here the density plot found for Cory's Shearwater, the bird most frequently seen.

7.11.4 Preliminary results

At least 13 bird species were seen of a 396 individuals spotted (Table 7.11.4.1). We also spotted mammals, whales (mainly in the north area) and dolphins (*Delphinus delphis*). And some turtles most likely Green Turtle (*Caretta caretta*) and flying fishes (Table 7.11.4.2).

Table 7.11.4.1 Species documented during the transit from Vigo to Las aplamas de Gran Canaria.

Order	Family	Common name	Species	N
Pelecaniformes	Phalacrocoracidae	European Shag	*Golosus aristotelis*	1*
Suliformes	Sulidae	Northern Gannet	*Morus bassanus*	2
		Brown Booby	*Sula leucogaster*	2
Charadriiformes	Laridae	Yellow-legged Gull	*Larus michahellis*	23
		Lesser Black-backed Gull	*L. fuscus graellsii*	8*
	Sternidae	Common Tern	*Sterna hirundo*	1
	Stercorariidae	Pomarine Skua	*Stercorarius pomarinus*	2*
Procellariformes	Hydrobatidae	European Storm-Petrel	*Hydrobates pelagicus*	2
	Procellariidae	Cory's Shearwater	*Calonectris borealis*	210
		Balearic Shearwater	*Puffinus mauretanicus*	3
		Manx Shearwater	*P. Puffinus*	2
		Bulwer's Petrel	*Bulweria bulwerii*	149
		Zino's Petrel	*Pterodroma madeira*	2

(*)= species seen out of survey

Table 7.11.4.2 Observations of seamammals, reptiles and fishes performed during iMirabilis2 Leg 0

Classe	Species	Quantity
Mammals	*Delphinus delphis*	24
Mammals	*Stenella frontalis*	2
Mammals	whale not iD	3
Reptiles	*Caretta caretta*	2
Fishes	Flying fish	13

Cory's shearwater was the most common bird seen, counting on 53% of individuals. Bulwer's Petrel was the second most frequent with nearly 38% of individuals (Fig. 7.11.4.1). Both account for more than 90% of the sights! This result fits with what can be expected because these two species are strictly pelagic birds and the trip was mainly in the open ocean. Only Yellow-Legged Gulls have a significant frequency of nearly 6%, this was because after our departure they followed us. Further when we encountered some fishery activity we spotted them too. Other species were basically rarities with less than a 1%. Other pelagic species like Zino's Petrel were a significant observation because it is an endangered species and their population numbers are really small. Balearic and Max Shearwaters were seen after our departure far from the Galician coast. Both are pelagic birds and their presence was interesting too because Balearic is an endangered species too and Manx is out of their breeding grounds and informs of their behaviour at this season.

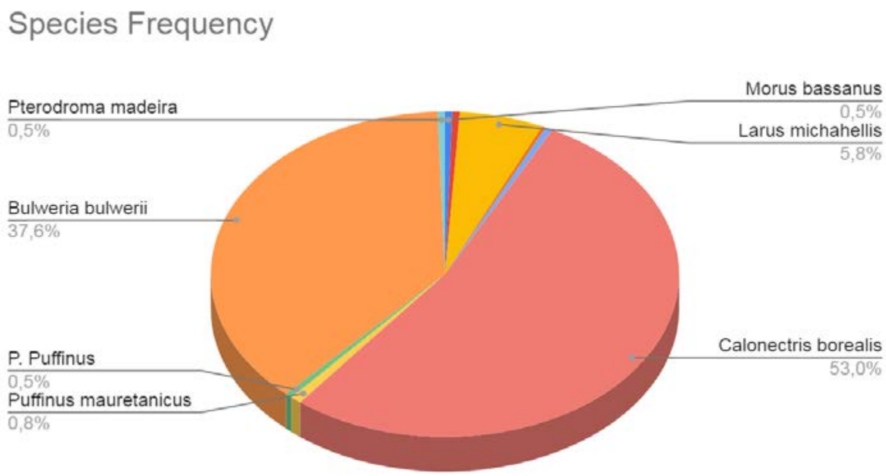


Figure 7.11.4.1 Seabird species frequency.

Regarding the observations per day (Fig. 7.11.4.2) we detected a peak the 29th of July when we crossed the channel between Madeira and Desertas. Further the numbers were lower two days before when we where in the middle of "the journey across the desert". We wonder if topography can also affect the seabird density furthermore coastal streams or both. But this has not been analysed yet. As this work has been part of a multidisciplinary project we hope to collaborate in the near future with the geology team members.

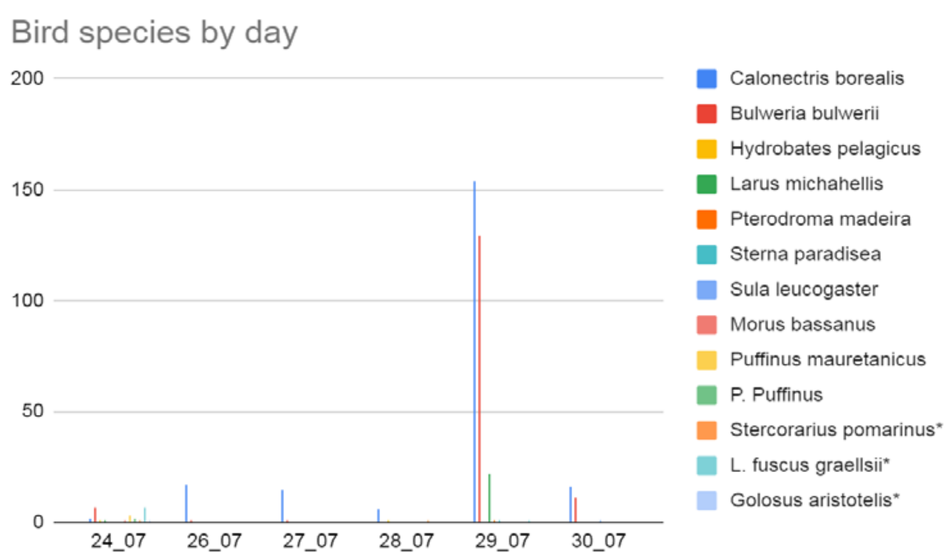


Figure 7.11.4.2 Seabird observations per day.

Pictures

We took 3329 pictures mainly of birds but also of other sea animals or items spotted during the trip. Some examples are giving in Fig. 7.11.4.3 (birds) and fig. 7.11.4.4 (mammals and reptiles).

Figure 7.11.4.3 Sea birds photographed during iMirabilis 2 leg 0 (Images: J.C. Abella).

(cont) **Figure 7.11.4.3** Sea birds photographed during iMirabilis 2 leg 0.

Figure 7.11.4.4 Sea mammals and reptils photographed during iMirabilis 2 leg 0.

7.11.5 Datasets to be submitted to PANGEA

Once the data register will be finished they will be uploaded in PANGEA.

7.12 Outreach and capacity building activities (K.A. Barnhill, B. Vinha, M. Roberts; V. Gunn)

7.12.1 Personnel involved

Kelsey Archer Barnhill and Vikki Gunn (onshore) were responsible for all outreach and capacity building activities. Everyone from the science party contributed in some ways through providing information for blog updates, being featured in a video, or writing a guest blog (details below).

7.12.2 Introduction. Aims

iMirabilis2, prior to COVID-19, aimed to include early career researchers (ECRs) on board for capacity building exercises. Once COVID-19 restrictions made it clear that ECRs from Brazil and South Africa would not be able to join the cruise, it was decided to have one person dedicated to outreach sail on board. Instead of offering hands-on experience to ECRs the plan shifted to bring the ‘deep sea to your desktop’ through daily blog posts, social media updates, recorded videos, and a ship-to-shore buddy scheme. Since training could not occur on a larger scale, we aimed to record training opportunities on board to maximize potential knowledge transfer. The ship-to-shore buddy scheme was created to have more personalized contacts between ECRs on and off the ship. Through this program, iAtlantic fellows and other associated early career researchers were given a closer look at life at sea. There was a large focus in this scheme towards ECRs from the South Atlantic and those who were scheduled to join iMirabilis2 pre-COVID.

7.12.3 Preliminary results

Vikki Gunn set up an expedition section on the iAtlantic website. On this website (iatlantic.ed/imirabilis2-expedition/) there are pages on the mission overview, meet the team, science on board, equipment & technology, training and capacity building, and the expedition blog. There are also resources for media and a collection of all videos created for outreach on board (Fig. 7.12.3.1).

Figure 7.12.3.1 Video banner on the iMirabilis2 expedition website.

In total 34 blog posts were written, 23 from Kelsey, 2 from Vikki and the rest from guest blog authors: Murray Roberts, Cova Orejas, Veerle Huvenne, Bea Vinha, Miguel Souto, Stewart Fairbairn, and Rich Austin-Berry. All blog posts can be accessed at: https://www.iatlantic.eu/imirabilis2-expedition/blog/ (Fig. 7.12.3.2).

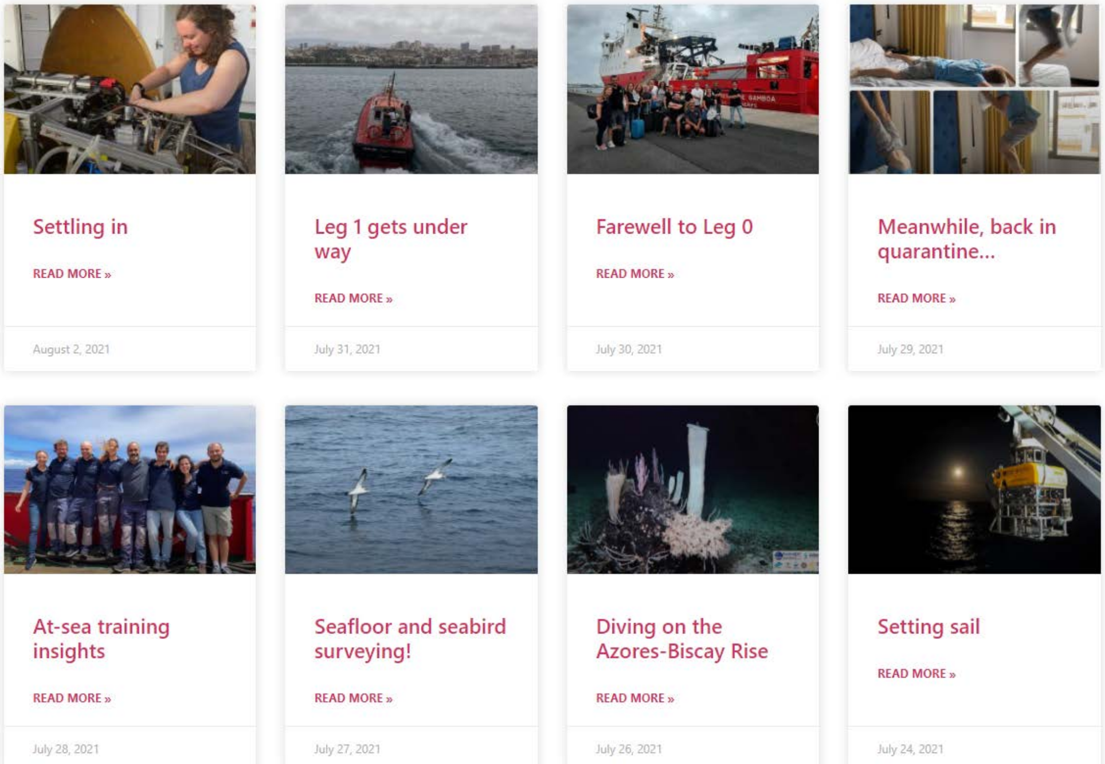


Figure 7.12.3.2 The expedition blog page landing site with 8 different posts shown.

Kelsey kept all iAtlantic social media accounts active throughout the cruise. On Twitter (https://twitter.com/iAtlanticEU), which was the main platform used, ~100 tweets were sent out in the run-up to and during the cruise. iAtlantic received over 150 new followers during the cruise. In the month of August alone, the iAtlantic tweets had 162,000 impressions (150% increase) and 8,176 profile visits (38% increase). These numbers are significantly higher than numbers seen in previous months as shown in their percent increase. The iAtlantic Instagram (https://www.instagram.com/iatlanticeu/) which had not been recently active before iMirabilis2 was reactivated during the cruise. Kelsey and Vikki posted about iMirabilis2 activities 17 times, which constitutes a majority of all posts on the Instagram page. On Facebook (https://www.facebook.com/iAtlanticEU), analytics were significantly improved as well during the cruise. 4003 people were reached in August, an increase of 2369%. Pictures, videos, links to blogs, and links to videos were the main subjects shared across social media platforms. All 17 videos created on board are also available on the iAtlantic Youtube channel (https://www.youtube.com/channel/UC-nxBSrvFXvTr41BLqUfFjg/featured). 8 of these videos are classified as tutorials and explainers.

On 27 August Kelsey led efforts to host a Reddit 'Ask Me Anything' event on the subreddit 'AskScience.' All science team members participated in efforts to answer the 21 questions submitted in this event which was open to the general public. This event was advertised across social media and to the iAtlantic fellows. In addition, the general public could ask questions about the expedition at any time as there was an 'Ask a question' form on the iMirabilis cruise website.

Five one-hour ship-to-shore buddy zoom calls were completed during the cruise. In total we had 18 buddies sign up to the scheme (Fig. 7.12.3.3). These buddies were based in Ghana, South Africa, Cabo Verde, Brazil, and Portugal. In addition to the live zoom calls, a WhatsApp group was used for informal communication between the on shore and on ship buddies. During calls all aspects of seagoing were discussed from sea sickness to technical requirements of landers and AUVs. Science team members on board who participated in these calls along with Kelsey include Bea Vinha, Daniëlle de Jonge, Alycia Smith, Richard Austin-Berry, and Eoin Ó hÓbáin. This scheme was appreciated by the on-shore buddies who wrote positively about the experiences on the blog.

Figure 7.12.3.3 A ship-to-shore buddy call on Zoom

7.12.4 Datasets to be submitted to PANGEA

N/A

8 Acknowledgements

A long and complex expedition as iMirabilis2, specially because it was planned and conducted in covid 19 pandemic times, would be not possible without counting with the help and contributions of many institutions and individuals.

We are indebt with the Cabo Verde authorities (Mr. Alexandre Nevsky, general Director of the Ministerio da Agricultura e Ambiente. Direçao Nacional do ambiente), who allow conducting our sampling program in Cabo Verde waters. Many thanks also for the support we have been having by Mrs Zofia Radwan, Mrs Sonia Freire and Mrs Liza Lima, during the whole process.

We are also grateful to the administration department from IEO-CSIC as well as the logistic from UTM-CSIC and the RV Sarmiento de Gamboa, without their continuous help and support this cruise would never happened. The UTM was not only fundamental for the expedition (special thanks goes to Jordi Sorribas, Miguel Angel Ojeda, Javier Prades, Arnau Rovira), they have been taking care of organizing and covering the costs of all the coid 19 PCR test for all the participants of the expedition this is highly acknowledge!. The whole scientific party is deeply thankful for this. The research vessel Sarmiento de Gamboa (SdG) and its crew, as well as the gears, equipment and technical support from the UTM-CSIC have been financed by the Spanish Ministry of Sience and Innovation.

We would like to thank the master of the Research Vessel Sarmiento de Gamboa Miguel Menéndez and the whole crew for their unvaluable support and fantastic work, as well as for making our work and life on board very pleasant. Thanks are due also to the technicians as well as the personnel at home (Barcelona and Vigo) from the UTM-CSIC for their technical support in all our activities on board and also preparing the cruise. We are grateful to the ROV team (LUSO) for their fantastic work on board and their disponibility.

Many thanks to Pedro Madureira (EMEPC) and his team for hosting part of iMirabilis 2 during the first leg, for training Bea and Kelsey in the work with an ROV and for supporting the work from our ornithologist on board: Joan Carles, Herculano and Nadito. Many thanks also to my very good and old friend Jacob for supporting us and helping to organize the ornithological work on board.

Thanks to Rui Freitas who made the connection between us Thor Haansteen from GEOMAR. Thor and his team from GEOMAR kindly gave us the high resolution MB bathymetry from Cadamosto and Nola Seamounts. Thanks to this we have been able to carefully plan our ROV dives in Cadamosto. Many thanks Thor!

Thanks also to Karen and Juergen (JAGO Team) great colleagues and friends for teaching us about Cabo Verde oceanographic and meterological conditions, this was really helpful for the planning! It is great to know that we always can count on you!

Special thanks goes also to Antonio Secilla for doing the iMirabilis2 logo.

The coordinator of iAtlantic Prof. Dr. Murray Roberts has been supporting before and during the expedition the planned work and activities. We are grateful for his support as well for the support of the coordination office in Edinburgh: Tehoni Massara, Mila Vukomanovic, Georgios Kazanidis and Christine Gable.

We also would like to thank Gonzalo Garcia de Arboleya, EU Project Officer of iAtlantic who was supporting and following our work with enthusiasm!

The iMirabilis2 research teams at home and on board have being just great helping before, during and after the expedition. A big thanks for a fantastic collaborative work from the beginning in pandemic times and for helping with the several planning and replanning!

I would like to say thanks to Daniela Gaurissas, Jennifer Durden and Dominique Anderson for all their work and engagement even if they were not able to be on board.

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10 Main station list, gear station lists, sample station lists and full technical reports

10.1 Main station list iMirabilis2 and overview map with the sampling stations of each gear.

BC= Box Corer; VV= Van Veen Grab; MUC= Multi corer; P= Plankton Net; ROV= ROV Luso;AUV= AUV Autosub6000; LR= Lander Respirometer; LB= Lander Baited trap; LC= Lander Camera; MB= Multibeam

St. nr.	Gear	Gear Nr.	Start Date	Start Time	End Date	End Time	Start Lat Deg N	Start Lat Min N	Start Lon Deg W	Start Lon Min W	End Lat Deg N	End Lat Min N	End Lon Deg W	End Lon Min W	Depth (start-end)	Comments
1	SBP	1	8/3/2021	23:46	8/4/2021	0:33	15	22.62	23	22.16	15	17.11	23	22.07	976-858	
2	CTD	1	8/4/2021	1:35	8/4/2021	2:22	15	18.9898	23	22.1448	15	18.991	23	22.1442	876	
3	MUC	1	8/4/2021	2:42	8/4/2021	3:33	15	18.9907	23	22.145	15	18.9902	23	22.1447	876	
4	MUC	2	8/4/2021	4:21	8/4/2021	5:06	15	18.9897	23	22.1443	15	18.9898	23	22.1442	876	
5	MUC	3	8/4/2021	5:13	8/4/2021	6:07	15	18.9897	23	22.1443	15	18.9902	23	22.144	876	
6	MUC	4	8/8/2021	6:26	8/8/2021	7:18	15	18.9905	23	22.1448	15	18.9898	23	22.144	876	
7	MB	1	8/4/2021	18:31	8/4/2021	22:43	14	52.56	23	5.078	14	19.83	25	5.03	4259-4387	Line1 Box South
7	MB	1	8/4/2021	23:25	8/5/2021	3:39	14	19.61	25	10.97	14	52.37	25	11.19	4413-4259	Line2 Box South
7	MB	1	8/5/2021	3:47	8/5/2021	4:16	14	52.84	25	11.21	14	49.139	25	11.192	4251-4219	Line 3 Same as Line 2 but backwards (opposite heading) until CTD 02
8	CTD	2	8/5/2021	6:30	8/5/2021	9:30	14	28.9368	25	14.8695	14	28.939	25	14.8743	4399	
9	LR	1	8/5/2021	19:44	8/8/2021	7:46	14	43.1417	25	12.1233	14	43.2525	25	12.1342	4168	
10	LC	1	8/5/2021	21:47	8/5/2021	22:01	14	43.6133	25	11.8888	-	-			4204	Baited camera did not sink. Recovered
11	LC	2	8/5/2021	22:46	8/7/2021	3:01	14	43.5752	25	11.9587					4204	BC 2 deployment - Recovery info - station 14
12	ROV	1	8/6/2021	8:13	8/6/2021	17:43	14	48.7187	24	30.1818	14	29.569	24	29.569	2079-1727	
13	LB	1	8/6/2021	22:49	8/9/2021	7:34	14	42.647	25	12.3658	14	41.9757	25	12.0045	4175-4182	
14	LC	2	8/7/2021	1:03	8/7/2021	3:01	14	43.587	25	11.9452	14	42.98	25	11.803	4163	BC 2 recovery - Same as station 11 - new station number was created for BC recovery (by mistake)

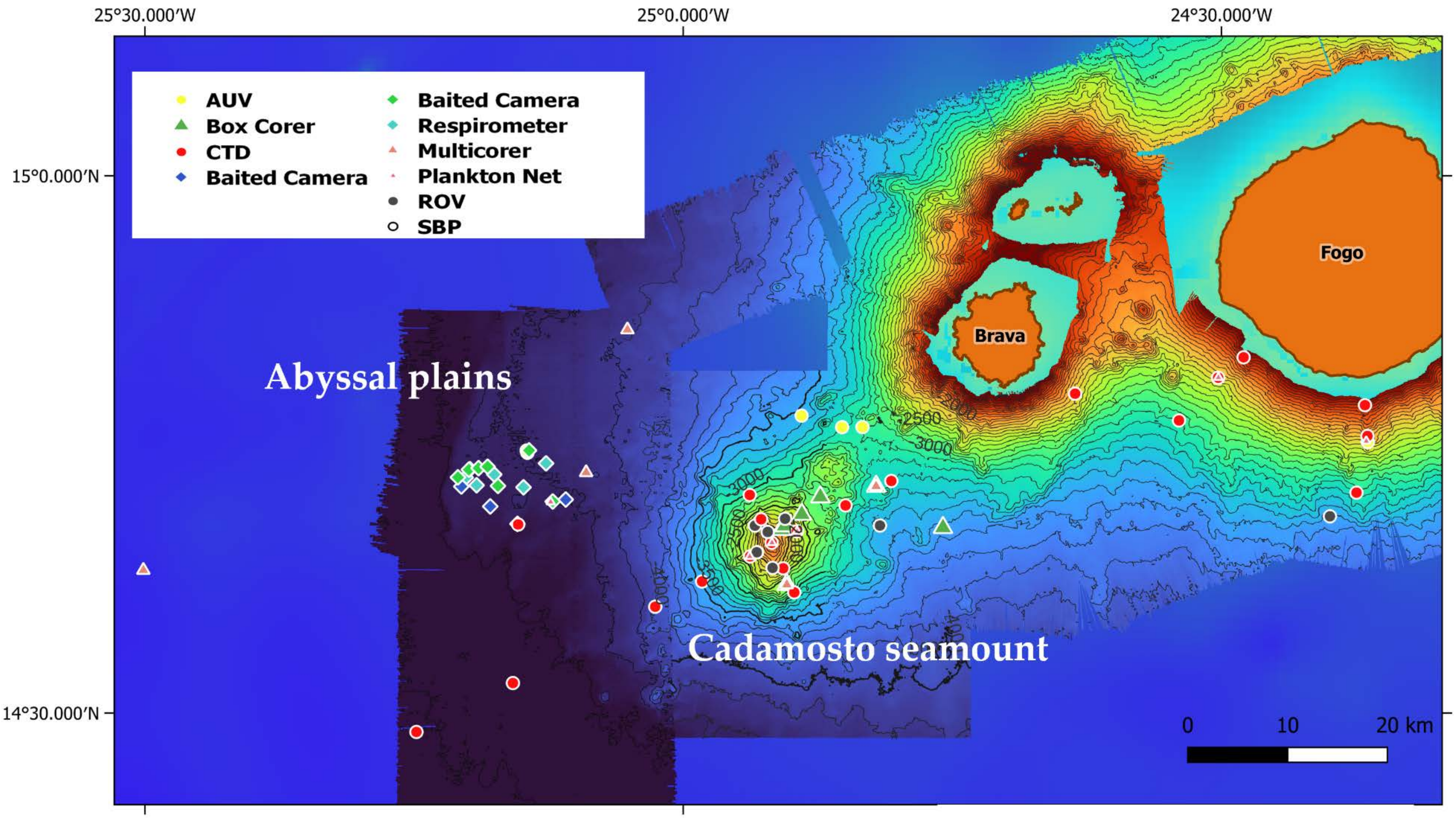
15	CTD	3	8/7/2021	5:35	8/7/2021	8:39	14	31.6685	25	9.49	14	31.7287	25	9.5623	4262	
16	AUV	157	8/7/2021	12:02	8/7/2021	17:02	14	44.564	25	8.69	14	43.6933	25	8.8953	4144	Mission aborted - the Autosub6000 came back to the surface
17	ROV	2	8/7/2021	19:55	8/7/2021	23:33	14	38.9777	24	55.8803	14	38.9722	24	55.8852	1850	ROV Dive aborted at 21:53 - Problems with 4K and HD camera
18	CTD	4	8/8/2021	0:23	8/8/2021	1:57	14	38.7407	24	56.2695	14	38.7332	24	56.3138	2006 -2026	
19	LC	3	8/8/2021	4:52	8/10/2021	7:45	14	43.67	25	11.4055						BC 3 deployment - Recovery info - station 26
20	BC	1	8/8/2021	11:22	8/8/2021	13:57	14	42.0612	24	52.3548	14	42.0618	24	52.3545	2800-2797	Pull-out (12:55) 3.1
21	BC	2	8/8/2021	15:14	8/8/2021	17:32	14	37.1693	24	54.228	14	37.1688	24	54.2283	2548	Pull-out (16:19) 2.9
22	BC	3	8/8/2021	18:57	8/8/2021	21:51	14	40.2355	24	54.5135	14	40.236	24	54.5152	1750	Cable: 1787; Pull-out (19:43) 5.6 - winch dropped because overweight. Core tangled ca 20m above bottom for 15min and at 1350m for 30min
23	CTD	5	8/8/2021	23:04	8/9/2021	1:30	14	37.3385	24	58.9452	14	37.3378	24	58.9448	3408-3411	
24	ROV	3	8/9/2021	15:14	8/10/2021	1:28	14	38.9702	24	55.8998	14	39.3002	24	55.1422	1946-4111	
25	CTD	6	8/10/2021	2:06	8/10/2021	3:28	14	39.5007	24	55.07	14	39.4908	24	57.7833	1421	
26	LC	3	8/10/2021	7:45			14	43.1568	25	12.5572					4170	BC 3 recovery - Same as station 19 - new station number was created for BC recovery (by mistake)
27	AUV	158	8/10/2021	9:17	8/10/2021	15:33	14	44.5275	25	8.6808	14	44.2398	25	8.7337	4009	
28	LR	2	8/10/2021	17:24	8/13/2021	8:16	14	42.7145	25	11.5142	14	42.391	25	11.6483	4176-4196	
29	MUC	5	8/10/2021	19:34	8/11/2021	0:26	14	37.9705	25	30.0905	14	37.9983	25	30.106	4395	Pull out 7.1 2149m - winch stopped at

																4140m cable 21h21. Start again 21h42
30	CTD	7	8/11/2021	3:38	8/11/2021	6:29	14	35.9305	25	1.557	14	35.9303	25	1.601	3959	
31	ROV	4	8/11/2021	18:58	8/12/2021	2:06	14	45.1237	24	21.8443	14	45.6275	24	21.8728	1939-1705	
32	AUV	159	8/12/2021	4:11	8/12/2021	9:35	14	45.133	24	21.835	14	44.16	24	21.999	2700	
33	CTD	8	8/12/2021	10:50	8/12/2021	12:25	14	45.4658	24	21.857	14	45.1302	24	21.8572	1889	
34	CTD	9	8/12/2021	14:01	8/12/2021	15:39	14	48.7223	24	30.18	14	48.7213	24	30.179	2088	
35	MB	2	8/12/2021	16:32	8/12/2021	23:54	14	50.565	24	30.2552	14	48.74	24	30.9	1500-2233	
36	LC	4	8/13/2021	5:38	8/14/2021	18:52	14	42.6775	25	10.3235	14	42.1283	25	10.6433	4190-4236	
37	CTD	10	8/13/2021	16:04	8/13/2021	17:01	14	47.1865	24	21.996	14	47.0823	24	21.9287	1037	
38	CTD	11	8/13/2021	18:19	8/13/2021	20:30	14	42.3032	24	22.4682	14	42.303	24	22.4673	2978	
39	CTD	12	8/13/2021	21:52	8/13/2021	22:41	14	49.8592	24	28.761	14	49.8592	24	28.7617	992	
40	MB	3	8/13/2021	22:56	8/14/2021	05:43	14	50.13	24	29.16	14	40.52	24	44.41	1222-3569	Brava
41	BC	4	8/14/2021	7:31	8/14/2021	9:42	14	40.4418	24	54.3385	14	40.4428	24	54.3378	1800-	Cable: 1777 P.O: 4.6 08:32
42	BC	5	8/14/2021	10:19	8/14/2021	12:33	14	40.3492	24	45.5193	14	40.3498	24	54.5192	1791	Cable: 1820 P.O.: 4.3 11:20 - invalid BC - it came turned and open
43	LR	3	8/14/2021	16:25	8/17/2021	7:10	14	43.316	25	10.5318	14	43.103	25	10.5652	4197	Depth from multibeam data
44	CTD	13	8/14/2021	21:25	8/14/2021	23:04	14	40.1412	24	53.6585	14	40.142	24	53.6572	2172	
45	AUV	160	8/15/2021	2:57	8/15/2021	9:05	14	44.652	25	8.724	14	44.4035	25	8.8072	4210	Aborted at 3350m
46	ROV	5	8/15/2021	11:44	8/15/2021	22:30	14	40.459	24	56.0005	14	40.1618	24	55.3018	2005-1730	
47	LC	5	8/16/2021	0:42	8/17/2021	9:34	14	43.7518	25	10.9013	14	43.35	25	10.53	4225	
48	LB	2	8/16/2021	1:39	8/18/2021	11:12	14	41.5323	25	10.753	14	41.5565	25	10.718	4247	
49	CTD	14	8/16/2021	3:30	8/16/2021	5:30	14	42.1717	24	56.2898	14	42.1723	24	56.2902	2867	
50	CTD	15	8/16/2021	6:10	8/16/2021	7:46	14	40.8153	24	55.6558	14	40.8153	24	55.6565	2067	
51	CTD	16	8/16/2021	8:57	8/16/2021	10:33	14	38.078	24	54.4278	14	38.077	24	54.428	2073	
52	BC	6	8/16/2021	11:32	8/16/2021	14:23	14	41.0885	24	53.3878	14	41.0897	24	53.3888	2447	Cable: 2430 12:55 PO: 6.9 -winch stopped at 2290m

																at 12:50 - started immediatly again
53	AUV	161	8/16/2021	19:10	8/16/2021	20:40	14	45.957	24	51.14	14	46.4365	24	51.1917	3185	Mission aborted
54	MB	4	8/16/2021	22:57	8/17/2021	2:36	14	42.369	24	44.38	14	41.61	24	44.71	3405	
55	ROV	6	8/17/2021	12:21	8/17/2021	20:13	14	38.099	24	55.0164	14	38.5499	24	54.9268	1952-1711	
56	AUV	162	8/17/2021	21:55	8/18/2021	21:45	14	45.962	24	50.006	14	46.0905	24	53'32.6 0''	3431	
57	LC	6	8/18/2021	7:20	8/19/2021	12:08	14	44.66	25	8.59	14	44.5247	25	08'44.3 5''	4209	
58	LR	4	8/18/2021	8:35	8/21/2021	7:00	14	42.6	25	8.9	14	42.6	25	8.9		
59	CTD	17	8/18/2021	13:30	8/18/2021	15:31	14	36.731	24	53.8093	14	36.711	24	53.798	2818	
60	CTD	18	8/18/2021	22:41	8/19/2021	0:57	14	42.952	24	48.3973	14	42.9518	24	48.3972	3247	
61	CTD	19	8/19/2021	1:42	8/19/2021	3:53	14	41.587	24	50.9478	14	41.5428	24	50.9962	2907-2903	
62	BC	7	8/19/2021	4:30	8/19/2021	8:17	14	42.6532	24	49.2438	14	42.6533	24	49.2442	3185	147 PO:5.7 06:15-Empty
63	LB	3	8/19/2021	13:17	8/22/2021	1:00	14	41.9175	25	6.5463	14	41.9	25	6.5		
64	ROV	7	8/19/2021	16:20	8/20/2021	0:40	14	40.8408	24	54.3192	14	40.4667	24	54.3378	1939-1761	
65	MUC	6	8/20/2021	2:10	8/20/2021	5:47	14	42.655	24	49.2483	14	42.6548	24	49.247	3184	3142m P.O.: 4.9 03:55
66	MUC	7	8/20/2021	7:05	8/20/2021	10:05	14	37.1637	24	54.2227	14	37.1705	24	54.228	2584	2554m P.O.: 7.8 08:31
67	P	1	8/20/2021	11:08	8/20/2021	12:30	14	39.5063	24	55.0498	14	39.506	24	55.038	1421-1400	
68	P	2	8/20/2021	13:02	8/20/2021	14:50	14	40.1403	24	53.6503	14	40.139	24	53.6493	2122-2116	
69	P	3	8/20/2021	15:29	8/20/2021	17:10	14	38.7382	24	56.2885	14	41.917	25	6.546	2037	
70	MB		8/20/2021	18:33	8/20/2021	22:00	14	38.07	24	44.4	14	45.61	24	31.46	3760	
71	CTD	20	8/20/2021	22:40	8/21/2021	0:53	14	46.3315	24	32.362	14	46.2658	24	32.3607	3008-3012	
72	MB		8/21/2021	1:06	8/21/2021	2:38	14	46.25	24	32.39	14	46.59	24	45.22	3011-2026	
73	LC	7	8/21/2021	7:53	8/22/2021	20:15	14	40.559	25	9.239	14	40.9027	25	9.1167	4000	
74	ROV	8	8/21/2021	11:14	8/21/2021	11:43	14	40.1075	24	55.288						Aborted - beacon connector between sarmiento and ROV
75	ROV	9	8/21/2021	12:26	8/21/2021	20:16	14	40.1077	24	55.2877	14	39.577	24	55.1337	1740-1421	

76	LR	5	8/21/2021	22:36	8/24/2021	7:06	14	43.938	25	7.6438	14	44.3345	25	8.21033	4207	
77	ROV	10	8/22/2021	6:57	8/22/2021	14:44	14	47.8313	24	38.16	14	47.8212	24	38.9217	2005-1668	
78	CTD	21	8/22/2021	20:37	8/22/2021	23:35	14	40.5238	25	9.1988	14	40.5237	25	9.199	4320-4313	
79	LC	8	8/23/2021	0:21	8/24/2021	6:30	14	41.8072	25	7.2702	14	41.7117	25	8.25183	4256	
80	MUC	8	8/23/2021	1:03	8/23/2021	5:52	14	43.428	25	5.4092	14	43.427	25	9.4097	4276	4170m Cable 03:25 P.O.: 6.0
81	MB		8/23/2021	7:00	8/23/2021	16:18	14	47.09	25	2.85	14	50.16	24	50.79		
82	MUC	9	8/23/2021	17:47	8/23/2021	22:27	14	51.4	25	3.1073	14	51.386	25	3.0977		
83	P	4	8/24/2021	0:23	8/24/2021	0:25	14	41.787	25	7.3883						Aborted due to currents
84	ROV	11	8/24/2021	14:47	8/24/2021	23:22	14	40.4637	24	49.0307	14	40.2777	24	48.4188	3499-3374	
85	AUV	163	8/25/2021	1:22	8/25/2021	3:30	14	46.601	24	53.398	14	47.2203	24	52.5193	3499	Aborted
86	MB		8/25/2021	4:36	8/25/2021	8:34	14	47.19	24	52.47	14	47.1	24	39.1		
87	ROV	12	8/25/2021	17:01	8/26/2021	0:47	14	40.9782	24	23.9495	14	40.8817	24	23.4635	3567	
88	P	5	8/26/2021	2:26	8/26/2021	2:27	14	45.176	24	21.9242	14	45.176	24	21.9242	1925	Aborted due to currents
89	P	6	8/26/2021	3:35	8/26/2021	5:24	14	48.7313	24	30.1662	14	40.8817	24	30.1658	2146	To 2000m 40m/min
90	P	7	8/26/2021	6:32	8/26/2021	8:10	14	47.8295	24	38.1513	14	47.8293	24	38.1523	1972	To 1870m 40m/min
91	CTD	22	8/26/2021	8:34	8/26/2021	10:03	14	47.83	24	38.1522	14	47.83	24	38.1517	1987-1973	
92	MB		8/26/2021	11:19	8/26/2021	15:00	14	42.38	24	27.83	14	56.5	24	9.8	3190	

Overview of the sampling stations of iMirabilis2 for all the gears deployed during iMirabilis2



10.2 CTD station list

Station	Numbering main station list	Date	Latitude	Longitude	Depth (m)
001	2	04-Aug-2021 01:40:41	15.3165	-23.3690	877.0
002		22-Aug-2021 20:41:28	14.6753	-25.1532	4238.0
202	8	05-Aug-2021 06:36:56	14.4822	-25.2477	4382.2
204	15	07-Aug-2021 05:39:56	14.5280	-25.1583	4286.7
207	30	11-Aug-2021 03:43:25	14.5988	-25.0260	3984.5
208	23	08-Aug-2021 23:09:54	14.6222	-24.9823	3437.3
209	18	08-Aug-2021 00:27:39	14.6457	-24.9383	2008.4
2095	25	10-Aug-2021 02:14:45	14.6582	-24.9173	1406.9
210	44	14-Aug-2021 21:28:39	14.6690	-24.8942	2223.0
211	61	19-Aug-2021 01:45:18	14.6928	-24.8493	2937.9
212	60	18-Aug-2021 22:45:25	14.7158	-24.8065	3218.1
221	49	16-Aug-2021 03:34:28	14.7028	-24.9382	2888.9
222	50	16-Aug-2021 06:15:03	14.6802	-24.9275	2083.2
223	51	16-Aug-2021 09:02:23	14.6345	-24.9070	2154.1
224	59	18-Aug-2021 13:33:42	14.6120	-24.8967	2918.3
301	33	12-Aug-2021 10:54:17	14.7522	-24.3642	1959.2
302	34	12-Aug-2021 14:05:08	14.8120	-24.5030	2124.6
303	37	13-Aug-2021 16:10:17	14.7857	-24.3667	1039.3
304	38	13-Aug-2021 18:23:25	14.7050	-24.3743	3014.3
305	39	13-Aug-2021 21:57:01	14.8308	-24.4793	1023.4
306	71	20-Aug-2021 22:51:30	14.7710	-24.5393	2988.9
401	78	26-Aug-2021 08:39:27	14.7970	-24.6358	1982.8

10.3 ADCP section list

Section	Sampled points	Start date	End date	Latitude	Longitude
Section 1	1	06-Aug-2021 08:03:01	-	14.8120	-24.5030
Section 2	2-17	07-Aug-2021 09:03:26	07-Aug-2021 10:15:11	14.5600 14.7419	-25.1571 -25.1450
Section 3	18-34	09-Aug-2021 10:47:15	09-Aug-2021 12:06:40	14.7333 14.7442	-25.1617 -25.1452
Section 4	35-66	20-Aug-2021 10:01:36	20-Aug-2021 12:36:37	14.6195 14.6584	-24.9038 -24.9173
Section 5	67-93	20-Aug-2021 12:41:40	20-Aug-2021 14:51:35	14.6597 14.6690	-24.9149 -24.8942
Section 6	94-122	20-Aug-2021 14:56:37	20-Aug-2021 17:16:39	14.6673 14.6456	-24.8967 -24.9382
Section 7	123-131	20-Aug-2021 17:21:35	20-Aug-2021 18:01:22	14.6457 14.6394	-24.9383 -24.8311
Section 8	132-1100	26-Aug-2021 23:55:52	30-Aug-2021 08:56:34	16.2619 27.5793	-23.3985 -15.4996

10.4 Samples obtain with the ROV

Date	St. nr	ROV Dive	Location	Sample nr	Sample	Time	Lon Deg W	Lon Deg M	Lat Deg N	Lat Min N	Depth (m)	Analysis	Preservation method	Notes
8/6/2021	12	Dive 01	Fogo Continental Slope	1	Octocoral	12:16	24°	29.8250	14°	48.8889	1947.4	Taxonomy	ethanol	
8/6/2021	12	Dive 01	Fogo Continental Slope	2	Octocoral + Crinoid + coral skelekton	12:37	24°	29.8182	14°	48.9024	1941.63	Taxonomy	ethanol	
8/6/2021	12	Dive 01	Fogo Continental Slope	3	Octocoral	13:02	24°	29.7702	14°	48.9196	1927.57	Acquaria		Sample collection for experiments - corals did not survive temperature changes
8/6/2021	12	Dive 01	Fogo Continental Slope	4	Octocoral	13:19	24°	29.7525	14°	48.9308	1920.84	Acquaria		Sample collection for experiments - corals did not survive temperature changes
8/6/2021	12	Dive 01	Fogo Continental Slope	5	Octocoral	13:47	24°	29.7227	14°	48.9475	1912.5	Acquaria		Sample collection for experiments - corals did not survive temperature changes
8/6/2021	12	Dive 01	Fogo Continental Slope	6	Octocoral	14:03	24°	29.7069	14°	48.9637	1920.01	Acquaria		Sample collection for experiments - corals did not survive temperature changes
8/6/2021	12	Dive 01	Fogo Continental Slope	7	Scleractinian coral (possibly new species)	15:57	24°	29.6355	14°	49.0723	1880.31	Taxonomy	ethanol	
8/6/2021	12	Dive 01	Fogo Continental Slope	8	Niskin Water sample (12L+3x3.5 L)	16:03	24°	29.6348	14°	49.0834	1876.25	e-DNA		
8/6/2021	12	Dive 01	Fogo Continental Slope	9	Push Core - Sediment	16:10	24°	29.6369	14°	49.0960	1876.96	e-DNA		

8/9/2021	24	Dive 03	Cadamosto Seamount	1	Ophiuroidea	17:09	24°	55.8876	14°	38.9338	2022	Stable Isotopes/Fatty acids	frozen	
8/9/2021	24	Dive 03	Cadamosto Seamount	2	Ophiuroidea	17:11	24°	55.8882	14°	38.9350	2022	Stable Isotopes/Fatty acids	frozen	
8/9/2021	24	Dive 03	Cadamosto Seamount	3	Ophiuroidea	17:12	24°	55.8896	14°	38.9342	2023	Stable Isotopes/Fatty acids	frozen	
8/9/2021	24	Dive 03	Cadamosto Seamount	4	Ophiuroidea	17:21	24°	55.8900	14°	38.9346	2023	Stable Isotopes/Fatty acids	frozen	
8/9/2021	24	Dive 03	Cadamosto Seamount	5	Pink sea urchin	17:28	24°	55.8895	14°	38.9337	2024	Stable isotopes	frozen	
8/9/2021	24	Dive 03	Cadamosto Seamount	6	White sea urchin	18:13	24°	55.8574	14°	38.9935	2002.13	Stable isotopes	frozen	
8/9/2021	24	Dive 03	Cadamosto Seamount	7	White sea urchin	18:15	24°	55.8564	14°	38.9932	2001.15	Stable isotopes	frozen	
8/9/2021	24	Dive 03	Cadamosto Seamount	8	White sea urchin	18:15	24°	55.8563	14°	38.9935	2001.15	Stable isotopes	frozen	
8/9/2021	24	Dive 03	Cadamosto Seamount	9	White sea urchin	18:16	24°	55.8574	14°	38.9939	2001.15	Stable isotopes	frozen	
8/9/2021	24	Dive 03	Cadamosto Seamount	10	White sea urchin	18:19	24°	55.8585	14°	38.9939	2000.17	Stable isotopes	frozen	
8/9/2021	24	Dive 03	Cadamosto Seamount	11	Push Core - Sediment	18:22	24°	55.8578	14°	38.9936	2000.17	Stable Isotopes/Fatty acids	frozen	
8/9/2021	24	Dive 03	Cadamosto Seamount	12	Niskin Water sample (12L+3x2.5 L)	20:47	24°	55.4348	14°	39.2003	1654.84	e-DNA		
8/9/2021	24	Dive 03	Cadamosto Seamount	13	Enallopsammia rostrata	21:12	24°	55.4333	14°	39.1963	1655.82	Stable Isotopes/Fatty acids	frozen	
8/9/2021	24	Dive 03	Cadamosto Seamount	14	Dead Enallopsammia rostrata-like	21:24	24°	55.4236	14°	39.2036	1643.02	Geochemistry	Dry in oven (50ºC)	
8/9/2021	24	Dive 03	Cadamosto Seamount	15	Enallopsammia rostrata	21:36	24°	55.4185	14°	39.2078	1636.13	Stable Isotopes/Fatty acids	frozen	Some colonies for experiments on board
8/9/2021	24	Dive 03	Cadamosto Seamount	16	Dead Enallopsam	21:40	24°	55.4182	14°	39.2072	1636.13	Geochemistry	Dry in oven (50ºC)	

					mia rostrata-like									
8/9/2021	24	Dive 03	Cadamosto Seamount	17	Enallopsammia rostrata	21:52	24°	55.4113	14°	39.2087	1627.26	Stable Isotopes/Fatty acids	frozen	Some colonies for experiments on board
8/9/2021	24	Dive 03	Cadamosto Seamount	18	Enallopsammia rostrata	21:57	24°	55.4113	14°	39.2075	1628.25	Taxonomy	Dry in oven (50ºC)	
8/9/2021	24	Dive 03	Cadamosto Seamount	19	Push Core - Sediment	22:44	24°	55.3666	14°	39.2273	1588.85	e-DNA		
8/11/2021	31	Dive 04	Fogo Continental Slope	1	Acanella arbuscula	20:47	24°	21.8942	14°	45.0865	1949.04		ethanol	
8/11/2021	31	Dive 04	Fogo Continental Slope	1	Acanella arbuscula	20:47	24°	21.8942	14°	45.0865	1949.04	Stable Isotopes/Fatty acids	frozen	
8/11/2021	31	Dive 04	Fogo Continental Slope	1	Acanella arbuscula	20:47	24°	21.8942	14°	45.0865	1949.04	Taxonomy	Dry in oven (50ºC)	
8/11/2021	31	Dive 04	Fogo Continental Slope	2	Acanella arbuscula	21:01	24°	21.8954	14°	45.0918	1948.06		ethanol	
8/11/2021	31	Dive 04	Fogo Continental Slope	2	Acanella arbuscula	21:01	24°	21.8954	14°	45.0918	1948.06	Stable Isotopes/Fatty acids	frozen	
8/11/2021	31	Dive 04	Fogo Continental Slope	2	*Acanella arbuscula*	21:01	24°	21.8954	14°	45.0918	1948.06	Taxonomy	Dry in oven (50ºC)	
8/11/2021	31	Dive 04	Fogo Continental Slope	3	*Acanella arbuscula*	21:44	24°	21.8669	14°	45.1567	1921.51		ethanol	
8/11/2021	31	Dive 04	Fogo Continental Slope	3	*Acanella arbuscula*	21:44	24°	21.8669	14°	45.1567	1921.51	Stable Isotopes/Fatty acids	frozen	
8/11/2021	31	Dive 04	Fogo Continental Slope	3	*Acanella arbuscula*	21:44	24°	21.8669	14°	45.1567	1921.51	Taxonomy	Dry in oven (50ºC)	
8/11/2021	31	Dive 04	Fogo Continental Slope	4	Glass Sponge	22:37	24°	21.8555	14°	45.2517	1888.07	Stable Isotopes/Fatty acids	frozen	
8/11/2021	31	Dive 04	Fogo Continental Slope	4	Glass Sponge	22:37	24°	21.8555	14°	45.2517	1888.07		ethanol	

8/11/2021	31	Dive 04	Fogo Continental Slope	5	Glass Sponge	22:49	24°	21.8559	14°	45.2557	1886.1	Stable Isotopes/Fatty acids	frozen	
8/11/2021	31	Dive 04	Fogo Continental Slope	5	Glass Sponge	22:49	24°	21.8559	14°	45.2557	1886.1	Taxonomy	Dry in oven (50ºC)	
8/11/2021	31	Dive 04	Fogo Continental Slope	6	Niskin Water sample (12L+3x2.5 L)	22:50	24°	21.8553	14°	45.2553	1886.1	e-DNA		
8/11/2021	31	Dive 04	Fogo Continental Slope	7	Glass Sponge Euplectella-like	23:13	24°	21.8540	14°	45.2970	1882.17	Stable Isotopes/Fatty acids	frozen	
8/11/2021	31	Dive 04	Fogo Continental Slope	7	Glass Sponge Euplectella-like	23:13	24°	21.8540	14°	45.2970	1882.17		ethanol	
8/11/2021	31	Dive 04	Fogo Continental Slope	8	Plexauridae	23:19	24°	21.8521	14°	45.2965	1882.17	Taxonomy	Dry in oven (50ºC)	
8/11/2021	31	Dive 04	Fogo Continental Slope	8	Plexauridae	23:19	24°	21.8521	14°	45.2965	1882.17	Stable Isotopes/Fatty acids	frozen	
8/11/2021	31	Dive 04	Fogo Continental Slope	9	Niskin Water sample (12L+3x2.5 L)	23:30	24°	21.8569	14°	45.315	1867.41	e-DNA		
8/11/2021	31	Dive 04	Fogo Continental Slope	10	Push Core - Sediment	23:48	24°	21.8589	14°	45.3551	1854.63	e-DNA		
8/11/2021	31	Dive 04	Fogo Continental Slope	11	Push Core - Sediment	23:53	24°	21.8593	14°	45.3547	1854.63	Stable Isotopes/Fatty acids	frozen	
8/15/2021	46	Dive 05	Cadamosto Seamount	1	Corallium-like	16:15	24°	55.8570	14°	40.3970	1910.69	Taxonomy	Dry in oven (50ºC)	
8/15/2021	46	Dive 05	Cadamosto Seamount	1	Corallium-like	16:15	24°	55.8570	14°	40.3970	1910.69	Stable Isotopes/Fatty acids	frozen	
8/15/2021	46	Dive 05	Cadamosto Seamount	2	Corallium-like	16:44	24°	55.8330	14°	40.3890	1892	Taxonomy	Dry in oven (50ºC)	

8/15/2021	46	Dive 05	Cadamosto Seamount	2	Corallium-like	16:44	24°	55.8330	14°	40.3890	1892	Stable Isotopes/Fatty acids	frozen	
8/15/2021	46	Dive 05	Cadamosto Seamount	3	White Elephant ear sponge (fragment)	17:08	24°	55.8208	14°	40.3800	1878.23	Stable Isotopes/Fatty acids	frozen	
8/15/2021	46	Dive 05	Cadamosto Seamount	4	White Elephant ear sponge (fragment)	17:12	24°	55.8206	14°	40.3784	1877.25	Stable Isotopes/Fatty acids	frozen	
8/15/2021	46	Dive 05	Cadamosto Seamount	5	Anthomastus	17:46	24°	55.7836	14°	40.3494	1828.06	Stable Isotopes/Fatty acids	frozen	
8/15/2021	46	Dive 05	Cadamosto Seamount	6	Anthomastus	17:49	24°	55.7841	14°	40.3510	1827.08	Stable Isotopes/Fatty acids	frozen	
8/15/2021	46	Dive 05	Cadamosto Seamount	7	Anthomastus on rock	18:28	24°	55.7165	14°	40.3206	1778.87	Stable Isotopes/Fatty acids	frozen	Rock stored dry
8/15/2021	46	Dive 05	Cadamosto Seamount	8	White Elephant ear sponge (fragment)	19:01	24°	55.6655	14°	40.3042	1759.18	Stable Isotopes/Fatty acids	frozen	LOST SAMPLE
8/15/2021	46	Dive 05	Cadamosto Seamount	9	Niskin Water sample (12L+3x2.5 L)	19:37	24°	55.5933	14°	40.2734	1683.39	e-DNA		
8/15/2021	46	Dive 05	Cadamosto Seamount	10	Push Core - Sediment	21:14	24°	55.3297	14°	40.1467	1743.44	e-DNA		Rocky bottom underneath - not enough sample
8/15/2021	46	Dive 05	Cadamosto Seamount	11	Zooplankton suction sampling	17:23	24°	55.8129	14°	40.3797	1865.45	Stable Isotopes/Fatty acids	frozen	We tried to sample zooplankton 3 times for 10min with the suction sampler - not successful - net was empty
8/17/2021	55	Dive 06	Cadamosto Seamount	1	Pink Holothurian	14:15	24°	55.0003	14°	38.1400	1946.09	Stable Isotopes/Fatty acids	frozen	
8/17/2021	55	Dive 06	Cadamosto Seamount	2	White Holothurian	14:34	24°	54.9982	14°	38.1481	1929.37	Stable Isotopes/Fatty acids	frozen	

8/17/2021	55	Dive 06	Cadamosto Seamount	3	Pink Holothurian	14:45	24°	54.9969	14°	38.1539	1925.44	Stable Isotopes/Fatty acids	frozen	LOST SAMPLE
8/17/2021	55	Dive 06	Cadamosto Seamount	4	White Holothurian	14:54	24°	54.9980	14°	38.1578	1922.49	Stable Isotopes/Fatty acids	frozen	LOST SAMPLE
8/17/2021	55	Dive 06	Cadamosto Seamount	5	Pink Holothurian	14:56	24°	54.9980	14°	38.1578	1922.49	Stable Isotopes/Fatty acids	frozen	LOST SAMPLE
8/17/2021	55	Dive 06	Cadamosto Seamount	6	White Holothurian	15:01	24°	54.9970	14°	38.1635	1919.54	Stable Isotopes/Fatty acids	frozen	LOST SAMPLE
8/17/2021	55	Dive 06	Cadamosto Seamount	7	Plexauridae	15:54	24°	54.9858	14°	38.2582	1889.05	Stable Isotopes/Fatty acids	frozen	
8/17/2021	55	Dive 06	Cadamosto Seamount	8	Enallopsammia rostrata skelekton	16:05	24°	54.9727	14°	38.2653	1889.05	Geochemistry	Dry in oven (50ºC)	
8/17/2021	55	Dive 06	Cadamosto Seamount	9	Enallopsammia rostrata skelekton	16:52	24°	54.9549	14°	38.3454	1856.59	Geochemistry	Dry in oven (50ºC)	
8/17/2021	55	Dive 06	Cadamosto Seamount	10	Anthomastus with rock	17:27	24°	54.9517	14°	38.4064	1803.47	Acquaria		Sample for experiments on board
8/17/2021	55	Dive 06	Cadamosto Seamount	11	Push Core - Sediment	17:51	24°	54.9402	14°	38.4420	1789.69	Stable Isotopes/Fatty acids	frozen	
8/17/2021	55	Dive 06	Cadamosto Seamount	12	Push Core - Sediment	17:53	24°	54.9403	14°	38.4428	1789.69	e-DNA		
8/17/2021	55	Dive 06	Cadamosto Seamount	13	Enallopsammia rostrata skelekton	17:56	24°	54.9407	14°	38.4428	1789.69	Geochemistry	Dry in oven (50ºC)	
8/17/2021	55	Dive 06	Cadamosto Seamount	14	Niskin Water sample (12L+3x2.5 L)	18:47	24°	54.9268	14°	38.5098	1725.72	e-DNA		
8/19/2021	64	Dive 07	Cadamosto Seamount	1	Niskin Water sample (12L+3x2.5 L)	18:16	24°	54.357	14°	40.856	2006.06	e-DNA		

8/19/2021	64	Dive 07	Cadamosto Seamount	2	Elephant's ear sponge (Fragment)	18:28	24°	54.348	14°	40.856	2006.06	Stable Isotopes/Fatty acids	frozen	
8/19/2021	64	Dive 07	Cadamosto Seamount	3	Pink Holothurian	19:25	24°	54.3278	14°	40.7937	1946.09	Stable Isotopes/Fatty acids	frozen	
8/19/2021	64	Dive 07	Cadamosto Seamount	4	Munida sp.	19:28	24°	54.3259	14°	40.7950	1945.11	Stable Isotopes/Fatty acids	frozen	
8/19/2021	64	Dive 07	Cadamosto Seamount	5	White scleractinian (potential new species ?)	20:16	24°	54.3229	14°	40.7462	1911.67	Taxonomy	ethanol	
8/19/2021	64	Dive 07	Cadamosto Seamount	6	Push Core - Sediment	21:53	24°	54.3538	14°	40.5531	1773.94	Stable Isotopes/Fatty acids	frozen	LOST SAMPLE - Core was open
8/19/2021	64	Dive 07	Cadamosto Seamount	7	Push Core - Sediment	21:55	24°	54.3534	14°	40.5544	1773.94	e-DNA		
8/21/2021	75	Dive 09	Cadamosto Seamount	1	Push Core - Sediment	14:22	24°	55.2988	14°	40.1031	1726.64	e-DNA		
8/21/2021	75	Dive 09	Cadamosto Seamount	2	Push Core - Sediment	14:26	24°	55.3001	14°	40.1026	1726.07	Stable Isotopes/Fatty acids	frozen	
8/21/2021	75	Dive 09	Cadamosto Seamount	3	Metallogorgia sp	15:23	24°	55.3316	14°	39.9224	1614.46	Stable Isotopes/Fatty acids	frozen	
8/21/2021	75	Dive 09	Cadamosto Seamount	4	Niskin Water samples (12L+3x2.5 L)	15:43	24°	55.3205	14°	39.9033	1584.91	e-DNA		
8/21/2021	75	Dive 09	Cadamosto Seamount	5	Metallogorgia sp	16:32	24°	55.3330	14°	39.8343	1533.69	Stable Isotopes/Fatty acids	frozen	
8/21/2021	75	Dive 09	Cadamosto Seamount	6	Metallogorgia sp	17:31	24°	55.3051	14°	39.8027	1518.91	Stable Isotopes/Fatty acids	frozen	
8/21/2021	75	Dive 09	Cadamosto Seamount	7	Enallopsammia rostrata (skelekton)	17:42	24°	55.2795	14°	39.7559	1513.98	Geochemistry	Dry in oven (50ºC)	
8/21/2021	75	Dive 09	Cadamosto Seamount	8	Pink Holothurian	18:23	24°	55.2098	14°	39.6841	1506.1	Stable Isotopes/Fatty acids	frozen	

8/21/2021	75	Dive 09	Cadamosto Seamount	0	Photogrammetry image acquisition - START	16:41	24°	55.3341	14°	39.8204	1523.84	Photogrammetry		
8/21/2021	75	Dive 09	Cadamosto Seamount	0	Photogrammetry image acquisition - END	16:52	24°	55.3358	14°	39.8091	1522.85	Photogrammetry		
8/22/2021	77	Dive 10	Brava Continental Slope	1	Push Core - Sediment	8:30	24°	38.1715	14°	47.8499	2003.12	e-DNA		
8/22/2021	77	Dive 10	Brava Continental Slope	2	Push Core - Sediment	8:34	24°	38.1667	14°	47.8518	2003.12	Paleoceanography	fridge (4ºC)	
8/22/2021	77	Dive 10	Brava Continental Slope	3	Push Core - Sediment	8:36	24°	38.1684	14°	47.8499	2003.12	Stable Isotopes/Fatty acids	frozen	
8/22/2021	77	Dive 10	Brava Continental Slope	4	Ermit Crab	8:40	24°	38.1698	14°	47.8511	2003.12	Stable Isotopes/Fatty acids	frozen	LOST SAMPLE
8/22/2021	77	Dive 10	Brava Continental Slope	5	Ermit Crab	9:42	24°	38.3255	14°	47.8292	1895.94	Stable Isotopes/Fatty acids	frozen	
8/22/2021	77	Dive 10	Brava Continental Slope	6	Ermit Crab	9:44	24°	38.3264	14°	47.8289	1894.95	Stable Isotopes	frozen	
8/22/2021	77	Dive 10	Brava Continental Slope	7	Plexauridae	11:56	24°	38.6494	14°	47.8222	1809.37	Stable Isotopes/Fatty acids	frozen	
8/22/2021	77	Dive 10	Brava Continental Slope	8	Plexauridae	12:17	24°	38.6701	14°	47.8214	1801.5	Stable Isotopes/Fatty acids	frozen	
8/22/2021	77	Dive 10	Brava Continental Slope	9	Niskin Water samples (12L+3x2.5 L)	13:35	24°	38.9067	14°	47.8738	1556.35	e-DNA		

10.5 Multi corer (MUC) samples

Station_No	MUC_No	Date	Time	Lat_N	Long_W	Depth_m	pull_out_tons	cable_out_m	core_length_cm	No_Cores	sliced?	RoseBengal?	Subcore_whole?	eDNa	Comments
3	1	8/4/2021	3:06	15.31651	23.36908	876	1.7	unknown		5	N	N	N	N	for Andrew Sweetman - experiment
4	2	8/4/2021	4:42	15.3165	23.36908	876	5.3	unknown		6	N	N	N	N	for Andrew Sweetman - experiment
5	3	8/4/2021	5:43	15.31649	23.36907	876	1.6	unknown		6	N	N	N	N	for Andrew Sweetman - experiment
6	4	8/4/2021	6:48	15.31651	23.36908	876	1.6	unknown		6	N	N	N	N	for Andrew Sweetman - experiment
29	5	8/10/2021	21:49	14.63284	25.50151	4394	7.1	unknown	34		Y	2	3	2	
65	6	8/20/2021	3:55	14.71092	24.82081	3184	4.9	3142	20	6	Y	2	3	1	
66	7	8/20/2021	8:31	14.61939	24.90371	2584	7.8	2554	13	2	Y	1	N	0	core may have landed on slope, landed on seabed twice or otherwise disturbed. 1 empty tube, 3 tubes no water
80	8	8/23/2021	3:25	14.7238	25.15682	4276	6	4170	35	5	Y	1	Y	1	two core tubes sliced for macrofauna for Danielle de Jonghe (0-2cm, 2-5cm)

10.6. Box Corer (BC) Samples

Station_No	BC_No	Date	Time	Lat_N	Long_W	Depth_m	pull_out_tons	cable_out_m	core_length_cm	sliced?	RoseBengal?	Subcore_whole?	Comments
20	1	8/8/2021	12:35	14.7010194	24.8725806	2800	3.1	unknown	17	Y	Y	Y	core probably partly washed out
21	2	8/8/2021	16:19	14.6194889	24.9038	2548	2.9	unknown	36	Y	Y	Y	
22	3	8/8/2021	19:43	14.6706056	24.9085583	1750	5.6	1757	3	N	N	N	Very small sample of gravelly sand. Core washed out, discarded
41	4	8/14/2021	8:32	14.6740306	24.9056417	1800	4.6	1777	5	N	N	N	gravelly sand. Small bag sample taken from top of boxcore
42	5	8/14/2021	11:20	14.6724861	24.9086556	1791	4.3	1820	0	N	N	N	core fell over and tangled in cable
52	6	8/16/2021	12:55	14.6848083	24.8897972	2447	6.9	2430	0	N	N	N	core fully washed out
62	7	19/082021	4:30	14.7108861	24.8207306	3185	5.7	3147	0	N	N	N	clamp on cable got blocked in core mechanism, core didn't close

10.7. List of samples collected for Stable Isotopes, Fatty Acids and Particulate Organic Carbon (POC) analysis

Date	Station nr	Location	Sampling Gear	Lat	Lon	Depth (m)	Sample	Analysis	Storage before anlysis	Notes
8/8/2021	18 (CTD 209)	Cadamosto seamount	CTD 04	-24.937825	14.64567833	2008	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Stable Isotopes Analysis	-80ºC	Bottom - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/8/2021	18 (CTD 209)	Cadamosto seamount	CTD 04	-24.937825	14.64567833	2008	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Lipids/Fatty acids	-80ºC	Bottom - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/8/2021	18 (CTD 209)	Cadamosto seamount	CTD 04	-24.937825	14.64567833	2008	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	POC	-80ºC	Bottom - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/8/2021	18 (CTD 209)	Cadamosto seamount	CTD 04	-24.937825	14.64567833	1900	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Stable Isotopes Analysis	-80ºC	100m above the bottom - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/8/2021	18 (CTD 209)	Cadamosto seamount	CTD 04	-24.937825	14.64567833	1900	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Lipids/Fatty acids	-80ºC	100m above the bottom - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/8/2021	18 (CTD 209)	Cadamosto seamount	CTD 04	-24.937825	14.64567833	1900	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	POC	-80ºC	100m above the bottom - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/8/2021	18 (CTD 209)	Cadamosto seamount	CTD 04	-24.937825	14.64567833	340	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Stable Isotopes Analysis	-80ºC	Minimum of Oxygen - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/8/2021	18 (CTD 209)	Cadamosto seamount	CTD 04	-24.937825	14.64567833	340	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Lipids/Fatty acids	-80ºC	Minimum of Oxygen - We collected water at 4 different depths using a CTD Rosette with

										bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/8/2021	18 (CTD 209)	Cadamosto seamount	CTD 04	-24.937825	14.64567833	340	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	POC	-80ºC	Minimum of Oxygen - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/8/2021	18 (CTD 209)	Cadamosto seamount	CTD 04	-24.937825	14.64567833	60	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Stable Isotopes Analysis	-80ºC	Maximum of chl-a - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/8/2021	18 (CTD 209)	Cadamosto seamount	CTD 04	-24.937825	14.64567833	60	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Lipids/Fatty acids	-80ºC	Maximum of chl-a - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/8/2021	18 (CTD 209)	Cadamosto seamount	CTD 04	-24.937825	14.64567833	60	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	POC	-80ºC	Maximum of chl-a - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/9/2021	24	Cadamosto seamount	ROV 03	-24.9314613	14.6488981	2022	Sample#1 Ophiuroidea	Stable Isotopes/Fatty acids	-80ºC	
8/9/2021	24	Cadamosto seamount	ROV 03	-24.9314709	14.6489182	2022	Sample#2 Ophiuroidea	Stable Isotopes/Fatty acids	-80ºC	
8/9/2021	24	Cadamosto seamount	ROV 03	-24.9314938	14.6489048	2023	Sample#3 Ophiuroidea	Stable Isotopes/Fatty acids	-80ºC	
8/9/2021	24	Cadamosto seamount	ROV 03	-24.9315014	14.6489115	2023	Sample#4 Ophiuroidea	Stable Isotopes/Fatty acids	-80ºC	
8/9/2021	24	Cadamosto seamount	ROV 03	-24.9314919	14.6488953	2024	Sample#5 Pink sea urchin	Stable Isotopes Analysis	-80ºC	
8/9/2021	24	Cadamosto seamount	ROV 03	-24.9309578	14.6498919	2002.13	Sample#6 White sea urchin	Stable Isotopes Analysis	-80ºC	
8/9/2021	24	Cadamosto seamount	ROV 03	-24.9309406	14.649888	2001.15	Sample#7 White sea urchin	Stable Isotopes Analysis	-80ºC	
8/9/2021	24	Cadamosto seamount	ROV 03	-24.9309387	14.6498919	2001.15	Sample#8 White sea urchin	Stable Isotopes Analysis	-80ºC	
8/9/2021	24	Cadamosto seamount	ROV 03	-24.9309578	14.6498985	2001.15	Sample#9 White sea urchin	Stable Isotopes Analysis	-80ºC	

8/9/2021	24	Cadamosto seamount	ROV 03	-24.930975	14.6498985	2000.17	Sample#10 White sea urchin	Stable Isotopes Analysis	-80ºC	
8/9/2021	24	Cadamosto seamount	ROV 03	-24.9309635	14.6498938	2000.17	Sample#11 Sediment	Stable Isotopes/Fatty acids	-80ºC	Push Core nº1
8/9/2021	24	Cadamosto seamount	ROV 03	-24.9238892	14.6532717	1655.82	Sample#13 Enallopsammia-like coral	Stable Isotopes/Fatty acids	-80ºC	
8/9/2021	24	Cadamosto seamount	ROV 03	-24.9236431	14.6534634	1636.13	Sample#15 Enallopsammia-like coral	Stable Isotopes/Fatty acids	-80ºC	
8/9/2021	24	Cadamosto seamount	ROV 03	-24.9235229	14.6534796	1627.26	Sample#17 Enallopsammia-like coral	Stable Isotopes/Fatty acids	-80ºC	
8/10/2021	25	Cadamosto seamount	CTD 06	-24.9178333	14.658345	1403	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Stable Isotopes Analysis	-80ºC	Bottom - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/10/2021	25	Cadamosto seamount	CTD 06	-24.9178333	14.658345	1403	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Lipids/Fatty acids	-80ºC	Bottom - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/10/2021	25	Cadamosto seamount	CTD 06	-24.9178333	14.658345	1403	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	POC	-80ºC	Bottom - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/10/2021	25	Cadamosto seamount	CTD 06	-24.9178333	14.658345	1301	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Stable Isotopes Analysis	-80ºC	100m above the bottom - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/10/2021	25	Cadamosto seamount	CTD 06	-24.9178333	14.658345	1301	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Lipids/Fatty acids	-80ºC	100m above the bottom - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/10/2021	25	Cadamosto seamount	CTD 06	-24.9178333	14.658345	1301	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	POC	-80ºC	100m above the bottom - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)

8/10/2021	25	Cadamosto seamount	CTD 06	-24.9178333	14.658345	445	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Stable Isotopes Analysis	-80ºC	Minimum of Oxygen - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/10/2021	25	Cadamosto seamount	CTD 06	-24.9178333	14.658345	445	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Lipids/Fatty acids	-80ºC	Minimum of Oxygen - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/10/2021	25	Cadamosto seamount	CTD 06	-24.9178333	14.658345	445	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	POC	-80ºC	Minimum of Oxygen - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/10/2021	25	Cadamosto seamount	CTD 06	-24.9178333	14.658345	50	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Stable Isotopes Analysis	-80ºC	Maximum of chl-a - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/10/2021	25	Cadamosto seamount	CTD 06	-24.9178333	14.658345	50	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Lipids/Fatty acids	-80ºC	Maximum of chl-a - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/10/2021	25	Cadamosto seamount	CTD 06	-24.9178333	14.658345	50	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	POC	-80ºC	Maximum of chl-a - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/11/2021	31	Fogo Island	ROV 04	-24.3649044	14.7514429	1949.04	Sample#1 Acanella-like coral	Stable Isotopes/Fatty acids	-80ºC	
8/11/2021	31	Fogo Island	ROV 04	-24.3649044	14.7514429	1949.04	Sample#1 Polychaete	Stable Isotopes/Fatty acids	-80ºC	In association with Acanella
8/11/2021	31	Fogo Island	ROV 04	-24.3649235	14.7515316	1948.06	Sample#2 Acanella-like coral	Stable Isotopes/Fatty acids	-80ºC	
8/11/2021	31	Fogo Island	ROV 04	-24.3649044	14.7514429	1949.04	Sample#2 Polychaete	Stable Isotopes/Fatty acids	-80ºC	In association with Acanella
8/11/2021	31	Fogo Island	ROV 04	-24.3644485	14.7526121	1921.51	Sample#3 Acanella-like coral	Stable Isotopes/Fatty acids	-80ºC	

8/11/2021	31	Fogo Island	ROV 04	-24.3644485	14.7526121	1921.51	Sample#3 Polychaete	Stable Isotopes/Fatty acids	-80ºC	In association with Acanella
8/11/2021	31	Fogo Island	ROV 04	-24.3642597	14.7541952	1888.07	Sample#4 Glass Sponge	Stable Isotopes/Fatty acids	-80ºC	
8/11/2021	31	Fogo Island	ROV 04	-24.3642654	14.754262	1886.1	Sample#5 Glass Sponge	Stable Isotopes/Fatty acids	-80ºC	
8/11/2021	31	Fogo Island	ROV 04	-24.3642349	14.7549515	1882.17	Sample#7 Glass Sponge Euplectella-like	Stable Isotopes/Fatty acids	-80ºC	
8/11/2021	31	Fogo Island	ROV 04	-24.3642349	14.7549515	1882.17	Sample#7 Shrimp	Stable Isotopes/Fatty acids	-80ºC	Inside Sponge
8/11/2021	31	Fogo Island	ROV 04	-24.3642349	14.7549515	1882.17	Sample#7 Shrimp	Stable Isotopes/Fatty acids	-80ºC	Inside Sponge
8/11/2021	31	Fogo Island	ROV 04	-24.3642025	14.7549419	1882.17	Sample#8 Plexauridae	Stable Isotopes/Fatty acids	-80ºC	
8/11/2021	31	Fogo Island	ROV 04	-24.3642025	14.7549419	1882.17	Sample#8 Brittle Stars	Stable Isotopes/Fatty acids	-80ºC	In association with plexauridae
8/11/2021	31	Fogo Island	ROV 04	-24.3642025	14.7549419	1882.17	Sample#8 Brittle Stars	Stable Isotopes/Fatty acids	-80ºC	In association with plexauridae
8/11/2021	31	Fogo Island	ROV 04	-24.3642025	14.7549419	1882.17	Sample#8 Brittle Stars	Stable Isotopes/Fatty acids	-80ºC	In association with plexauridae
8/11/2021	31	Fogo Island	ROV 04	-24.3642025	14.7549419	1882.17	Sample#8 Cirripedi lepadomorfi	Stable Isotopes/Fatty acids	-80ºC	In association with plexauridae
8/11/2021	31	Fogo Island	ROV 04	-24.364315	14.7559185	1854.63	Sample#10 Sediment	Stable Isotopes/Fatty acids	-80ºC	Push Core nº1
8/12/2021	33	Fogo Island	CTD 08	-24.3642833	14.757763	1959	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Stable Isotopes Analysis	-80ºC	Bottom - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/12/2021	33	Fogo Island	CTD 08	-24.3642833	14.757763	1959	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Lipids/Fatty acids	-80ºC	Bottom - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)

8/12/2021	33	Fogo Island	CTD 08	-24.3642833	14.757763	1959	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	POC	-80ºC	Bottom - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/12/2021	33	Fogo Island	CTD 08	-24.3642833	14.757763	1859	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Stable Isotopes Analysis	-80ºC	100m above the bottom - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/12/2021	33	Fogo Island	CTD 08	-24.3642833	14.757763	1859	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Lipids/Fatty acids	-80ºC	100m above the bottom - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/12/2021	33	Fogo Island	CTD 08	-24.3642833	14.757763	1859	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	POC	-80ºC	100m above the bottom - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/12/2021	33	Fogo Island	CTD 08	-24.3642833	14.757763	400	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Stable Isotopes Analysis	-80ºC	Minimum of Oxygen - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/12/2021	33	Fogo Island	CTD 08	-24.3642833	14.757763	400	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Lipids/Fatty acids	-80ºC	Minimum of Oxygen - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/12/2021	33	Fogo Island	CTD 08	-24.3642833	14.757763	400	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	POC	-80ºC	Minimum of Oxygen - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/12/2021	33	Fogo Island	CTD 08	-24.3642833	14.757763	45	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Stable Isotopes Analysis	-80ºC	Maximum of chl-a - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/12/2021	33	Fogo Island	CTD 08	-24.3642833	14.757763	45	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Lipids/Fatty acids	-80ºC	Maximum of chl-a - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)

8/12/2021	33	Fogo Island	CTD 08	-24.3642833	14.757763	45	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	POC	-80ºC	Maximum of chl-a - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/12/2021	34	Fogo Island	CTD 09	-24.503	14.8120383	2124	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Stable Isotopes Analysis	-80ºC	Bottom - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/12/2021	34	Fogo Island	CTD 09	-24.503	14.8120383	2124	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Lipids/Fatty acids	-80ºC	Bottom - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/12/2021	34	Fogo Island	CTD 09	-24.503	14.8120383	2124	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	POC	-80ºC	Bottom - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/12/2021	34	Fogo Island	CTD 09	-24.503	14.8120383	2024	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Stable Isotopes Analysis	-80ºC	100m above the bottom - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/12/2021	34	Fogo Island	CTD 09	-24.503	14.8120383	2024	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Lipids/Fatty acids	-80ºC	100m above the bottom - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/12/2021	34	Fogo Island	CTD 09	-24.503	14.8120383	2024	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	POC	-80ºC	100m above the bottom - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/12/2021	34	Fogo Island	CTD 09	-24.503	14.8120383	360	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Stable Isotopes Analysis	-80ºC	Minimum of Oxygen - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/12/2021	34	Fogo Island	CTD 09	-24.503	14.8120383	360	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Lipids/Fatty acids	-80ºC	Minimum of Oxygen - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)

8/12/2021	34	Fogo Island	CTD 09	-24.503	14.8120383	360	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	POC	-80ºC	Minimum of Oxygen - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/12/2021	34	Fogo Island	CTD 09	-24.503	14.8120383	50	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Stable Isotopes Analysis	-80ºC	Maximum of chl-a - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/12/2021	34	Fogo Island	CTD 09	-24.503	14.8120383	50	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Lipids/Fatty acids	-80ºC	Maximum of chl-a - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/12/2021	34	Fogo Island	CTD 09	-24.503	14.8120383	50	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	POC	-80ºC	Maximum of chl-a - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/13/2021	37	Fogo Island	CTD 10	-24.3666	14.7864416	1037	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Stable Isotopes Analysis	-80ºC	Bottom - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/13/2021	37	Fogo Island	CTD 10	-24.3666	14.7864416	1037	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Lipids/Fatty acids	-80ºC	Bottom - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/13/2021	37	Fogo Island	CTD 10	-24.3666	14.7864416	1037	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	POC	-80ºC	Bottom - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/13/2021	37	Fogo Island	CTD 10	-24.3666	14.7864416	937	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Stable Isotopes Analysis	-80ºC	100m above the bottom - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/13/2021	37	Fogo Island	CTD 10	-24.3666	14.7864416	937	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Lipids/Fatty acids	-80ºC	100m above the bottom - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)

8/13/2021	37	Fogo Island	CTD 10	-24.3666	14.7864416	937	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	POC	-80ºC	100m above the bottom - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/13/2021	37	Fogo Island	CTD 10	-24.3666	14.7864416	340	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Stable Isotopes Analysis	-80ºC	Minimum of Oxygen - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/13/2021	37	Fogo Island	CTD 10	-24.3666	14.7864416	340	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Lipids/Fatty acids	-80ºC	Minimum of Oxygen - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/13/2021	37	Fogo Island	CTD 10	-24.3666	14.7864416	340	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	POC	-80ºC	Minimum of Oxygen - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/13/2021	37	Fogo Island	CTD 10	-24.3666	14.7864416	45	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Stable Isotopes Analysis	-80ºC	Maximum of chl-a - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/13/2021	37	Fogo Island	CTD 10	-24.3666	14.7864416	45	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Lipids/Fatty acids	-80ºC	Maximum of chl-a - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/13/2021	37	Fogo Island	CTD 10	-24.3666	14.7864416	45	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	POC	-80ºC	Maximum of chl-a - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/14/2021	44	Cadamosto seamount	CTD13	-24.8943083	14.66902	2221	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Stable Isotopes Analysis	-80ºC	Bottom - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/14/2021	44	Cadamosto seamount	CTD13	-24.8943083	14.66902	2221	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Lipids/Fatty acids	-80ºC	Bottom - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)

8/14/2021	44	Cadamosto seamount	CTD13	-24.8943083	14.66902	2221	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	POC	-80ºC	Bottom - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/14/2021	44	Cadamosto seamount	CTD13	-24.8943083	14.66902	2100	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Stable Isotopes Analysis	-80ºC	100m above the bottom - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/14/2021	44	Cadamosto seamount	CTD13	-24.8943083	14.66902	2100	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Lipids/Fatty acids	-80ºC	100m above the bottom - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/14/2021	44	Cadamosto seamount	CTD13	-24.8943083	14.66902	2100	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	POC	-80ºC	100m above the bottom - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/14/2021	44	Cadamosto seamount	CTD13	-24.8943083	14.66902	435	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Stable Isotopes Analysis	-80ºC	Minimum of Oxygen - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/14/2021	44	Cadamosto seamount	CTD13	-24.8943083	14.66902	435	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Lipids/Fatty acids	-80ºC	Minimum of Oxygen - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/14/2021	44	Cadamosto seamount	CTD13	-24.8943083	14.66902	435	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	POC	-80ºC	Minimum of Oxygen - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/14/2021	44	Cadamosto seamount	CTD13	-24.8943083	14.66902	50	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Stable Isotopes Analysis	-80ºC	Maximum of chl-a - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/14/2021	44	Cadamosto seamount	CTD13	-24.8943083	14.66902	50	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Lipids/Fatty acids	-80ºC	Maximum of chl-a - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)

8/14/2021	44	Cadamosto seamount	CTD13	-24.8943083	14.66902	50	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	POC	-80ºC	Maximum of chl-a - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/15/2021	46	Cadamosto seamount	ROV 05	-24.9309502	14.6732836	1910.69	Corallium	Stable Isotopes/Fatty acids	-80ºC	
8/15/2021	46	Cadamosto seamount	ROV 05	-24.9305515	14.6731501	1892	Corallium	Stable Isotopes/Fatty acids	-80ºC	
8/15/2021	46	Cadamosto seamount	ROV 05	-24.9303474	14.6730003	1878.23	White Elephant ear sponge (fragment)	Stable Isotopes/Fatty acids	-80ºC	
8/15/2021	46	Cadamosto seamount	ROV 05	-24.9303436	14.6729746	1877.25	White Elephant ear sponge (fragment)	Stable Isotopes/Fatty acids	-80ºC	
8/15/2021	46	Cadamosto seamount	ROV 05	-24.9297276	14.6724901	1828.06	Anthomastus	Stable Isotopes/Fatty acids	-80ºC	
8/15/2021	46	Cadamosto seamount	ROV 05	-24.9297352	14.6725168	1827.08	Anthomastus	Stable Isotopes/Fatty acids	-80ºC	
8/15/2021	46	Cadamosto seamount	ROV 05	-24.9286098	14.6720114	1778.87	Anthomastus	Stable Isotopes/Fatty acids	-80ºC	
8/16/2021	50	Cadamosto seamount	CTD15	-24.9275966	14.680255	2082	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	POC	-80ºC	Bottom - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/16/2021	50	Cadamosto seamount	CTD15	-24.9275966	14.680255	1982	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	POC	-80ºC	100m above the bottom - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/16/2021	50	Cadamosto seamount	CTD15	-24.9275966	14.680255	410	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	POC	-80ºC	Minimum of Oxygen - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/16/2021	50	Cadamosto seamount	CTD15	-24.9275966	14.680255	65	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	POC	-80ºC	Maximum of chl-a - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)

8/17/2021	55	Cadamosto seamount	ROV 06	-24.9166718	14.6356668	1946.09	Sample#1 Pink Holothurian	Stable Isotopes/Fatty acids	-80ºC	
8/17/2021	55	Cadamosto seamount	ROV 06	-24.9166374	14.6358032	1929.37	Sample#2 White Holothurian	Stable Isotopes/Fatty acids	-80ºC	
8/17/2021	55	Cadamosto seamount	ROV 06	-24.9164314	14.6376381	1889.05	Sample#7 plexauridae	Stable Isotopes/Fatty acids	-80ºC	
8/17/2021	55	Cadamosto seamount	ROV 06	-24.9156704	14.6407013	1789.69	Sample #11 Sediment	Stable Isotopes/Fatty acids	-80ºC	Push core nº1
8/18/2021	59	Cadamosto seamount	CTD 17	-24.8968216	14.6121833	2915	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	POC	-80ºC	Bottom - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/18/2021	59	Cadamosto seamount	CTD 17	-24.8968216	14.6121833	2815	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	POC	-80ºC	100m above the bottom - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/18/2021	59	Cadamosto seamount	CTD 17	-24.8968216	14.6121833	432	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	POC	-80ºC	Minimum of Oxygen - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/18/2021	59	Cadamosto seamount	CTD 17	-24.8968216	14.6121833	45	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	POC	-80ºC	Maximum of chl-a - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/19/2021	64	Cadamosto seamount	ROV 07	-24.9058208	14.6809187	2006.06	Sample#2 Elephant's ear sponge	Stable Isotopes/Fatty acids	-80ºC	
8/19/2021	64	Cadamosto seamount	ROV 07	-24.9054642	14.6798964	1946.09	Sample#3 Pink Holothurian	Stable Isotopes/Fatty acids	-80ºC	
8/19/2021	64	Cadamosto seamount	ROV 07	-24.9054317	14.6799183	1945.11	Sample#4 Munida sp.	Stable Isotopes/Fatty acids	-80ºC	
8/20/2021	67	Cadamosto seamount	Plankton Net 01	-24.9174966	14.65843833	1400	Squid	Stable Isotopes/Fatty acids	-80ºC	Summit of Cadamosto Seamount

8/20/2021	67	Cadamosto seamount	Plankton Net 01	-24.9174966	14.65843833	1400	Jellyfish	Stable Isotopes/Fatty acids	-80ºC	
8/20/2021	67	Cadamosto seamount	Plankton Net 01	-24.9174966	14.65843833	1400	Fish	Stable Isotopes/Fatty acids	-80ºC	
8/20/2021	68	Cadamosto seamount	Plankton Net 01	-24.9174966	14.65843833	1400	Siphonophora	Stable Isotopes/Fatty acids	-80ºC	
8/20/2021	68	Cadamosto seamount	Plankton Net 01	-24.9174966	14.65843833	1400	Zooplankton (copepods, salps, fish larvae, cephalopod larvae, gelatinous zooplankton)	Stable Isotopes/Fatty acids	-80ºC	One subsample fixed in ethanol, one subsample fixed in 4% formaldehyd
8/20/2021	68	Cadamosto seamount	Plankton Net 02	-24.89417166	14.669005	2120	Ctenophora	Stable Isotopes/Fatty acids	-80ºC	
8/20/2021	68	Cadamosto seamount	Plankton Net 02	-24.89417166	14.669005	2120	Fish	Stable Isotopes/Fatty acids	-80ºC	
8/20/2021	68	Cadamosto seamount	Plankton Net 02	-24.89417166	14.669005	2120	Shrimps	Stable Isotopes/Fatty acids	-80ºC	
8/20/2021	68	Cadamosto seamount	Plankton Net 02	-24.89417166	14.669005	2120	Zooplankton (copepods, salps, fish larvae, cephalopod larvae, gelatinous zooplankton)	Stable Isotopes/Fatty acids	-80ºC	
8/20/2021	69	Cadamosto seamount	Plankton Net 03	-24.93814166	14.6456366	2037	Siphonophora	Stable Isotopes/Fatty acids	-80ºC	
8/20/2021	69	Cadamosto seamount	Plankton Net 03	-24.93814166	14.6456366	2037	Fish	Stable Isotopes/Fatty acids	-80ºC	
8/20/2021	69	Cadamosto seamount	Plankton Net 03	-24.93814166	14.6456366	2037	Shrimps	Stable Isotopes/Fatty acids	-80ºC	
8/20/2021	69	Cadamosto seamount	Plankton Net 03	-24.93814166	14.6456366	2037	Zooplankton (copepods, salps, fish larvae, cephalopod larvae, gelatinous zooplankton)	Stable Isotopes/Fatty acids	-80ºC	
8/21/2021	75	Cadamosto Seamount	ROV 09	-24.921668	14.668376	1726	Sample#2 Push Core - Sediment	Stable Isotopes/Fatty acids	-80ºC	
8/21/2021	75	Cadamosto Seamount	ROV 09	-24.9221935	14.6653738	1614.46	Sample#3 Metallogorgia sp	Stable Isotopes/Fatty acids	-80ºC	
8/21/2021	75	Cadamosto Seamount	ROV 09	-24.9222183	14.6639051	1533.69	Sample#5 Metallogorgia sp	Stable Isotopes/Fatty acids	-80ºC	

8/21/2021	75	Cadamosto Seamount	ROV 09	-24.9217529	14.6633787	1518.91	Sample#6 Metallogorgia sp	Stable Isotopes/Fatty acids	-80ºC	
8/21/2021	75	Cadamosto Seamount	ROV 09	-24.9201641	14.6614017	1506.1	Sample#8 Pink Holothurian	Stable Isotopes/Fatty acids	-80ºC	
8/22/2021	77	Brava Continental Shelf	ROV 10	-24.6361408	14.7974997	2003.12	Sample#2 Push Core - Sediment	Stable Isotopes/Fatty acids	-80ºC	
8/22/2021	77	Brava Continental Shelf	ROV 10	-24.6387596	14.7971535	1895.94	Sample#5 Ermit Crab	Stable Isotopes/Fatty acids	-80ºC	
8/22/2021	77	Brava Continental Shelf	ROV 10	-24.6387749	14.7971487	1894.95	Sample#6 Ermit Crab	Stable Isotopes Analysis	-80ºC	
8/22/2021	77	Brava Continental Shelf	ROV 10	-24.6441574	14.7970371	1809.37	Sample#7 Plexauridae	Stable Isotopes/Fatty acids	-80ºC	
8/22/2021	77	Brava Continental Shelf	ROV 10	-24.6445026	14.7970238	1801.5	Sample#8 Plexauridae	Stable Isotopes/Fatty acids	-80ºC	
		Control					25 mm GF/F Filers - Mili Q water (x3)	SIA/FA/POC	-80ºC	5 Controls for each analysis
		Control					25 mm GF/F Filers - Mili Q water (x3)	SIA/FA/POC	-80ºC	
		Control					25 mm GF/F Filers - Mili Q water (x3)	SIA/FA/POC	-80ºC	
		Control					25 mm GF/F Filers - Mili Q water (x3)	SIA/FA/POC	-80ºC	
		Control					25 mm GF/F Filers - Mili Q water (x3)	SIA/FA/POC	-80ºC	
8/26/2021	89	Fogo Island	Plankton Net 6	-24.50277	14.81218833	2146	Fish	Stable Isotopes/Fatty acids	-80ºC	
8/26/2021	89	Fogo Island	Plankton Net 6	-24.50277	14.81218833	2146	Shrimp (tail)	Stable Isotopes/Fatty acids	-80ºC	
8/26/2021	89	Fogo Island	Plankton Net 6	-24.50277	14.81218833	2146	Zooplankton	Stable Isotopes/Fatty acids	-80ºC	
8/26/2021	90	Brava Continental Shelf	Plankton Net 7	-24.635855	14.79715833	1972	Fish	Stable Isotopes/Fatty acids	-80ºC	
8/26/2021	90	Brava Continental Shelf	Plankton Net 7	-24.635855	14.79715833	1972	Shrimp	Stable Isotopes/Fatty acids	-80ºC	

8/26/2021	90	Brava Continental Shelf	Plankton Net 7	-24.635855	14.79715833	1972	Zooplankton	Stable Isotopes/Fatty acids	-80ºC	
8/26/2021	91	Brava Continental Shelf	CTD 22	-24.63587	14.79716667	1982	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Stable Isotopes Analysis	-80ºC	Bottom - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/26/2021	91	Brava Continental Shelf	CTD 22	-24.63587	14.79716667	1982	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Lipids/Fatty acids	-80ºC	Bottom - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/26/2021	91	Brava Continental Shelf	CTD 22	-24.63587	14.79716667	1982	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	POC	-80ºC	Bottom - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/26/2021	91	Brava Continental Shelf	CTD 22	-24.63587	14.79716667	1882	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Stable Isotopes Analysis	-80ºC	100m above the bottom - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/26/2021	91	Brava Continental Shelf	CTD 22	-24.63587	14.79716667	1882	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Lipids/Fatty acids	-80ºC	100m above the bottom - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/26/2021	91	Brava Continental Shelf	CTD 22	-24.63587	14.79716667	1882	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	POC	-80ºC	100m above the bottom - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/26/2021	91	Brava Continental Shelf	CTD 22	-24.63587	14.79716667	370	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Stable Isotopes Analysis	-80ºC	Minimum of Oxygen - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/26/2021	91	Brava Continental Shelf	CTD 22	-24.63587	14.79716667	370	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Lipids/Fatty acids	-80ºC	Minimum of Oxygen - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/26/2021	91	Brava Continental Shelf	CTD 22	-24.63587	14.79716667	370	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	POC	-80ºC	Minimum of Oxygen - We collected water at 4 different depths using a CTD Rosette with

										bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/26/2021	91	Brava Continental Shelf	CTD 22	-24.63587	14.79716667	60	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Stable Isotopes Analysis	-80ºC	Maximum of chl-a - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/26/2021	91	Brava Continental Shelf	CTD 22	-24.63587	14.79716667	60	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	Lipids/Fatty acids	-80ºC	Maximum of chl-a - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)
8/26/2021	91	Brava Continental Shelf	CTD 22	-24.63587	14.79716667	60	25 mm GF/F Filers - 1L of water per each filter (x3 replicates)	POC	-80ºC	Maximum of chl-a - We collected water at 4 different depths using a CTD Rosette with bottles of 12L. For each depth, we collected 3 bottles (3 replicates)

10.8 UTM technical report

INFORME TÉCNICO DE LOS EQUIPOS. CAMPAÑA iMiriabilis2 (Leg 1)

Autor: Pablo Rodríguez Fornes
Departamentos: Acústica, Mecánica, TIC,Equipos fijos.
Fecha: 30/08/2021

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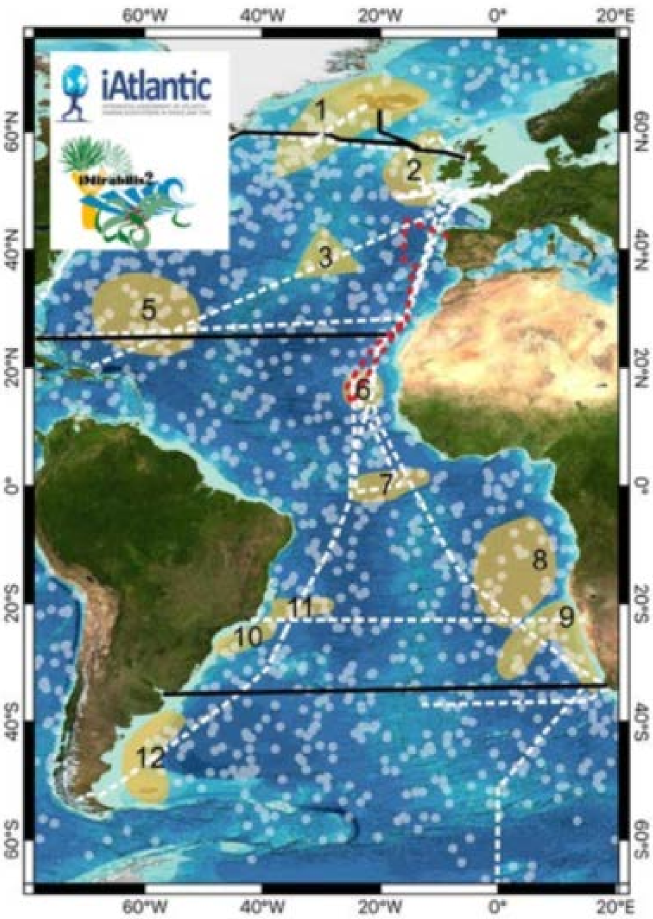
INFORMACIÓN GENERAL

FICHA TÉCNICA			
ACRÓNIMO	**iMIRABILIS2. Leg1**		
TÍTULO PROYECTO	*iAtlantic*		
CÓDIGO REN		CÓDIGO UTM	29SG20210801
JEFE CIENTÍFICO	Covadonga Orejas	INSTITUCIÓN	IEO
INICIO 1er LEG	Las Palmas de Gran Canaria(ESP) 01/8/2021	FINAL	Las Palmas de Gran Canaria(ESP) 30/8/2021
BUQUE	Sarmiento de Gamboa		
ZONA DE TRABAJO	Cabo Verde		
RESPONSABLE TÉCNICO	Pablo Rodríguez	Organización	U.T.M.
EQUIPO TÉCNICO	Roger Mocholí (UTM TIC), Pablo Rodríguez (UTM-Equipos Fijos), Ivan Mouzo (Equipos desplegables), Ivan Casal, Mario Sánches (Mecánica).		

2 CARACTERÍSTICAS DE CAMPAÑA



iMirabilis2 es una expedición internacional multidisciplinar con actividades que contribuyen a muchas tareas de los paquetes de trabajo de iAtlantic. Las actividades en el mar incluirán el estudio de la columna de agua de agua (por ejemplo, medición de parámetros ceanográficos, muestreo de agua y plancton) y el fondo marino. iMirabilis2 moviliza equipos de estudio del fondo marino de última generación, como el vehículo submarino autónomo (AUV) Autosub6000 (https://noc.ac.uk/facilities/marineautonomous-robotic-systems/autosubs) y el vehículo teledirigido (ROV) Luso (EMEPC, https://www.emepc.pt/rov-luso?lang=en).

Esta avanzada tecnología permitirá a iAtlantic explorar los ecosistemas bentónicos con gran detalle produciendo grandes resultados fotográficos de alta resolución de alta resolución que se procesarán automáticamente utilizando nuevos enfoques de aprendizaje automático. Los resultados de estos estudios se utilizarán para producir mapas de hábitat de alta resolución frente a Cabo Verde de los que actualmente se dispone de escasa información. Además, el ROV Luso permitirá recoger especímenes seleccionados con fines taxonómicos y de datación.

Además, durante la campaña se probarán nuevas tecnologías serán probadas durante iMirabilis_2, incluyendo el muestreador de ADN electrónico 'RoCSI', recientemente desarrollado por investigadores del Centro Nacional de Oceanografía (NOC, Reino Unido). También se desplegarán equipos fondeados temporales (landers) para obtener información in situ sobre parámetros medioambientales y la fauna de peces demersales de aguas profundas. El trabajo experimental ex situ incluye experimentos a corto plazo con especímenes recogidos con el ROV e incubaciones de muestras de sedimentos recogidos por el multicore.

Además, se han previsto actividades de divulgación, ya que un miembro de la expedición se dedicará por completo a estas actividades.

3.- INSTRUMENTACIÓN acústica

3.1.- Sonda multihaz de aguas profundas. Atlas HYDROSWEEP DS

DESCRIPCIÓN

La sonda multihaz Hydrosweep DS es una sonda multihaz de última generación, diseñada para realizar levantamientos batimétricos de fondos marinos hasta profundidades mayores de 11000 metros, cumpliendo las normativas IHO S44 para dichos levantamientos.

La Sonda multihaz Atlas Hydrosweep DS es un sistema completo que incluye desde los transductores hasta el procesado final de los datos y su impresión final.

El equipo está compuesto por los siguientes módulos:

Transductores: Instalados en una barquilla situada a proa del buque, a 6 m. de profundidad.

Transceptores: Es la electrónica de adquisición y tratamiento de los datos. La forman diferentes unidades:

AEU: Unidad de electrónica analógica. Contiene la electrónica de potencia (electrónica de transmisión y bloques de capacitadores) y recepción (preamplificadores, digitalizadores).

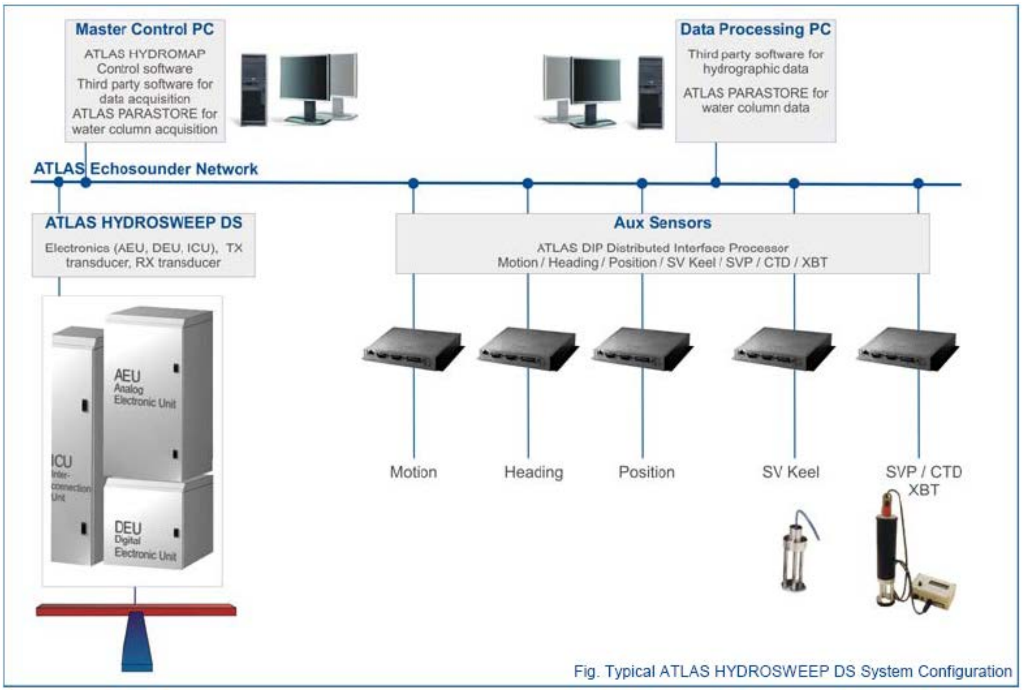
DEU: Unidad Digitalizadora. Incluye toda la unidad de tratamiento y filtrado de los datos adquiridos. También incluye las fuentes de alimentación de baja y alta tensión para el resto de unidades.

ICU: Unidad de interconexión.

Ordenador de Control: Gestiona la adquisición de los datos en diferentes formatos y controla la electrónica de adquisición.

Sensores auxiliares (posición, actitud, velocidad del sonido, etc): Se conectan a unidades independientes de adquisición (DIP) que re-envían la información a la red para que esté disponible para todos los instrumentos (Atlas MD, Atlas PS).

La adquisición de los datos brutos se hace con el software propio de Atlas (Atlas Naviscan), creando los ficheros (*.SBD). Se utiliza también un software externo, en este caso PDS de la casa Teledyne, creando ficheros (*.S7K) y (*.PDS).



Esquema del sistema. Atlas DS

Características técnicas

Frecuencia de emisión: 14.5 a 16 kHz.
Rango de operación: 10 a 11000 metros
Max. Range Resolution: 6.1 cm
Precisión: 0.5 m, 0.2% de la profundidad (2 sigma)
Longitud de pulso: 0.17 a 25 ms.
Frecuencia de muestreo: <12.2 Khz.
Máx. tasa de emisión: <10 Hz.
Cobertura máxima: 6 veces la profundidad, 20 km máximo. En esta campaña hemos estado en 5 veces la profundidad.
Nº de haces: 141 por hardware y 960 con High Order Beamforming.
Apertura del haz: 1º x 1º.
Espaciado de haces: Equi-angular, equidistante.
Estabilización
Telegramas de profundidad: Cabeceo, balanceo.
Software PDS: Cabeceo, balanceo, guiñada, altura de ola.
Interfaces:
Sensor de actitud Applanix POS-MV
Softtware de adquisición Teledyne PDS y Naviscan EIVA
Sensor de velocidad del sonido superficial
Sistema de navegación EIVA.
Parámetros de trabajo:

Operation		Sensor installation parameters:
Depth window:		TX Location:
Deep Search Window	Variable	X= 16.08 m.
Swath Width		Y=0.01
Variable (150-200%)		Z= 6.57
Beam pattern		RX Location:
Across beam spacing	Equal Footprint	X= 16.08 m.
Sidescan		Y=0.01
Coverage by swath		Z= 6.57

Port/Stdb: 300% - 8.000 m. Sounder Environment Bottom Source Depth Manual C Mean source: System C-Profile C-Keel source: System C-Keel Bottom Depths Manual Depth: 3000 m. Basic Settings Transmission sequence: Single pulse Transmission source level: Depth controlled Advanced settings Transmision Shading: Automatic	TX Offsets: Roll=-0.19 Pitch=2.15 Yaw=0.01 TX Offsets: Roll=-0.32 Pitch=2.48 Yaw=-0.10 Latency= 0.000 s

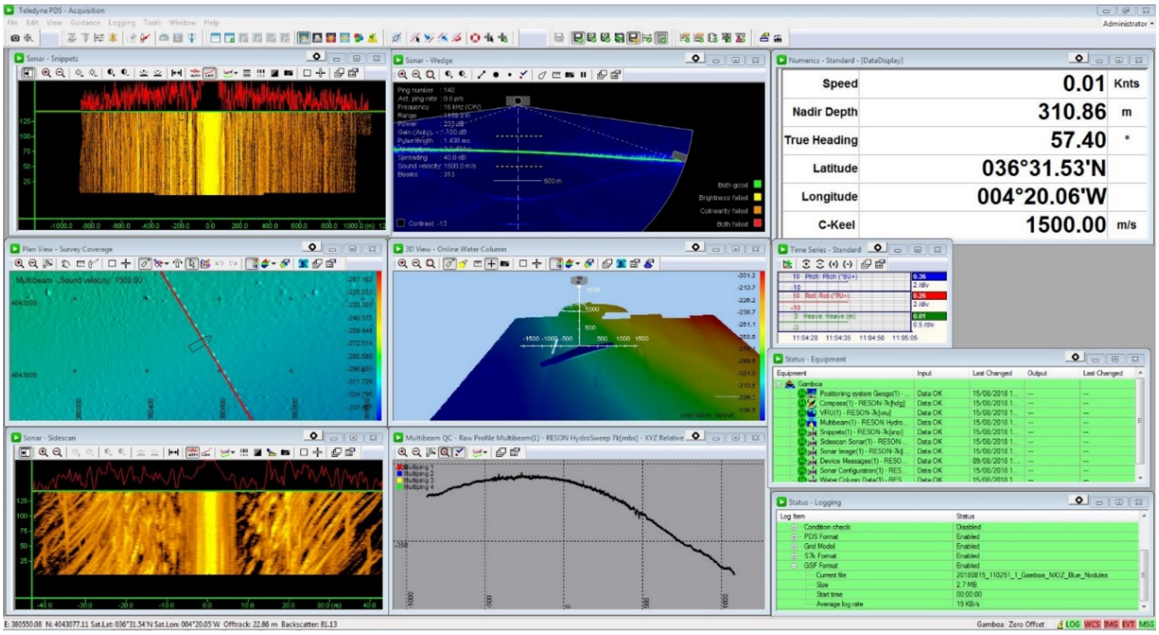


Imagen del funcionamiento en pantalla del sistema de adquiscion pds.

METODOLOGÍA

Se han realizado transectos alrededor de las islas y en la áreas de despliegue de los landers y del AUV para determinar las mejores posiciones en función de los objetivos de la campaña.

Se han utilizado los perfiles CTD para introducir los perfiles de velocidad del sonido, que no tenían mucha variabilidad

CALIBRACIÓN

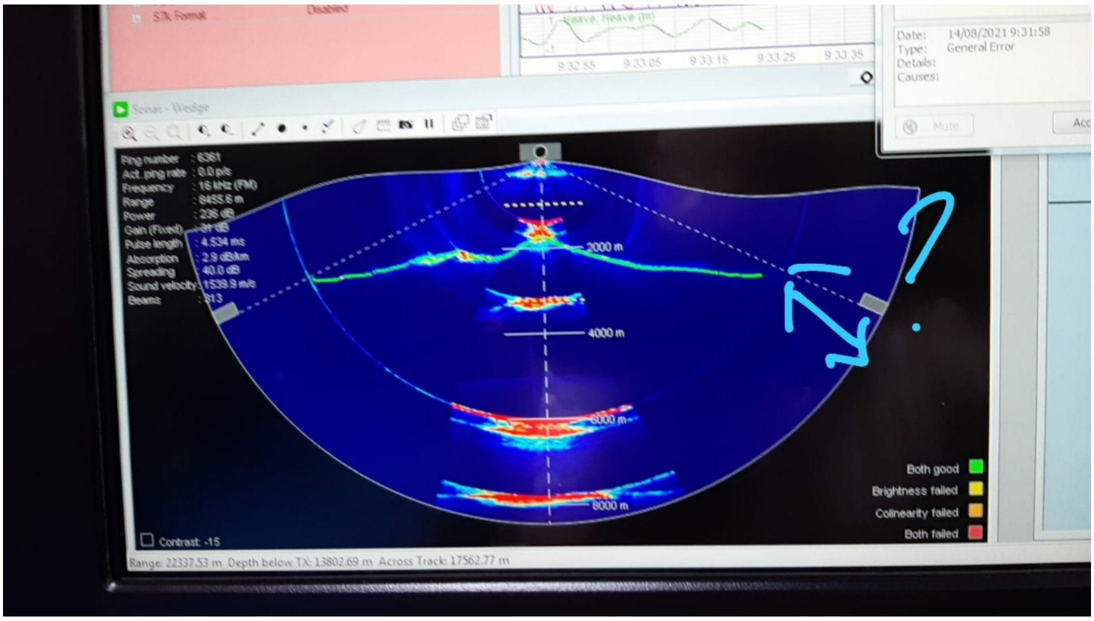
No se ha realizado calibración. Dos líneas realizadas en la zona abisal se pueden usar para calibración de roll

INCIDENCIAS

Se ha trabajado con la zona UTM 26N.

Se ha trabajado sin sincronizar

Se observa que trabaja con una tasa de disparo inferior a la óptima, se baja la cobertura y parece que funciona, pero no siempre es asi.   El problema parece venir de la comunicación entre el software de Atlas y PDS. Si se modifican los limites angulares desde el software de Atlas, en lugar de utilizar la interface gráfica de PDS si que se ajusta correctamente el pingrate y los dato son correctos.



Desde Reson se nos recomienda no trabajar **NUNCA** con la potencia al 100%. En lugar de esto recomiendan trabajar con amplitud controlada por la profundidad, los datos mejoran notablemente. En caso de necesitar amplitud constante para analizar el backscatter se recomienda poner la profundidad de referencia en manual (en lugar de controlada por el PHF) con una profundidad aproximada al máximo esperable en la zona de trabajo.

3.2 Sonda biológica Kongsberg ek60

Descripción

Se trata de una ecosonda científica de haz partido, lo cual permite determinar la distribución de tamaños de los blancos presentes en un volumen concreto. En el Sarmiento de Gamboa este ecosonda cuenta con cinco transductores (de 18, 38, 70, 120 y 200 kHz respectivamente), situados en la quilla de babor del barco, cinco transceptores (GPTs) situados en el local de ecosondas, y una unidad de procesado (ordenador) con el software de adquisición y procesado, situada en el laboratorio de equipos electrónicos.

Metodología

La sonda biológica EK60 se ha conectado para sustituir la sonda hidrográfica que falló en el Leg anterior, se ha utilizado como sondador convencional y para seguir las operaciones de muestreo Se ha utilizado solamente la frecuencia de 18 kHz

El software de adquisición de datos ha sido el Simrad ER60 2.2.1.

Las configuraciones utilizadas durante la campaña han sido las siguientes:

<u>18 kHz:</u>

Duración del pulso: 1024 microsegundos

Intervalo de muestra: 256 microsegundos

Ancho de banda: 1574 Hz

Potencia: 2000 W

Profundidad del transductor: 9.76 metros

3.3. Correntímetro doppler ADCP RDI- Ocean Surveyor 75 kHz

Descripción

El ADCP (Acoustic Doppler Current Profiler) de 75 kHz se ha empleado en la campaña tanto para el usual registro de datos de dirección e intensidad de corrientes.

El perfilador de corrientes por efecto Doppler es un equipo que nos da las componentes de la velocidad del agua en diferentes capas de la columna de agua. El transductor está instalado en la quilla retráctil de babor. El sistema consta de un transductor que emite ondas acústicas, una unidad electrónica que genera los pulsos y pre-procesa las ondas recibidas, y un PC que adquiere los datos y los procesa.

El ADCP utiliza el efecto Doppler transmitiendo sonido a una frecuencia fija y escuchando los ecos retornados por los reflectores en el agua. Estos reflectores son pequeñas partículas o plancton que reflejan el sonido hacia el ADCP. Estos reflectores flotan en el agua y se mueven a la misma velocidad que el agua. Cuando el sonido enviado por el ADCP llega a los reflectores, éste está desplazado a una mayor frecuencia debido al efecto Doppler, este desplazamiento frecuencial es proporcional a la velocidad relativa entre el ADCP y los reflectores. Parte de este sonido desplazado frecuencialmente es reflejado hacia el ADCP donde se recibe desplazado una segunda vez. La fórmula que relaciona la velocidad con la frecuencia es:

$F_d=2\ F_s\ (V/C)$

Donde:

$\mathbf{F_d}$ es el desplazamiento Doppler en frecuencia

$\mathbf{F_s}$ es la frecuencia del sonido cuando todo está en calma

V es la velocidad relativa (m/seg)

C es la velocidad del sonido (m/seg)

Para poder calcular los vectores tridimensionales de la corriente necesitamos tener tres haces de sonido apuntando en diferentes direcciones. El equipo instalado en el Sarmiento de Gamboa dispone de cuatro haces, un par produce una componente horizontal y una vertical, mientras el otro par de haces produce una segunda componente horizontal perpendicular, así como una segunda componente vertical de la velocidad. De esta forma tenemos dos velocidades horizontales y dos estimaciones de la velocidad vertical para las tres componentes del flujo. Con las dos estimaciones de la velocidad vertical podemos detectar errores debidos a la no homogeneidad del agua, así como fallos en el equipo.

Metodología

El ADCP de 75KHz se ha utilizado para obtener datos acerca de la intensidad y dirección de las corrientes marinas. La frecuencia de trabajo fue de 75 kHz, utilizándose una configuración durante toda la campaña.

Devido a la cantidad de estaciones en las que era necesario desconectar los equipos acústicos, solamente se ha conectado el equipo en el tránsito de regreso a las Palmas de GC.

El software de adquisición de datos ha sido el Vm-Das 1.46.

El archivo de configuración que se ha utilizado es el mismo que el de la campaña Medwaves: ---------------
---\

```
; ADCP Command File for use with VmDas software.
;
; ADCP type:     75 Khz Ocean Surveyor
; Setup name:    default
; Setup type:    High resolution (broadband) and long range profile (narrowband)
;
; NOTE:  Any line beginning with a semicolon in the first
;        column is treated as a comment and is ignored by
;        the VmDas software.
;
; NOTE:  This file is best viewed with a fixed-point font (e.g. courier).
; Modified Last: 12August2003
;----------------------------------------------------------------------------/
; Restore factory default settings in the ADCP
cr1
; set the data collection baud rate to 38400 bps,
; no parity, one stop bit, 8 data bits
; NOTE:  VmDas sends baud rate change command after all other commands in
; this file, so that it is not made permanent by a CK command.
cb611
; Set for narrowband single-ping profile mode (NP), one hundred (NN) 16 meter bins (NS),
; 8 meter blanking distance (NF)
NP00001
NN100
NS0800
NF0800
; Set for broadband single-ping profile mode (WP), one hundred (WN) 4 meter bins (WS),
; 8 meter blanking distance (WF), 390 cm/s ambiguity vel (WV)
WP00001
WN125
WS0800
WF0800
WV390
; Enable single-ping bottom track (BP),
; Set maximum bottom search depth to 1200 meters (BX)
BP000
BX12000
; output velocity, correlation, echo intensity, percent good
WD111100000
;ND111100000
; One and a half seconds between bottom and water pings
TP000000
; Zero seconds between ensembles
; Since VmDas uses manual pinging, TE is ignored by the ADCP.
; You must set the time between ensemble in the VmDas Communication options
TE00000000
; Set to calculate speed-of-sound, no depth sensor, external synchro heading
; sensor, no pitch or roll being used, no salinity sensor, use internal transducer
; temperature sensor
```

```
EZ1020001
; Output beam data (rotations are done in software)
EX00000
; Set transducer misalignment (hundredths of degrees)
EA04513
; Set transducer depth (decimeters)
ED00045
; Set Salinity (ppt)
ES36
; save this setup to non-volatile memory in the ADCP
CK
```

3.4. Posicionamiento SUBMARINO HIPAP 452

Descripción:

El sistema de posicionamiento submarinos HiPAP proporciona posiciones de precisión de elementos sumergidos (ROV’s, AUVs, plataformas remolcadas, etc.) a partir de la medición de los tiempos y ángulos de llegada de una señal acústica emitida por uno (o varios) traspondedor/es submarinos. (Fig 6.1)
El sistema instalado en el BO Sarmiento de Gamboa es un Hipap 452, actualizado para tenrer una cobertura de 200º
El sistema instalado a bordo del BO Sarmiento de Gamboa es similar al de la Fig 6.2. con una unidad de casco (hoist) propia

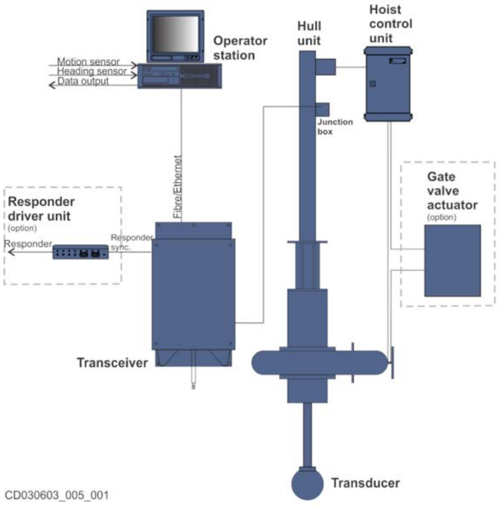


Fig. 6. 2

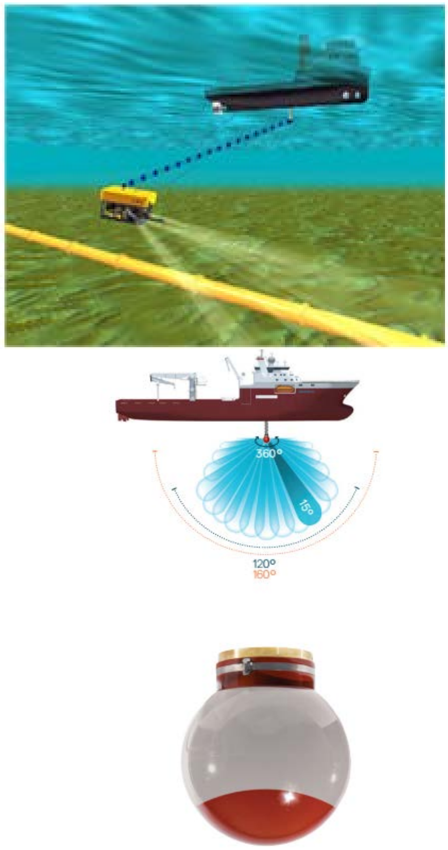


Fig. 6. 1

Caracterísitcas Técnicas:

Transceptor HiPAP 452.

Datos del fabricante.

	HiPAP 352/452 Single system
S/N [dB rel. 1µPa]	20
Angular accuracy (X & Y direction) [°]	0.1
Range accuracy, Cymbal [m]	0.02
Angular repeatability up to [°] S/N 30 dB rel. 1µPa	0.018
Receiver beam [°]	15
Operational coverage [°]	±90
Main coverage [°]	±80

Fig. 6.4. Caracterísiticas Generales.

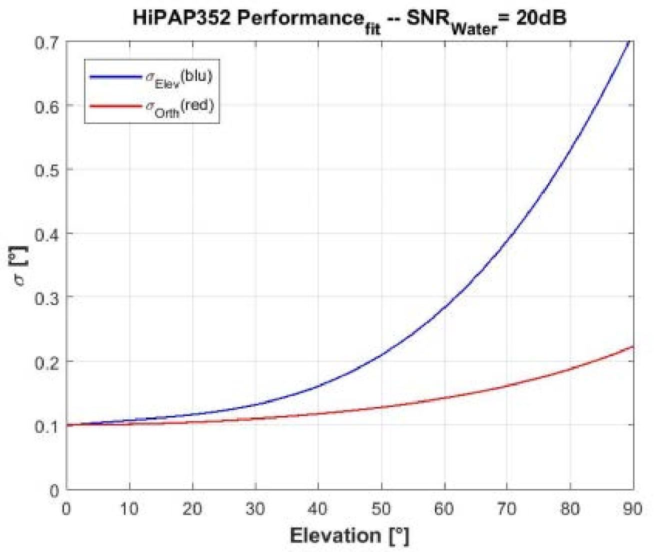


Fig. 6.5. Precisión en función del ángulo de elevación.

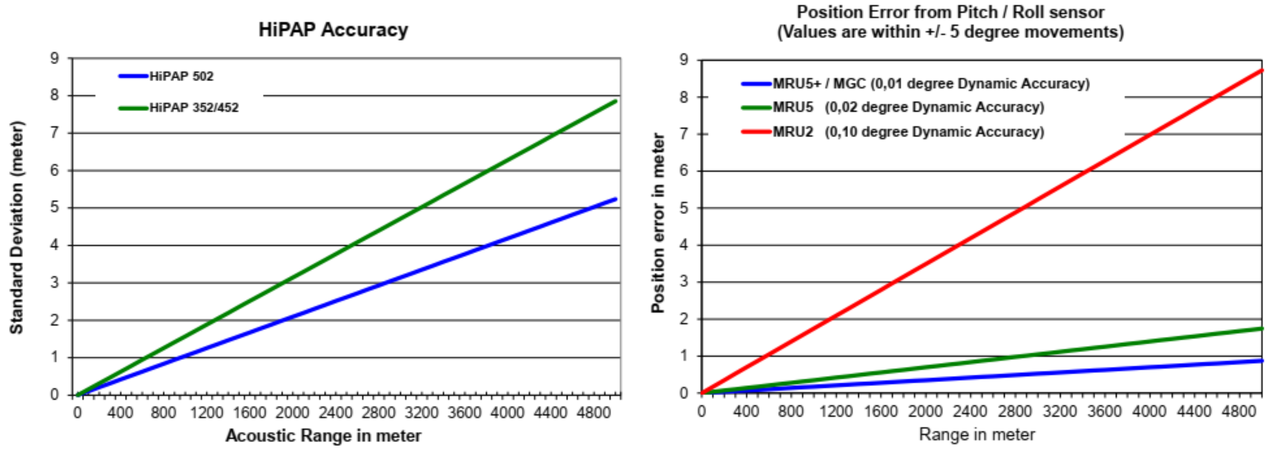


Fig. 6.6. Precisión en función del alcance y capacidad de la MRU.

Traspondedor CNode MiniS:

Los traspondedores KS CNode son una familia de traspondedores con estructura modular que permiten adaptarlos a diferentes metodología y usos. Pueden instalarse en instalaciones fijas submarinas, boyas o vehículos y permiten la transmisión simultánea de señal de posicionamiento (USBL, SSBL o LBL) así como de datos, de sensores internos o externos o la comunicación entre diferentes traspondedores..

Metodología:
Antes de cada inmersión se baja el transductor situado en un poste retráctil en la parte media del buque, de este modo se minimiza el ruido acústico, también se apagaban todos los equipos acústicos. El funcionamiento de HiPaP ha sido excelente en todo momento.
El equipo Autosub tiene instalado un usbl Sonardyne Ranger, compatible con los canales fsk de HiPAP.
Se han habilitado los siguientes canales:
M22 y M50 : Para uso del ROV
B45: Para uso del autosub
El seguimiento del ROV ha sido efectivo desde los 25-30 m. de profundidad.

Incidencias:
En una ocasión el traspondedor no funcionó una vez sumergido, se izó de nuevo a cubierta, se limpió el conector y al volver a lanzar funcionó normalmente. Suponemos que al estar descubierto durnate la noche algo de sal s e depositó sobre los pines del conector y no cerraba bien el contacto de arranque.
Se instaló un segundo traspondedor (M50) de respeto en caso de que fallara el primero (M20).
Al intentar cargar el Traspondedor M24 dio fallo de carga utilizando dos cargadores distintos, se enviará al fabricante para revisión.
Ninguna incidencia reseñable más.

500 canales Cymbal Modo responder / trasponder Posicionamiento LBL y SSBL Porf. Máxima: 4000 m.	Sensor interno de inclinación Cobertura: 40º Frecuencia: 21 – 31 kHz. Temp. De operación: -5º / +55ºC Autonomía (Cymbal) : 2 a 7 dias

4.- Applanix POS MV

Introducción

El POS-MV es el sensor de actitud de la instrumentación científica del barco. Consta de dos antenas GPS, situadas en el sobrepuente, una unidad central y su pantalla, situadas en el rack de proa del laboratorio de Equipos Electrónicos Proa (Sondas) y la VRU situada en el local de gravimetría.

El equipo toma datos del GPS y de la VRU (Unidad de referencia vertical) que da información sobre la actitud del barco, cabeceo, balanceo, oleaje. Procesa los datos y genera telegramas NMEA heading, actitud y de posición, que se reparten por todo el barco a través de unas cajas con puertos serie también se reparten los telegramas vía Ethernet.

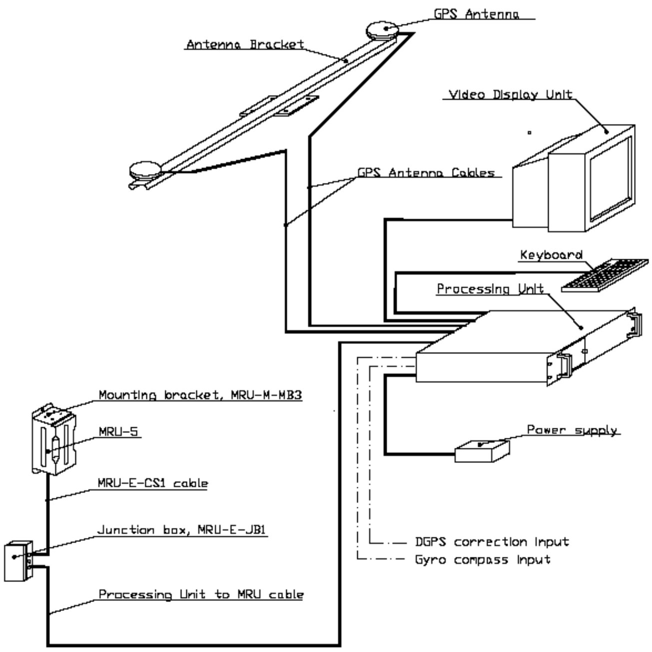
La posición que proporciona el POS-MV corresponde al centro de gravedad del Barco (MRU en el local de gravimetría).

Descripción del sistema

Las antenas GPS proporcionan la información de Heading, velocidad, posición y tiempo, mientras que la VRU proporciona la información de actitud.

Para asegurar que las marcas de tiempo son correctas, el PPS del GPS se utiliza como tiempo de referencia tanto para la unidad central como la VRU.

La información de POS-MV esta disponible en la pantalla y en 5 Leds situados en la unidad central. Los Leds indican el estado de la unidad.



Esquema de la instalación del POS-MV.

Características técnicas

Precisión del cabeceo y balanceo: 0.02º RMS (1 sigma)

Precisión de altura de ola: 5 cm o 5% (el que sea mayor)

Precisión del rumbo: 0.01º (1 sigma)

Precisión de la posición: 0,5 a 2 m (1 sigma) dependiendo de las correcciones

Precisión de la velocidad: 0,03 m/s en horizontal

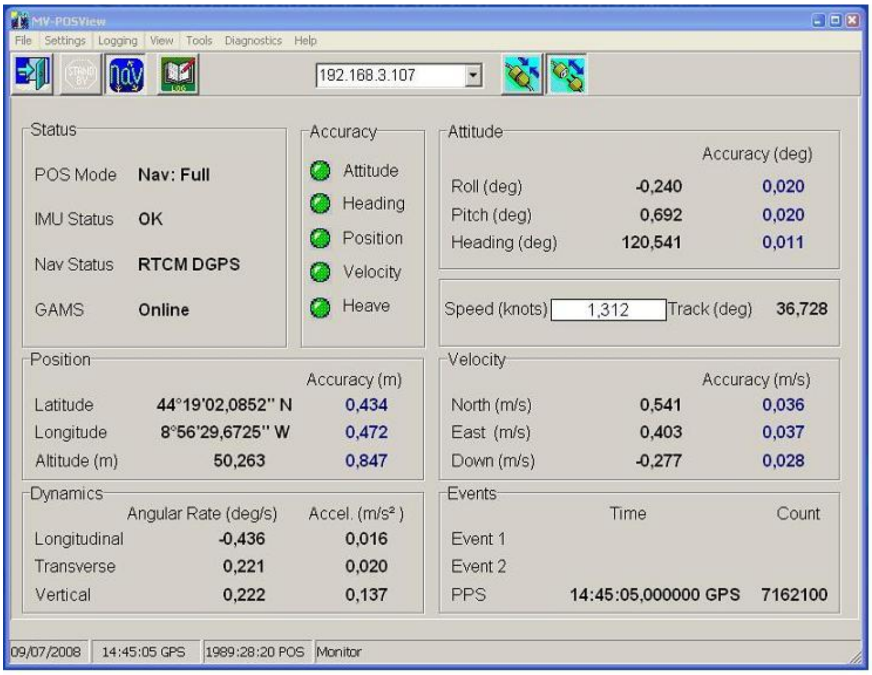


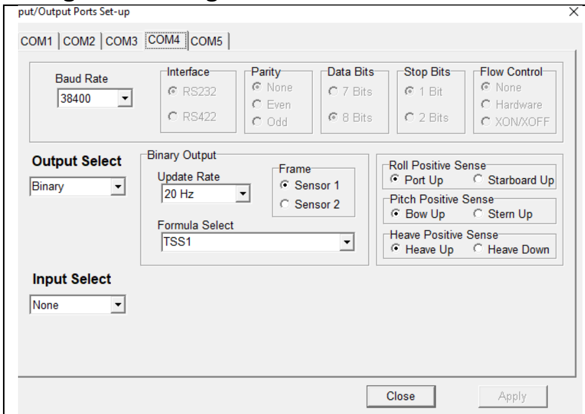
Imagen de la pantalla principal del POS-MV

Incidencias

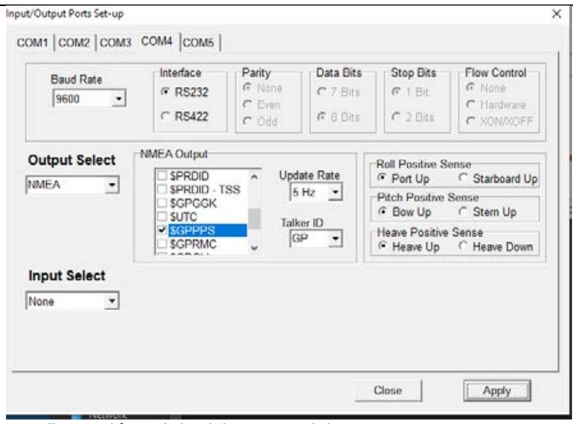
Ninguna.

Metodología

El equipo se ha llevado encendido con la configuración normal, excepto por el puerto COM4 wque se ha configurado de manera especial para enviar información al ROV. Al finalizar la campaña se restauró la configuración original.



Configuración para la campaña



Configuración original (restaurada)

5.- SISTEMA DE NAVEGACIÓN EIVA

Descripción

El sistema de navegación EIVA consta de un ordenador con S.O. Windows, los datos de los diferentes sensores le llegan vía Ethernet y serie. Con estos datos y un software especifico, el programa genera una representación georreferenciada de la posición del barco y crea una serie de telegramas que alimentan a diferentes sistemas e instrumentos.

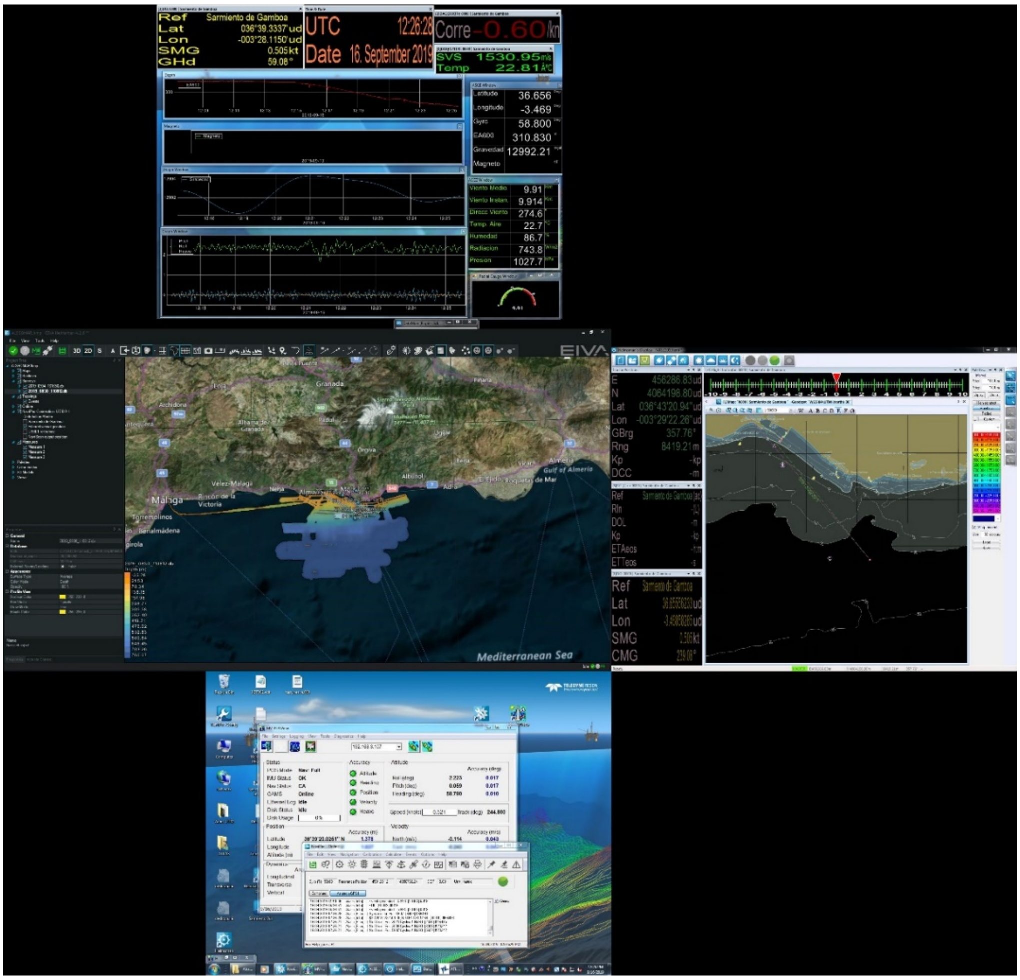
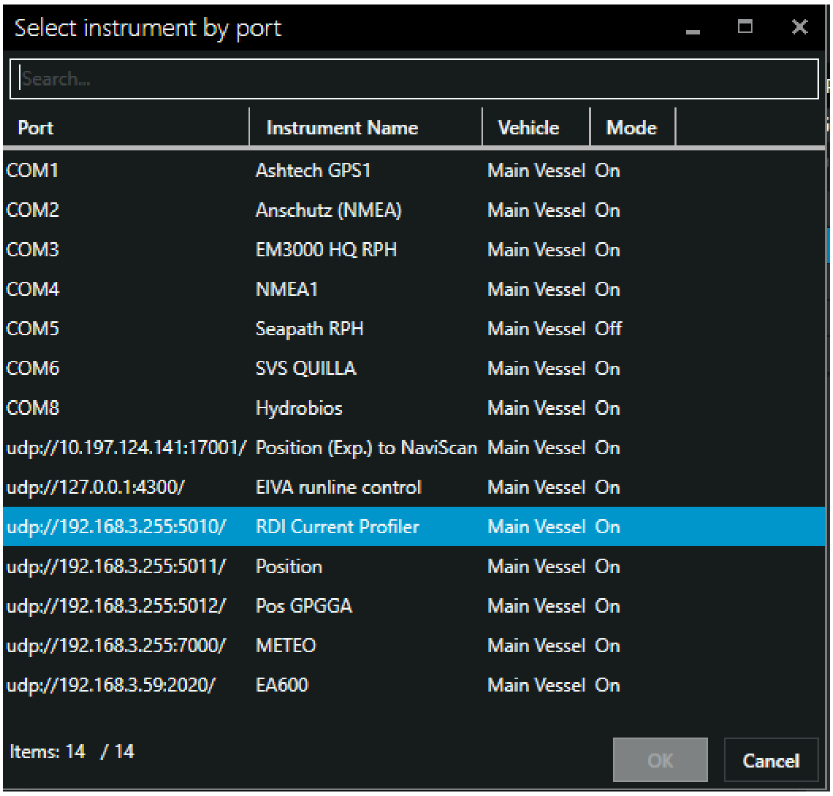


Imagen del navegador Eiva,

Los sensores de entrada son los siguientes:



Port	Instrument Name	Vehicle	Mode
COM1	Ashtech GPS1	Main Vessel	On
COM2	Anschutz (NMEA)	Main Vessel	On
COM3	EM3000 HQ RPH	Main Vessel	On
COM4	NMEA1	Main Vessel	On
COM5	Seapath RPH	Main Vessel	Off
COM6	SVS QUILLA	Main Vessel	On
COM8	Hydrobios	Main Vessel	On
udp://10.197.124.141:17001/	Position (Exp.) to NaviScan	Main Vessel	On
udp://127.0.0.1:4300/	EIVA runline control	Main Vessel	On
udp://192.168.3.255:5010/	RDI Current Profiler	Main Vessel	On
udp://192.168.3.255:5011/	Position	Main Vessel	On
udp://192.168.3.255:5012/	Pos GPGGA	Main Vessel	On
udp://192.168.3.255:7000/	METEO	Main Vessel	On
udp://192.168.3.59:2020/	EA600	Main Vessel	On

El programa recoge todos los datos de los sensores que le llegan por los diferentes puertos y los representa en pantalla, sobre un sistema geodésico elegido anteriormente.

Para facilitar la navegación, en el puente hay un monitor repetidor del navegador.

Incidencias

Durante toda la campaña se trabajó con la proyección, UTM 29N

El sistema ha dejado de funcionar durante breves momentos en dos ocasiones durante la campaña. Ha sido necesario reiniciarlo completamente .

6.- Perfilado de la Velocidad del Sonido de la columna de agua.

En la campaña iMirabilis2 solo se han utilizado una sonda desechable batitermográficas para obtener los valores de la velocidad del sonido de la columna de agua. El resto de perfiles se han obtenido a partir de los perfiles CTD realizados o perfiles sintéticos obtenidos a partir de la base de datos WO9/WO13 con el programa Sound Velocity Manager

Sondas batitermográficas xbt

Descripción

El sistema de adquisición de datos oceanográficos SIPPICAN MK-21 utiliza un PC estándar y un conjunto de sondas desechables para medir y visualizar parámetros físico-químicos del océano, tales como temperatura (sondas XBT), velocidad del sonido (sondas XSV), conductividad y salinidad (XCTD). El sistema realiza la adquisición, presentación y almacenamiento de los datos en tiempo quasi-real, permitiendo una presentación posterior de los datos para su análisis.

Especificaciones

EXPENDABLE BATHYTHERMOGRAPH (XBT)

	APPLICATIONS	MAXIMUM DEPTH	RATED SHIP SPEED*	VERTICAL RESOLUTION
T-4	Standard probe used by the US Navy for ASW operations	460 m 1500 ft	30 knots	65 cm
T-5	Deep ocean scientific and military applications	1830 m 6000 ft	6 knots	65 cm
Fast Deep™	Provides maximum depth capabilities at the highest possible ship speed of any XBT	1000 m 3280 ft	20 knots	65 cm
T-6	Oceanographic applications	460 m 1500 ft	15 knots	65 cm
T-7	Increased depth for improved sonar prediction in ASW and other military applications	760 m 2500 ft	15 knots	65 cm
Deep Blue	Increased launch speed for oceanographic and naval applications	760 m 2500 ft	20 knots	65 cm
T-10	Commercial fisheries applications	200 m 660 ft	10 knots	65 cm
T-11 (Fine Structure)	High resolution for US Navy mine countermeasures and physical oceanographic applications	460 m 1500 ft	6 knots	18 cm

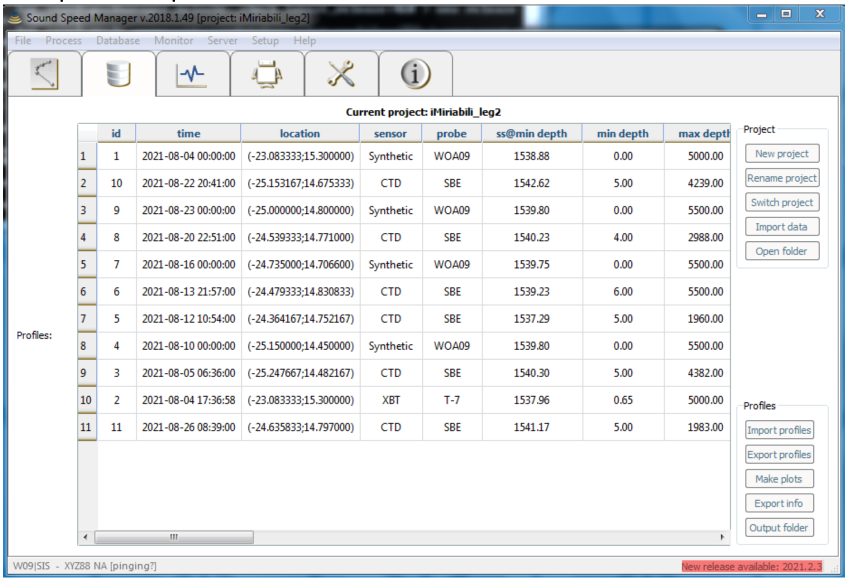
EXPENDABLE SOUND VELOCIMETER (XSV)

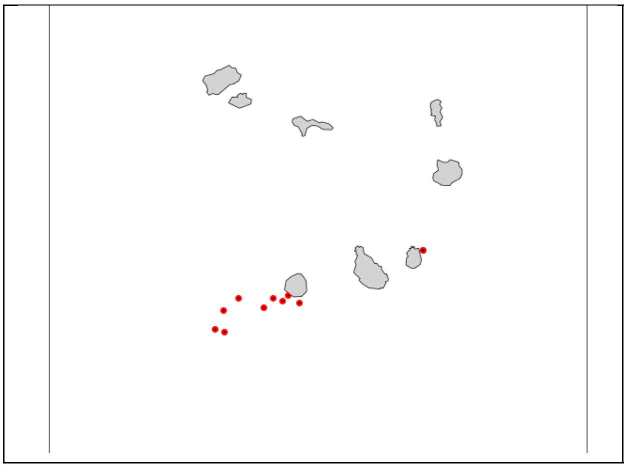
	APPLICATIONS	MAXIMUM DEPTH	RATED SHIP SPEED*	VERTICAL RESOLUTION
XSV-01	ASW application where salinity varies; Naval and civilian oceanographic and acoustic applications	850 m 2790 ft	15 knots	32 cm
XSV-02	Increased depth for improved ASW operation where salinity varies; Naval and civilian oceanographic and acoustic applications	2000 m 6560 ft	8 knots	32 cm
XSV-03	High resolution data for improved mine counter-measures and ASW operations in shallow water; geophysical survey work; commercial oil industry support	850 m 2790 ft	5 knots	10 cm

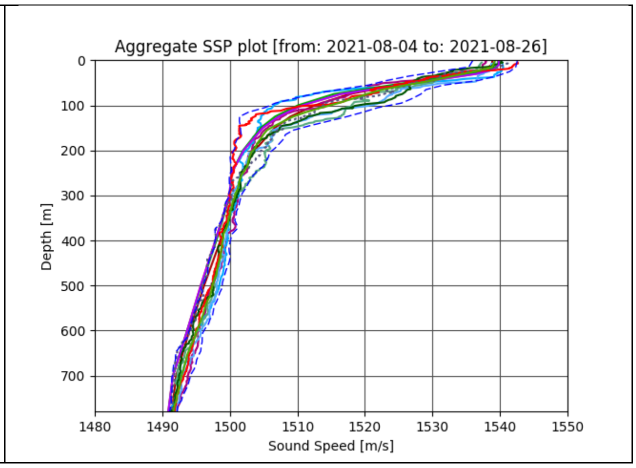
System depth accuracy: 4.6 meters or 2% of depth; whichever is larger (for XSV).
*All probes may be used at speeds above rated maximum, however there will be a proportional reduction in depth capability.
All probes are shipped 12 to a case which is constructed of weather-resistant biodegradable material. Shipping weight varies from 25 lbs. to 43 lbs. depending on probe type. Dimensions of the case vary from 17" X 14" X 18" (2.3 cu. ft.) to 17" X 14" X 19" (2.6 cu. ft.).

Metodología
Solamente se ha realizado un lanzamiento de una sonda xbt07, complementándose el perfil conla base de datos WO9
Loas lanzamientos se han realizado desde la banda de babor con el lanzador de mano.

Para la evaluacion de los perfiles de velocidad del sonido se han utilizado fundamentalmente perfiles de CTD con la velocidad del sonido calculada y perfiles generados a partir de la Base de Datos WOA9 y WOA13 mediante el programa SoundSpeed Manager. En la imagen solo se muestran los perfiles en tiempo de adquisición.



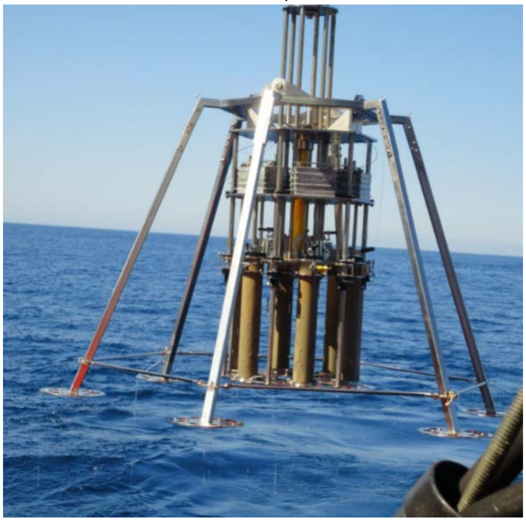




6.1.4.-Incidencias
Ninguna

7. Informática y comunicaciones

8. MUESTREO
En ésta campaña se han desplegado los siguientes equipos:
8.1. MULTICORER
Descripción
Modelo 70.000 KC Denmark ® 6xØ 100mm; fabricante Kc Denmark:



Consta de una estructura en acero inox con 6 tubos de policarbonato de alta resistencia de Ø100mm para la recogida de testigos de sedimento en todas las profundidades. Su funcionamiento es el siguiente:

Al posarse la estructura en el fondo del mar, su núcleo interno el cual va provisto de una serie de planchas de plomo y un cilindro hidráulico, se desplaza hacia la parte inferior penetrando así los tubos en el sedimento con la ayuda de las planchas de plomo. El cilindro hidráulico trabaja como un amortiguador contra los impactos que produciría al posarse y levantarse del fondo.

Una vez se empieza subir, el núcleo interno se desplaza nuevamente a la parte superior, desenterrando así los tubos del fondo marino, y con un mecanismo de cierre, se cerrarán los tapones de la parte superior de los tubos haciendo así un efecto de vacío, mientras tanto en la parte inferior unas guillotinas cerrarán enérgicamente los tubos finalizado el proceso.

Metodología

Una vez armado comenzamos la maniobra, quitamos los pasadores de seguridad y la ponemos en el agua bajando a 10 m/min durante los primeros 20-30 m y aumentando después la velocidad hasta unos 40-50 metros/minuto.

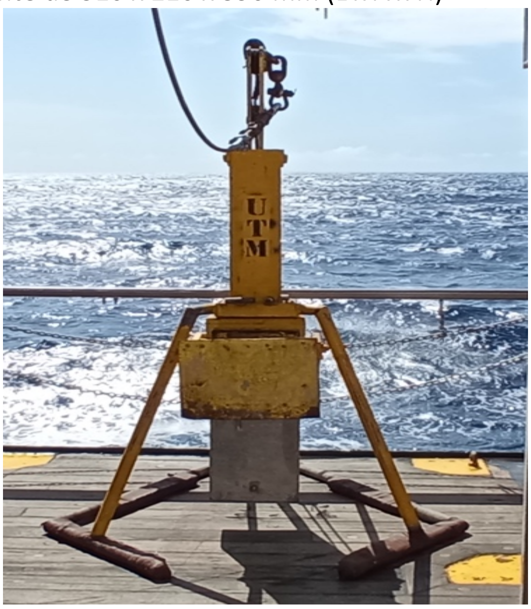
Una vez ha tocado fondo se para y se cobra a la velocidad más baja posible hasta que haya despegado del fondo, momento en el que podremos subir la velocidad a unos 40-50 m/min. Hasta superficie.

Una vez en cubierta se colocan los pasadores de seguridad y se deja que el cable pierda tensión para proceder a la extracción de los tubos y a su posterior muestreo.

8.2. BOX CORER

Descripción del Equipo

La Box Corer es un equipo que permite la obtención de muestras estratificadas de los sedimentos mediante un recipiente de 310 x 210 x 590 mm (L x A x H)



Metodología

Maniobra de largado:

Se coloca la Caja en la estructura soporte y se abre el basculante hasta que se pueda fijar el soporte de tiro con el disparador. Este se sujeta hasta que el chigre coge tensión y no deja que el émbolo se dispare.

Llegado a este punto y con el equipo en tensión se sacan los pasadores del eje central y se comienza la maniobra de puesta en el agua y largado.

Una vez en el agua se resetean los metros de cable y se comienza a largar a 10 m/min unos 40 m y después se aumenta la velocidad a 40 m/min.

Monitorizamos la bajada mediante la sonda EK Monohaz y controlamos la llegada al fondo mediante la sonda y la perdida de tensión del cable. En bajas profundidades también se percibe un movimiento en la pasteca.

Al posar su estructura en el fondo la caja central se desplaza y penetra en el sedimento gracias a la velocidad de largado y al peso del eje central, el soporte de tiro pierde tensión y deja que el bulón se libere mediante un muelle que tira de él. Esto permite que al tirar con el chigre el cable liberado tire mediante un juego de poleas del basculante, haciendo que este cierre la caja por debajo y guarde la muestra de sedimento hasta la superficie.

Maniobra de cobrado:

Se comienza a cobrar a 10 m/min hasta que se nota el máximo pico de tensión. Se recuperan 20 m más por seguridad a esta velocidad y se comprueba en la sonda que ha despegado del suelo. Cuando todo esto se cumpla aumentamos la velocidad a 40 m/min hasta la superficie.

Una vez en cubierta colocamos el pasador en el basculante antes de dejar que pierda tensión y también los pasadores del eje central. Con todas las seguridades puestas, apoyamos del todo el equipo en cubierta hasta que el cable pierda la tensión y podemos comenzar el proceso de extracción de la caja para su posterior muestreo.

PUNTOS DE MUESTREO REALIZADOS

Station number	Gear	Gear Number	Start Date	Start Time	End Time	Depth
3	MUC	1	04/08/2021	2:42	3:33	876
4	MUC	2	04/08/2021	4:21	5:06	876
5	MUC	3	04/08/2021	5:13	6:07	876
6	MUC	4	08/08/2021	6:26	7:18	876
20	BC	1	08/08/2021	11:22	13:57	2797
21	BC	2	08/08/2021	15:14	17:32	2548
22	BC	3	08/08/2021	18:57	21:51	1750
29	MUC	5	10/08/2021	19:34	0:26	4395
41	BC	4	14/08/2021	7:31	9:42	1800
42	BC	5	14/08/2021	10:19	12:33	1791
52	BC	6	16/08/2021	11:32	14:23	2447
62	BC	7	19/08/2021	4:30	8:17	3185
65	MUC	6	20/08/2021	2:10	5:47	3184
66	MUC	7	20/08/2021	7:05	10:05	2584
80	MUC	8	23/08/2021	1:03	5:52	4276
82	MUC	9	23/08/2021	17:47	22:27	4088

*MUC: Multicorer; BC:Box Corer

8.3. Incidencias

En la tercera maniobra de Multicorer el Chigre de Corer ha comenzado a dar algunos fallos en la regulación del par provocando la parada de éste en algunas fases de la maniobra.

Debido a que se escucha un ligero ruido en el interior del motor durante su funcionamiento hemos trabajado a la velocidad máxima de 30 m/min y no se ha vuelto a escuchar. También se limitó la profundidad máxima de trabajo a 2500 m. inicialmente, ampliándose en la medida que el problema no iba a más.

Este problema habrá que revisarlo a la llegada a puerto con los técnicos de IBERCISA.

9. Equipamiento de laboratorio

Durante la campaña que nos ocupa, el personal científico ha estado utilizando algunos de los laboratorios fijos del barco. Dado que en esta campaña no se embarcaba ningún técnico de laboratorio antes de la salida se realizó una revisión de los procedimientos de arranque y funcionamiento de los equipos solicitados. Finalmente se han utilizado algunos equipos adicionales (mufla y baño termostático) aunque solamente para realizar unas acciones muy determinadas y duranate un periodo de tiempo muy breve.

LABORATORIO PRINCIPAL
En el laboratorio principal se ha trabajado con los siguientes instrumentos pertenecientes a la UTM:
Destilador Milli-Q Advantage A10 (Millipore)

Número de serie: F6NN74065A
Descripción: Equipo generador de agua ultrapura Milli-Q.
Características técnicas:
Resistividad del agua producida: >18 MΩ.cm
Conductividad del agua producida: 1-0.055 µS/cm
TOC: 1-999 ppb
Caudal de distribución: 0.5-3 L/min
Filtro final de 0.22 µm

Milli-Q Advantage

Dispensador Q-Pod

Incidencias:
Ninguna

Estufa bacteriológica Incudigit 80L (JP Selecta)
Número de serie: 0485522
Descripción: Estufa para la incubación de cultivos biológicos.
Características técnicas:

-Capacidad: 80 L
-Temperatura máxima: 80 ºC
-Homogeneidad: ±2 %
-Estabilidad: ±0.25 ºC
-Error de consigna: ±2 %
-Resolución: 0.1 ºC
-Medidas interiores (WxHxD): 50x40x40 cm
Se ha mantenido encendida como respeto a la otra, pero no se han desecado muestras.

Estufa desecación Digitronic 80L (JP Selecta)
Número de serie: 0487147
Descripción: Estufa para secar instrumental y muestras húmedas.
Características técnicas:

-Capacidad: 76L
-Temperatura máxima: 250ºC
-Estabilidad: 0.5ºC
-Homogeneidad: 1.25ºC hasta 50ºC, 2.5ºC hasta 100ºC, 6.25ºC hasta 250ºC
-Error de consigna: 1ºC hasta 50ºC, 2ºC hasta 100ºC, 5ºC hasta 250ºC
-Dimensiones interiores (WxHxD): 50x38x40 cm
Hemos tenido problemas para mantener la pregunta estable, muy probablemente por desconocimiento del operador más que por fallo del equipo.

LABORATORIO DE ANÁLISIS
En el laboratorio de análisis se han utilizado los siguientes equipos pertenecientes a la UTM:

Destilador Milli-Q Advantage A10 (Millipore)
Número de serie: F6NN74065F
Descripción: Equipo generador de agua ultra pura Milli-Q.
Características técnicas:
-Resistividad del agua producida: >18 MΩ.cm
-Conductividad del agua producida: 1-0.055 µS/cm
-TOC: 1-999 ppb
-Caudal de distribución: 0.5-3 L/min
-Filtro final de 0.22 µm

LABORATORIO DE QUÍMICA
En el laboratorio de química se han utilizado los siguientes equipos de la UTM:
Campana extractora Flowtronic (Burdinola)

Descripción: Vitrina para manipular productos tóxicos y proteger al trabajador.
Características técnicas:
-Extracción de gases regulable
-Luz interior

-Guillotina con ventanas correderas
-Dimensiones 80x180x75 cm

LABORATORIO DE DISECCIÓN
Este laboratorio ha sido usado por el equipo investigador para pesar especímenes atrapados en la trampa fondeada

ALMACÉN DE MUESTRAS E INCUBADORAS
Este almacén consta de tres cámaras:
- PRECÁMARA: Espacio en el cual está dispuesto el siguiente equipamiento:
Ultracongeladores MDF-593 (Sanyo) X2
Número de serie: 60711453 y 60711452
Descripción: Equipo que permite mantener las muestras a -80 ºC.
Características técnicas:
-Tamaño interno (WxDxH): 1280x500x762 mm
-Capacidad efectiva: 487 L
-Control de temperatura: de -20 hasta -85 ºC
-Sensor de temperatura: Pt100

Cámara de congelados: Espacio destinado a mantener las muestras a temperatura de congelación. En este caso se ha programado a -20 ºC.
Cámara fría: Espacio destinado a mantener las muestras frescas. En este caso se ha programado a 4 ºC.

LABORATORIO TERMORREGULADO

El laboratorio termorregulado se ha mantenido a 21 ºC. En este espacio se han montado unos acuarios para monitorizar especímenes recogidos con el ROV. Los acuarios se montaron encima de las poyatas con protección para salpicadoras (que no se han producido)

Equipo de superclima Comptrol 1002 (Stulz)
Número de serie: 0530050511/01
Descripción: Equipo de climatización ambiental que permite mantener unas condiciones de temperatura y humedad controladas en todo el laboratorio.
Características técnicas:
-Rango de valores de temperatura: 10-30 °C
-Rango de valores de humedad: 10-90 %
-Ventilación ajustable
Incidencias
Al poner en marcha el equipo y verificar su funcionamiento se observó que la cámara no enfriaba y el equipo no funcionaba a la temperatura de consigna. Se reseteó el equipo y funcionó correctamente.

LOCAL DE AGUA DESTILADA

En este local están dispuestos dos generadores de agua destilada que alimentan a todos los laboratorios del barco. Durante esta campaña se ha trabajado todo el tiempo con el destilador situado a proa del local.

Destilador de agua Elix 10 Reference (Millipore) x2
Número de serie: FJPA52255C / F4EA26702
Descripción: Generador de agua destilada. Estos equipos disponen de un tanque de reserva 200 L cada uno y de bombas impulsoras que envían el agua destilada a todos los laboratorios.
Características técnicas:
-Capacidad de producción: 10 L/h
-Resistividad del agua producida: > 15 MΩ/cm
-COT< 30 ppb

Incidencias y mantenimientos
Ninguno

CONTINUO

Captación de agua de mar en continuo

En la cubierta de máquinas, en proa, existe una captación que toma el agua de mar a una profundidad de unos 4,5 m. A partir de aquí, el agua es impulsada empleando una bomba con el rotor de teflón y, a través de un sistema de tuberías de polietileno de alta densidad, es distribuida por todos los laboratorios. Existen dos bombas, de las cuales se utiliza solamente una de ellas y la otra se mantiene de respeto, si bien es posible poner ambas bombas al mismo tiempo en caso necesario.

Este sistema se utiliza durante todas las campañas de oceanografía química, física y biológica y la UTM registra datos en continuo de temperatura, conductividad y relativos de fluorescencia. En concreto, en este departamento se gestiona el fluorómetro:

Incidencias

Fue necesario parar las bombas porque el personal de máquinas íba a realizar soldadura en las cercanías. Se protegió el fluorómetro con una manta térmica y se desconectó de la red eléctrica para evitar posibles retornos del equipo de soldadura.

Fluorómetro 10 AU (Turner Designs)

Número de serie: 6964RTD

Descripción: Instrumento para cuantificar la cantidad de clorofila del medio de forma continua.

Características técnicas:

-Detector: Fotomultiplicador; Rojo (185-870 nm)

-Límites de detección:

Chlorophyll a: 0.025 µg/L

Rhodamine WT Dye: 0 - 250 ppb

FluoresceinDye: 0 - 250 ppb

-Rango de medida

Chlorophyll a: 0 - 250 µg/L

Rhodamine WT Dye: 0 - 250 ppb

FluoresceinDye: 0 - 250 ppb

-Filtros: Clorofila, Rodamina y sin filtro.

-Portacubetas para flujo continuo

-Fuente de luz: Lámpara halógena UV (clorofila).

iMirabilis2_D01_S12 – SW Fogo Island

iMirabilis2

TECHNICAL DIVE REPORT 06/08/2021

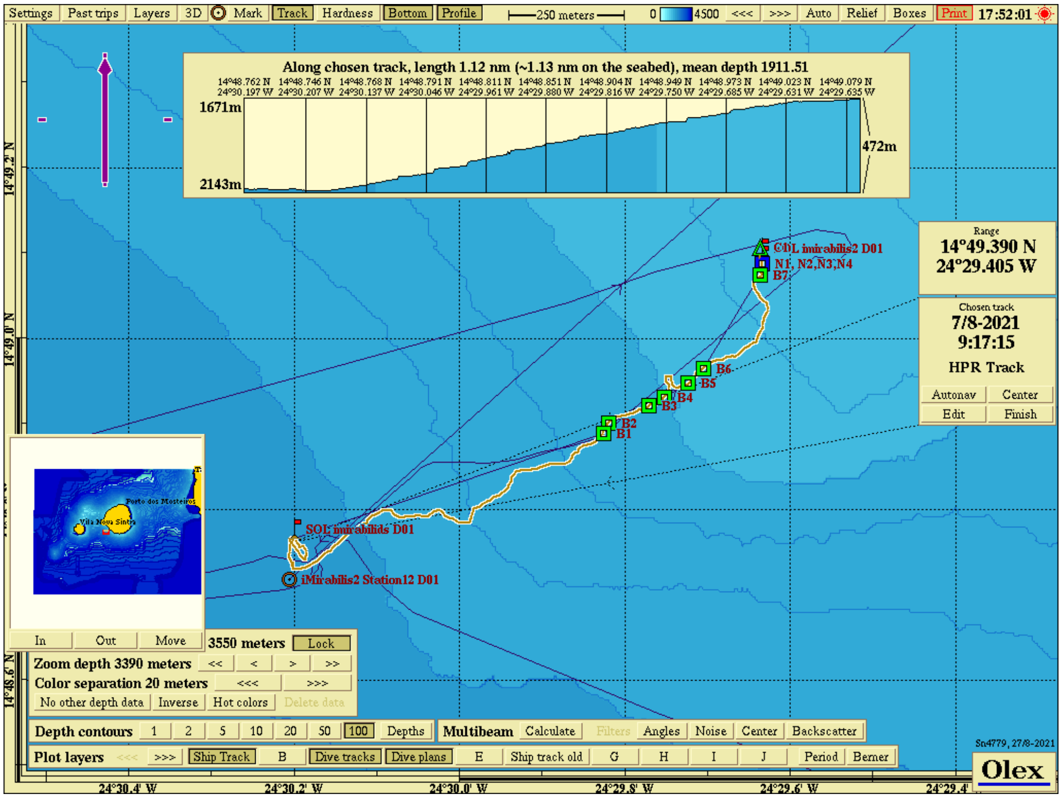
General Dive Details

Campaign	iMirabilis2
Operation Code	iMirabilis2_D01_S12
Vessel	R/V Sarmiento de Gamboa
Institution	CSIC, IEO and EMEPC; iAtlantic project
Operation Supervisor	António Calado
Scientific Coordinator	Covadonga Orejas and Beatriz Vinha
ROV Supervisor	António Calado
ROV Team	António Calado, Andreia Afonso, Bruno Ramos, Miguel Souto, Renato Bettencourt
Type of Operation	ROV Dive – scientific survey (biological sampling and habitat mapping)
Equipment	ROV Luso
Date and Time (UTC)	6th August de 2021 08:11
Duration (HH:mm:ss)	09:38:01

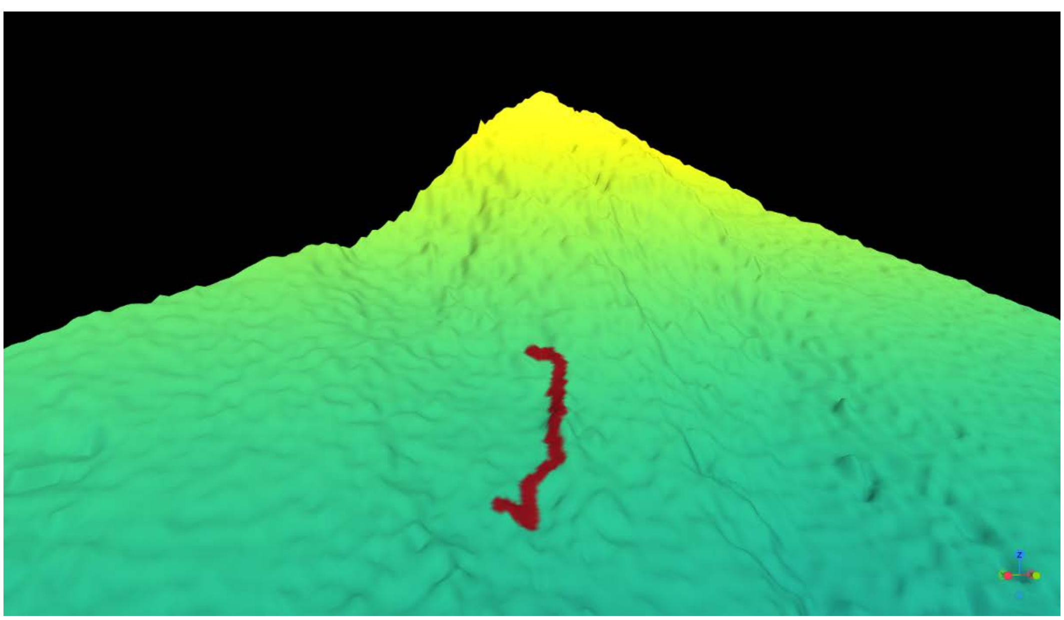
Working Area

Name	SW Fogo Island
Latitude	14º48’46.5420’’N
Longitude	024º30’12.0840’’W
Depth (m)	2150

Dive Maps



3D Overview with ROV trajectory



Sample List

TYPE OF SAMPLES	TOTAL NUMBER
Biological	7
Push Cores	1
Niskin	3
Suction	0

Data Files

FILE	EQUIPMENT	PARAMETERS		OBSERVATIONS
imirabilis2_D01_S12_SAIV_1.txt imirabilis2_D01_S12_SAIV_2.txt	SAIV CTD	Salinity	√	Calculated (manufacturer calibration 2019- recommended every 2 years)
		Conductivity	√	(manufacturer calibration 2019- recommended every 2 years)
		Sound velocity	√	Calculated (manufacturer calibration 2019- recommended every 2 years)
		Temperature	√	(manufacturer calibration 2019- recommended every 2 years)
		Density	√	Calculated (manufacturer calibration 2019- recommended every 2 years)
		Pressure	√	Calibrated before the dive (manufacturer calibration 2019- recommended every 2 years)
	Oxygen sensor	Concentration dissolved oxygen and percentage of oxygen saturation	√	(manufacturer calibration 2019- recommended every 2 years)

	Turbidity sensor	Turbidity	√	(manufacturer calibration 2019- recommended every 2 years)
Imirabilis2_D01_S12_INS_telemetry.txt	IxBlue INS ROVdata	ROV heading, roll, pitch	√	
Imirabilis2_D01_S12_HIPAP.txt	Kongsberg HIPAP ROV position system	ROV position	√	
Imirabilis2_D01_S12_ABY_telemetry.txt	Compass	Heading	√	
	Gyro	Pitch/roll	√	
	Depth sensor	Depth	√	
	Altimeter	Altitude	√	
Imirabilis2_D01_S12_Idronaut.txt	Idronaut CTD	Salinity	√	Calculated (manufacturer calibration 2019- recommended every 2 years)
		Conductivity	√	(manufacturer calibration 2019- recommended every 2 years)
		Temperature	√	(manufacturer calibration 2019- recommended every 2 years)
		Pressure	√	(manufacturer calibration 2019- recommended every 2 years)
	Oxygen sensor	Concentration dissolved oxygen and percentage of oxygen saturation	√	Calibrated before the dive (manufacturer calibration 2019- recommended every 2 years)

Imirabilis2_D01_S12_Idronaut.txt	Fluorescence sensor	Fluorescence	√	(manufacturer calibration 2019- recommended every 2 years)
	Turbidity sensor	Turbidity	√	(manufacturer calibration 2019- recommended every 2 years)
	pH sensor	pH	√	Calibrated before the dive (manufacturer calibration 2019- recommended every 2 years)
	Redox potential sensor	Redox potential	√	(manufacturer calibration 2019- recommended every 2 years)
Imirabilis2_D01_S12_Contros.txt	CH_4 and CO_2 sensors	CH_4 and CO_2 concentration and pCO_2	√	CH4 last calibration in 2016 and verified in 2020 (manufacturer does not support this sensor anymore). CO2 last calibration in 2021 (recommended calibration – every year)
Imirabilis2_D01_S12_video_raw_06_08_2021_10_44_00.mov	UHD camera	Video	√	PRORES video files (3840x2160)
Video_Camera 2_OVERLAY_2021-08-06 08-10-33.105Z.mp4 to Video_Camera 2_OVERLAY_2021-08-06 17-33-22.728Z.mp4	UHD camera	Video	√	MP4 video files(3840x2160)
IMG_0386_logo.png to IMG_1062_logo.png IMG_0386_luso.png to IMG_1062_luso.png	Photo Camera	Photo	√	3648x2736px images with metadada in Metadata_luso_iM2.csv (with only Luso logo or with addition of campaign logo)

2021-08-06_09-31-02.979 - Camera Viewer - Camera 2.jpg to 2021-08-06_15-41-39.525 - Camera Viewer - Camera 2.jpg 2021-08-06_09-31-02.979 - Camera Viewer - Camera 2 - video_luso.png to 2021-08-06_15-41-39.525 - Camera Viewer - Camera 2 - video_luso.png 2021-08-06_09-31-02.979 - Camera Viewer - Camera 2 - video_luso_iM2.png to 2021-08-06_15-41-39.525 - Camera Viewer - Camera 2 - video_luso_iM2.png	UHD camera	Still image	√	Name of the file has the suffix: • "- Video.jpg" has overlay info on the image These images come from the video with Overlay showed on the screen during the dive; • "- Video_luso.png" no overlay, but luso logo on the image; • "- Video_luso_iM2.png" no overlay, but luso and campaign logo on the image;

Products

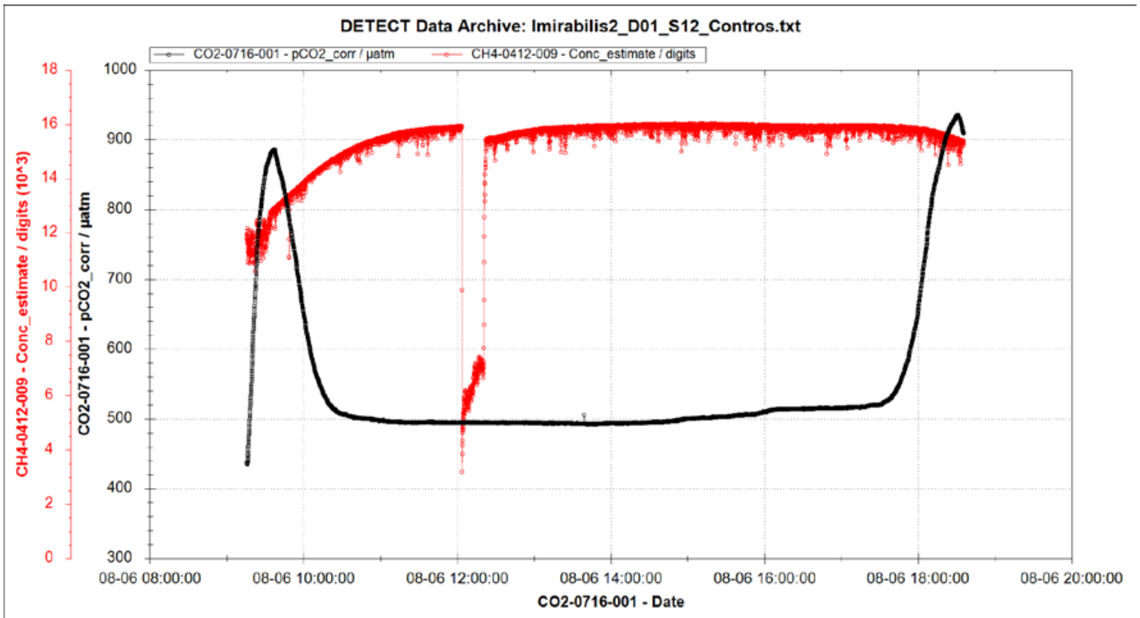
FILE	OBSERVATIONS
Imirabilis2_D01_S12_Contros.txt	Contros data
Imirabilis2_D01_S12_Idronaut.txt	Idronaut data
imirabilis2_D01_S12_SAIV_1.txt imirabilis2_D01_S12_SAIV_2.txt	SAIV data
Imirabilis2_D01_S12_INS_telemetry.txt Imirabilis2_D01_S12_ABY_telemetry.txt	Telemetry data
Imirabilis2_D01_S12_HIPAP.txt	Position data
iM2_D01_S12_ROV_trajectory.prj/qpj/shp/shx/dbf	Shape-file with trajectory
Imirabilis2_D01_S12_QGIS_pic.png	QGIS image with ROV trajectory on bathymetry
iM2_D01_S12_Olex_Map.tif	Olex image with ROV trajectory, profile and samples
Metadata_luso.csv and Metadata_luso_iM2.csv	Information retrieved using a software downloaded from the internet and not delivered by Kongsberg
iM2_D01_S12_Contros_Graph.png	Contros data graphic
iM2_D01_S12_Idronaut_graph.png	Idronaut data graphic

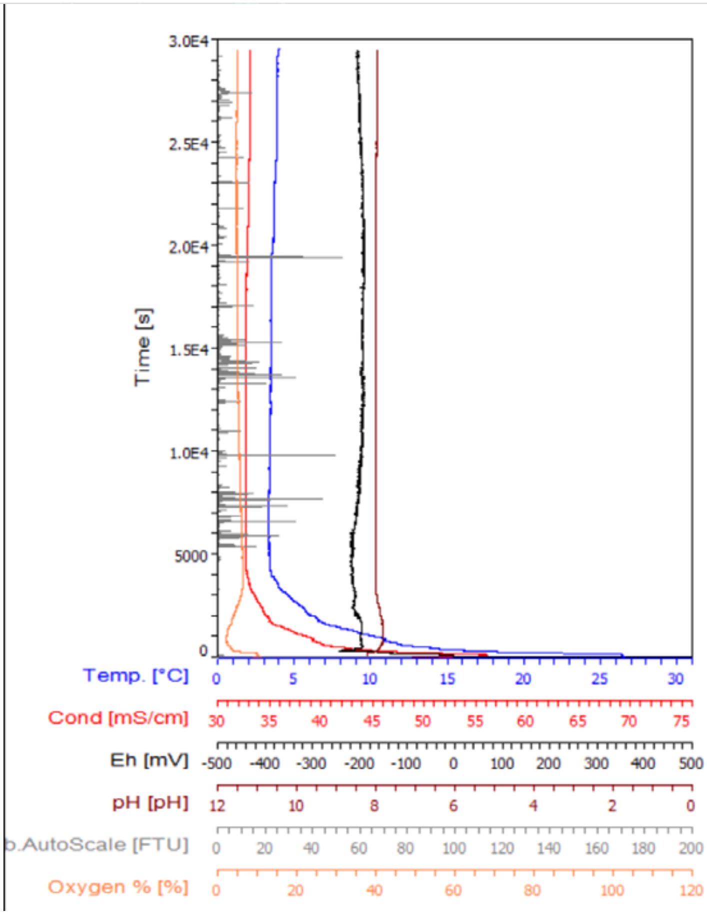
iM2_D01_S12_SAIV_1_graph.png and iM2_D01_S12_SAIV_2_graph.png	SAIV data graphic
1 video	Raw UHD videos
56 videos	Abyssal videos with video overlay information
677 images	Images from photo camera
213 images	Still images from video
Imirabilis_D01_S12_ship_1.jpg Imirabilis_D01_S12_ship_2.jpg	DP ship conditions

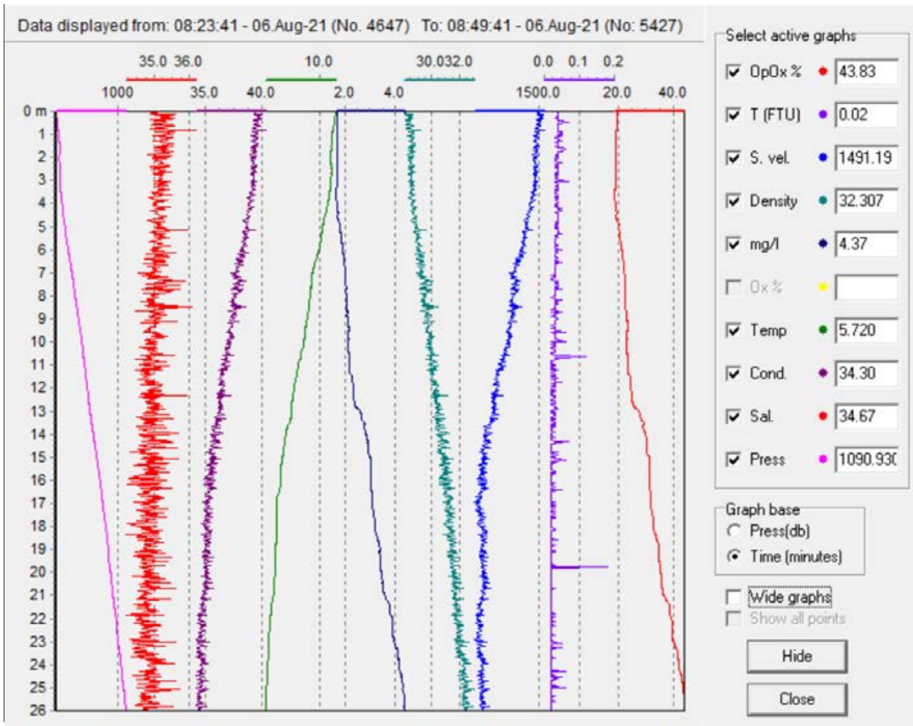
Help Files

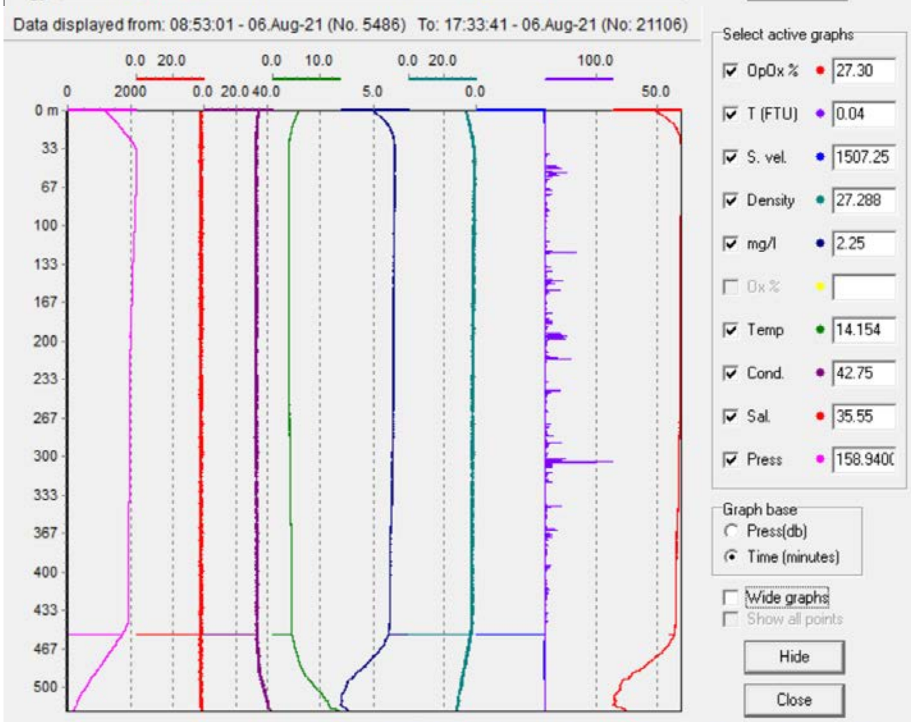
FILE	OBSERVATIONS
CONTROS HydroC® CH4 data format.jpg	Imirabilis2_DXX_SXX_Contros.txt data format (CH_4 columns)
CONTROS HydroC® CO2 data format.jpg	Imirabilis2_DXX_SXX_Contros.txt data format (CO_2 columns)
ABY telemetry data format.pdf	Imirabilis2_DXX_SXX_ABY_telemetry.txt data format
Idronaut data format.txt	Imirabilis2_DXX_SXX_Idronaut.txt data format
HIPAP data format.pdf	Imirabilis2_DXX_SXX_HIPAP.txt data format
SAIV data format.txt	imirabilis2_DXX_SXX_SAIV.txt data format
INS_telemetry data format.pdf	Imirabilis2_DXX_SXX_INS_telemetry.txt data format

Data Graphs

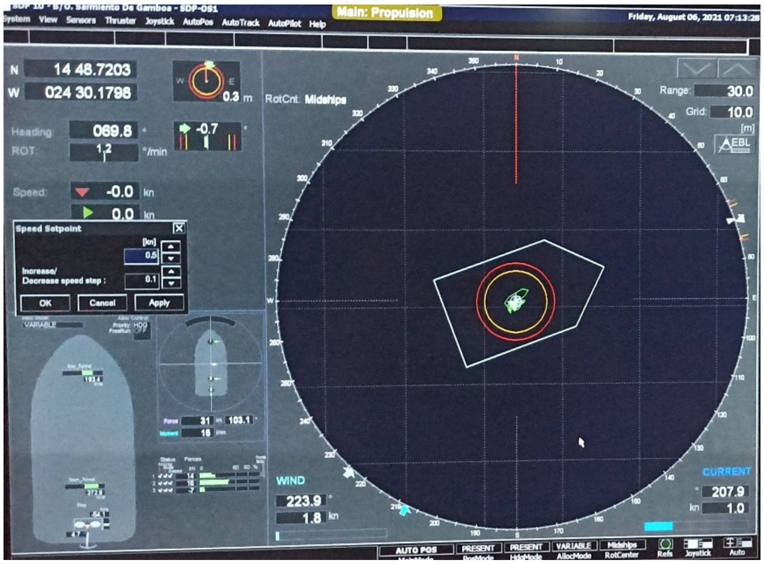

DETECT Data Archive: Imirabilis2_D01_S12_Contros.txt
CO2-0716-001 - pCO2_corr / µatm
CH4-0412-009 - Conc_estimate / digits
CH4-0412-009 - Conc_estimate / digits (10^3)
CO2-0716-001 - pCO2_corr / µatm
CO2-0716-001 - Date
08-06 08:00:00
08-06 10:00:00
08-06 12:00:00
08-06 14:00:00
08-06 16:00:00
08-06 18:00:00
08-06 20:00:00


Time [s]
Temp. [°C]
Cond [mS/cm]
Eh [mV]
pH [pH]
b.AutoScale [FTU]
Oxygen % [%]


Data displayed from: 08:23:41 - 06.Aug-21 (No. 4647) To: 08:49:41 - 06.Aug-21 (No: 5427)
Select active graphs
OpOx % 43.83
T (FTU) 0.02
S. vel. 1491.19
Density 32.307
mg/l 4.37
Ox %
Temp 5.720
Cond. 34.30
Sal. 34.67
Press 1090.930
Graph base
Press(db)
Time (minutes)
Wide graphs
Show all points
Hide
Close


Data displayed from: 08:53:01 - 06.Aug-21 (No. 5486) To: 17:33:41 - 06.Aug-21 (No: 21106)
Select active graphs
OpOx % 27.30
T (FTU) 0.04
S. vel. 1507.25
Density 27.288
mg/l 2.25
Ox %
Temp 14.154
Cond. 42.75
Sal. 35.55
Press 158.9400
Graph base
Press(db)
Time (minutes)
Wide graphs
Show all points
Hide
Close

Meteorological and Ocean Conditions



Technical Dive Log

Time	DESCRIPTION - AUG 6, 2021	TAGS
6:05:49	All working. Nothing to report.	Pre-dive checks
6:42:08	SAIV pressure sensor calibrated. Oxygen sensor calibration problem, tried again and it was done now. pH sensor calibrated.	Sensors
8:11:58		Off deck
8:12:50	Software problem with SAIV.	Sensors
8:15:20	Contros recording only started now.	Sensors
8:20:20	DVL data not going to multilogger from ixblue	Sensors
8:29:28	BR (Pilot),AC (co-pilot),RB(Winch)	Pilot exchange
8:38:13	Station number not in the video until now	Other
8:49:09	SAIV clock was not synchronized. Recording stopped and started again to synchronize.	Sensors
9:27:47		At bottom
9:47:55	Rotation of the Vessel because of the current	Vessel
10:11:37	AC(Pilot),AA(co-pilot),BR(winch)	Pilot exchange
10:24:03	Direct take stopped recording, media express start captures, but the abyssal video is starting to getting slow. Trying Direct take again.	Image
10:47:35	A lot of problems with video raw recording. The mov video format stops recording and only mp4 is working now.	
10:49:43	Telemetry stopped. EIVA not working fine. Started again.	
12:19:28	AA(Pilot),MS(Co-pilot),AA(Winch)	Pilot exchange
14:00:00		Sensors
14:27:40	MS(Pilot),RB(Co-pilot),AA(Winch)	Pilot exchange
14:41:38	4k camera telemetry not working. Solved changing the serial connection to the System computer.	Sensors
15:12:02	Problems with the positioning because the ROV is not well showed in the Olex software	Sensors
15:23:55	Problem with the latitude was solved. EIVA Datamon was not well configured.	Sensors
16:16:56		Off bottom
16:29:54	RB(Pilot),BR(Co-pilot),MS(Winch)	Pilot exchange
17:20:15	AC (pilot); MS (co-pilot); AA (winch)	Pilot exchange
17:29:15	Still cam and DVL turned off	Sensors
17:34:00	SAIV, Idronaut and contros turned off	Sensors
17:35:00	The Contros pumps were not turned off	Sensors
17:48:00	Leak of oil in the LARS (in the back of the LARS and on the left of the electronics)	LARS
17:50:00		On deck

iMirabilis2_D02_S17 - SW Cadamosto Seamount - aborted

iMirabilis2

TECHNICAL DIVE REPORT 07/08/2021

General Dive Details

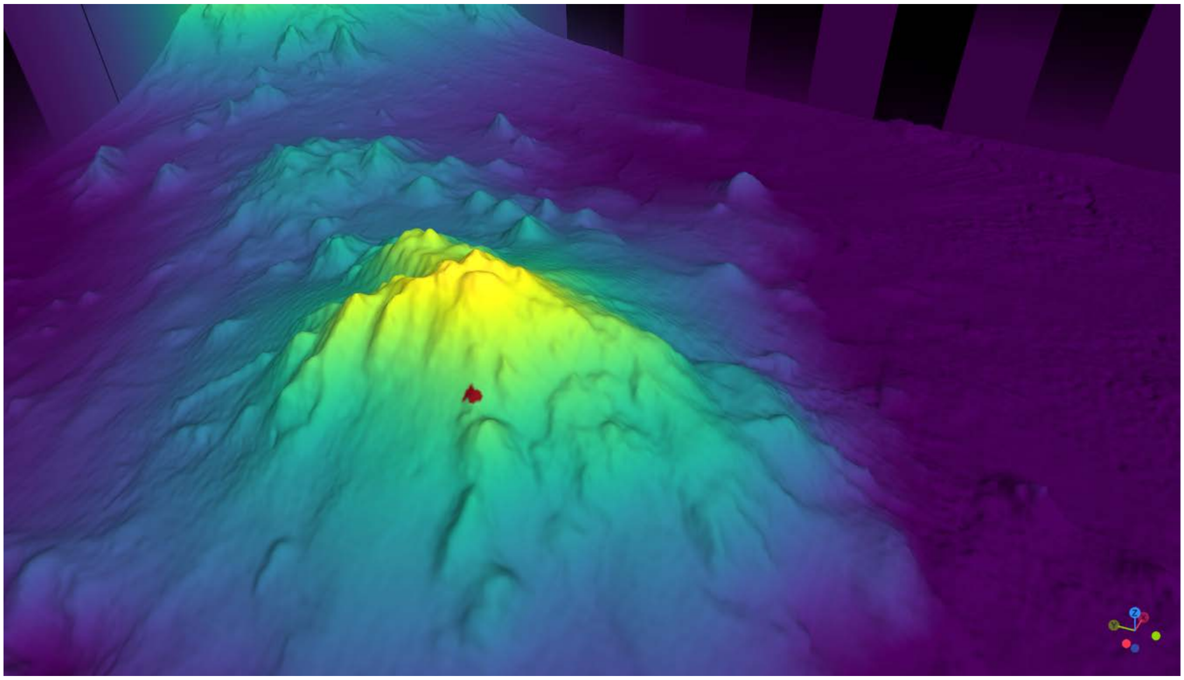
Campaign	iMirabilis2
Operation Code	iMirabilis2_D02_S17
Vessel	R/V Sarmiento de Gamboa
Institution	CSIC, IEO and EMEPC; iAtlantic project
Operation Supervisor	António Calado
Scientific Coordinator	Covadonga Orejas and Beatriz Vinha
ROV Supervisor	António Calado
ROV Team	António Calado, Andreia Afonso, Bruno Ramos, Miguel Souto, Renato Bettencourt
Type of Operation	ROV Dive – scientific survey (biological sampling and habitat mapping)
Equipment	ROV Luso
Date and Time (UTC)	7th August de 2021 19:54
Duration (HH:mm:ss)	03:39:36

Working Area

Name	SW Cadamosto Seamount
Latitude	14º38’57.0300’’N
Longitude	024º55’55.5060’’W
Depth (m)	2000

Dive Maps

3D Overview with ROV trajectory



Sample List

TYPE OF SAMPLES	TOTAL NUMBER
Biological	0
Push Cores	0
Niskin	0
Suction	0

Data Files

FILE	EQUIPMENT	PARAMETERS		OBSERVATIONS
		Salinity	√	Calculated (manufacturer calibration 2019- recommended every 2 years)
	SAIV CTD	Conductivity	√	(manufacturer calibration 2019- recommended every 2 years)

Imirabilis2_D02_S17_SAIV_1.txt		Sound velocity	√	Calculated (manufacturer calibration 2019- recommended every 2 years)
Imirabilis2_D02_S17_SAIV_2.txt		Temperature	√	(manufacturer calibration 2019- recommended every 2 years)
		Density	√	Calculated (manufacturer calibration 2019- recommended every 2 years)
Imirabilis2_D02_S17_SAIV_3.txt		Pressure	√	Calibrated before the dive (manufacturer calibration 2019- recommended every 2 years)
	Oxygen sensor	Concentration dissolved oxygen and percentage of oxygen saturation	√	(manufacturer calibration 2019- recommended every 2 years)
	Turbidity sensor	Turbidity	√	(manufacturer calibration 2019- recommended every 2 years)
Imirabilis2_D02_S17_INS_telemetry.txt	IxBlue INS ROVdata	ROV heading, roll, pitch	√	
Imirabilis2_D02_S17_HIPAP.txt	Kongsberg HIPAP ROV position system	ROV position	√	
	Compass	Heading	√	

	Gyro	Pitch/roll	√	
Imirabilis2_D02_S17_ABY_telemetry.txt	Depth sensor	Depth	√	
	Altimeter	Altitude	√	
		Salinity	√	Calculated (manufacturer calibration 2019- recommended every 2 years)
	Idronaut CTD	Conductivity	√	(manufacturer calibration 2019- recommended every 2 years)
Imirabilis2_D02_S17_Idronaut.TXT		Temperature	√	(manufacturer calibration 2019- recommended every 2 years)
		Pressure	√	(manufacturer calibration 2019- recommended every 2 years)
	Oxygen sensor	Concentration dissolved oxygen and percentage of oxygen saturation	√	Calibrated before the dive (manufacturer calibration 2019- recommended every 2 years)
Imirabilis2_D02_S17_Idronaut.TXT	Fluorescence sensor	Fluorescence	√	(manufacturer calibration 2019- recommended every 2 years)
	Turbidity sensor	Turbidity	√	(manufacturer calibration 2019- recommended every 2 years)
	pH sensor	pH	√	Calibrated before the dive (manufacturer calibration 2019- recommended every 2 years)
	Redox potential sensor	Redox potential	√	(manufacturer calibration 2019- recommended every 2 years)

Imirabilis2_D02_S17_Contros.txt	CH_4 and CO_2 sensors	CH_4 and CO_2 concentration and pCO_2	√	CH4 last calibration in 2016 and verified in 2020 (manufacturer does not support this sensor anymore). CO2 last calibration in 2021 (recommended calibration – every year)
Imirabilis2_D02_S17_video_raw_07_08_2021_19_52_20.mov to Imirabilis2_D02_S17_video_raw_07_08_2021_22_44_37.mov	HD camera	Video	√	PRORES HQ video files (1920x1080)
Video_Camera 1_OVERLAY_2021-08-07 19-52-19.858Z.mp4 to Video_Camera 1_OVERLAY_2021-08-07 23-26-20.744Z.mp4	UHD camera	Video	√	MP4 video files(3840x2160)

Products

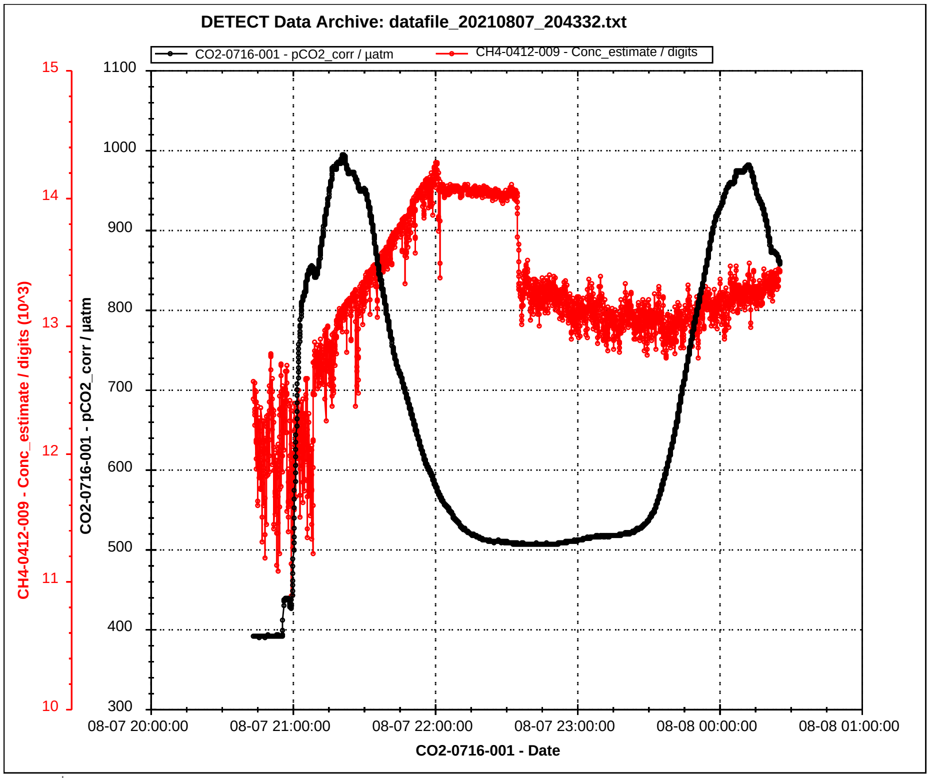
FILE	OBSERVATIONS
Imirabilis2_D02_S17_Contros.txt	Contros data
Imirabilis2_D02_S17_ROV_trajectory.prj/qpj/shp/shx/dbf	Shape-file with trajectory
Imirabilis2_D02_S17_QGIS_pic.png	QGIS image with ROV trajectory on bathymetry
Imirabilis2_D02_S17_Contros_graph.jpg	Contros data graphic
Imirabilis2_D02_S17_Idronaut_graph.png	Idronaut data graphic
Imirabilis2_D02_S17_SAIV_1_graph.png, Imirabilis2_D02_S17_SAIV_2_graph.png and Imirabilis2_D02_S17_SAIV_3_graph.png	SAIV data graphic
Imirabilis2_D02_S17_Idronaut.txt	Idronaut data
Imirabilis2_D02_S17_SAIV_1.txt Imirabilis2_D02_S17_SAIV_2.txt Imirabilis2_D02_S17_SAIV_3.txt	SAIV data
Imirabilis2_D02_S17_INS_telemetry.txt Imirabilis2_D02_S17_ABY_telemetry.txt	Telemetry data

Imirabilis2_D02_S17_HIPAP.txt	Position data
3 videos	Raw HD videos
15 videos	Abyssal videos with video overlay information
Imirabilis_D02_S17_ship_1.jpg Imirabilis_D02_S17_ship_2.jpg	DP ship conditions

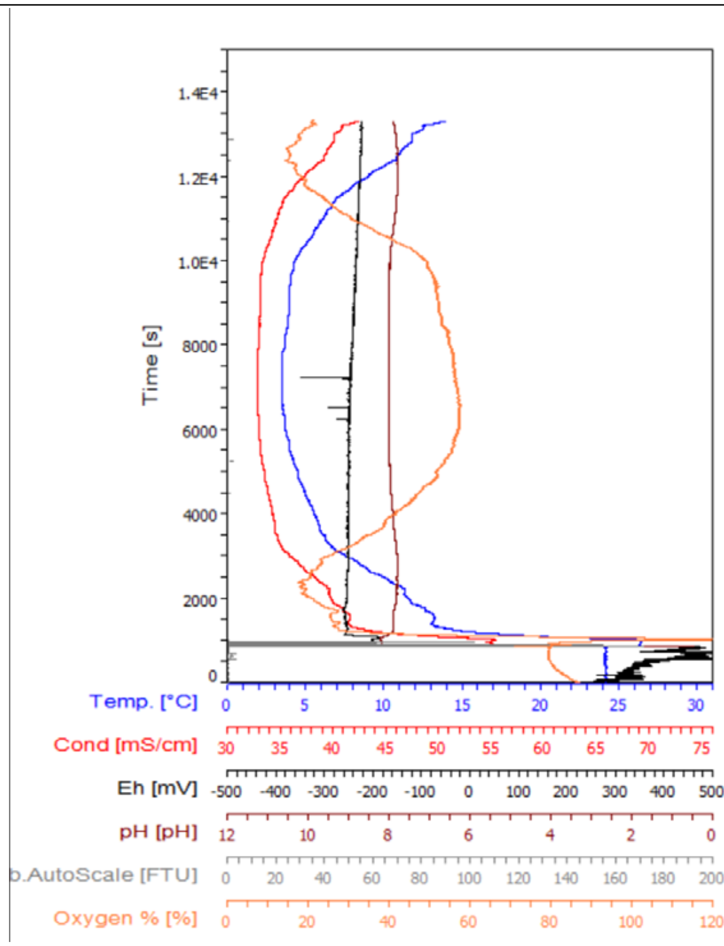
Help Files

FILE	OBSERVATIONS
CONTROS HydroC® CH4 data format.jpg	Imirabilis2_DXX_SXX_Contros.txt data format (CH_4 columns)
CONTROS HydroC® CO2 data format.jpg	Imirabilis2_DXX_SXX_Contros.txt data format (CO_2 columns)
ABY telemetry data format.pdf	Imirabilis2_DXX_SXX_ABY_telemetry.txt data format
Idronaut data format.txt	Imirabilis2_DXX_SXX_Idronaut.txt data format
HIPAP data format.pdf	Imirabilis2_DXX_SXX_HIPAP.txt data format
SAIV data format.txt	imirabilis2_DXX_SXX_SAIV.txt data format
INS_telemetry data format.pdf	Imirabilis2_DXX_SXX_INS_telemetry.txt data format

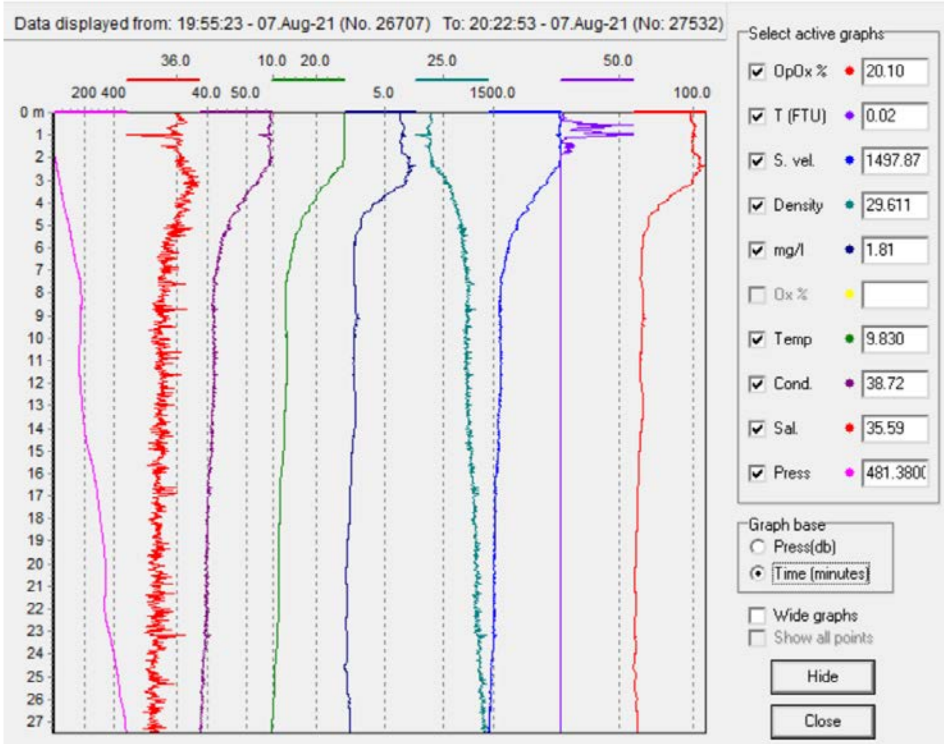
Data Graphs



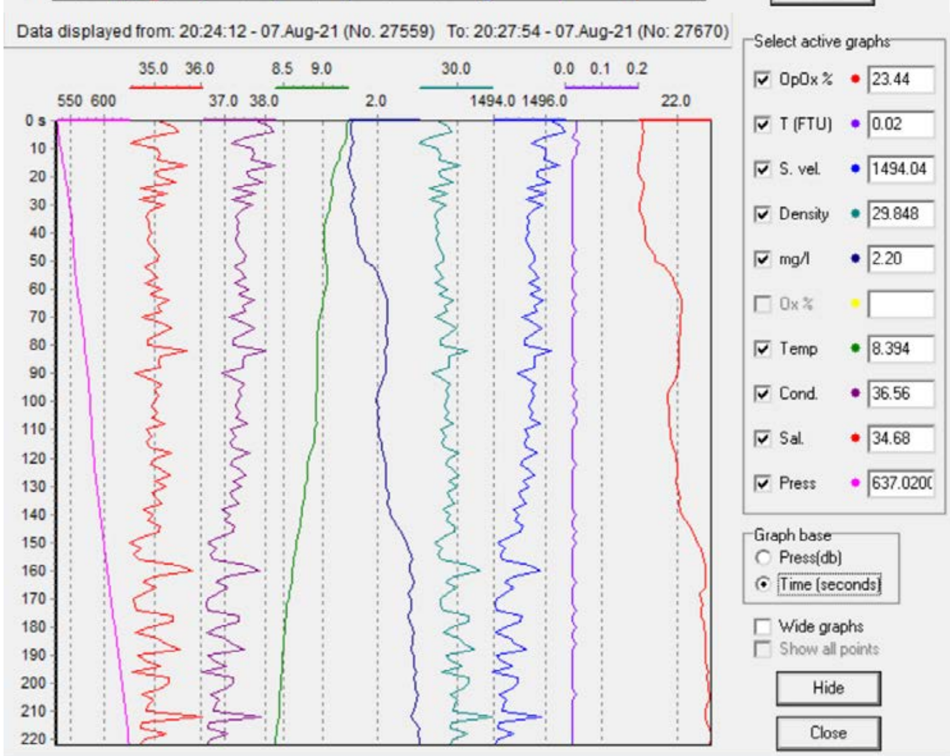
DETECT Data Archive: datafile_20210807_204332.txt
CO2-0716-001 - pCO2_corr / µatm
CH4-0412-009 - Conc_estimate / digits
CH4-0412-009 - Conc_estimate / digits (10^3)
CO2-0716-001 - pCO2_corr / µatm
CO2-0716-001 - Date
08-07 20:00:00
08-07 21:00:00
08-07 22:00:00
08-07 23:00:00
08-08 00:00:00
08-08 01:00:00



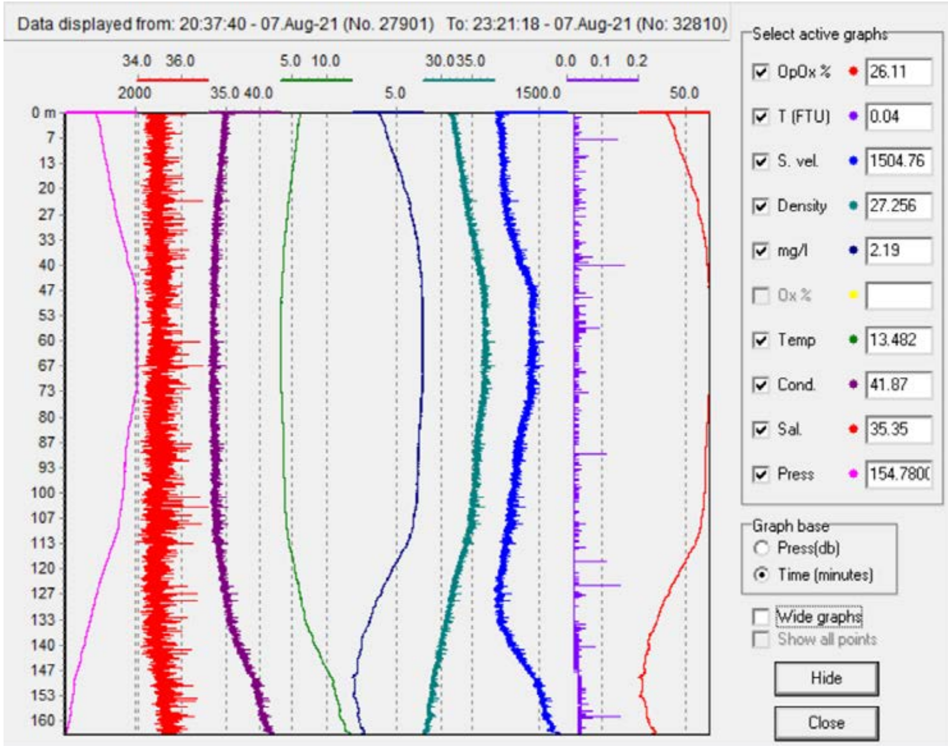
Time [s]
Temp. [°C]
Cond [mS/cm]
Eh [mV]
pH [pH]
b.AutoScale [FTU]
Oxygen % [%]



Data displayed from: 19:55:23 - 07.Aug-21 (No. 26707) To: 20:22:53 - 07.Aug-21 (No: 27532)
36.0
10.0 20.0
25.0
50.0
200 400
40.0 50.0
5.0
1500.0
100.0
0 m
Select active graphs
OpOx % 20.10
T (FTU) 0.02
S. vel. 1497.87
Density 29.611
mg/l 1.81
Ox %
Temp 9.830
Cond. 38.72
Sal. 35.59
Press 481.3800
Graph base
Press(db)
Time (minutes)
Wide graphs
Show all points
Hide
Close



Data displayed from: 20:24:12 - 07.Aug-21 (No. 27559) To: 20:27:54 - 07.Aug-21 (No: 27670)
35.0 36.0
8.5 9.0
30.0
0.0 0.1 0.2
550 600
37.0 38.0
2.0
1494.0 1496.0
22.0
0 s
Select active graphs
OpOx % 23.44
T (FTU) 0.02
S. vel. 1494.04
Density 29.848
mg/l 2.20
Ox %
Temp 8.394
Cond. 36.56
Sal. 34.68
Press 637.0200
Graph base
Press(db)
Time (seconds)
Wide graphs
Show all points
Hide
Close



Meteorological and Ocean Conditions

Technical Dive Log

Time	DESCRIPTION - AUG 7, 2021	TAGS
18:56:00	Idronaut and SAIV calibrated for pressure. Idronaut oxygen calibrated.	Sensors
19:34:58	Ok	Pre-dive checks
19:43:34	Camera is not seeing the horizon correct. We are rotating the 4k camera to make it right.	Other
19:54:20		Off deck
19:54:41	INS recording only started now	Sensors
19:55:54	Contros Pumps turned on	Sensors
20:03:13	4k camera not working	
20:05:31	Problem with position in the INS, not receiving.	
20:07:48	Camera working again, starting the dive again :)	
20:09:35	Restarting the EIVA software.	
20:13:21	Telemetry not being received in Abyssal	
20:17:54	Turning EIVA again	
20:18:00	RB (Pilot), BR (Co-Pilot), MS (Winch)	Pilot exchange
20:22:36	INS not receiving data, SAIV turned off.	Sensors
20:36:17	INS turned off and started again	
21:16:22	INS problems again with the heading	
21:17:43	4k camera stop working	
21:37:00		At bottom
21:37:09	Still camera, INS turned on and 4k camera working now	
21:45:00	Aborted because 4k is not working	Off bottom
22:54:49	Hyperdeck recording and abyssal recording, but overlay information is wrong	Image
23:02:01	AC (pilot); MS (co-pilot); AA (winch)	Pilot exchange

23:23:16	Contros pumps, SAIV, Idronaut, INS, still cam and DVL turned off.	Sensors
23:28:05	SAIV stopped again. Heading of the INS is not correct	Sensors
23:30:42	Contros turned off	Sensors
23:33:57		On deck
	AUG 8, 2021	
0:04:37	Everything working. Only serial communications to INS are not working.	Post-dive checks
0:10:24	During coming up with the ROV INS, DVL, Still and 4k were working fine. Data coming to the INS thru serial communication still not working during the ascending.	Other

iMirabilis2_D03_S24 - SW Cadamosto Seamount

iMirabilis2

TECHNICAL DIVE REPORT 09/08/2021

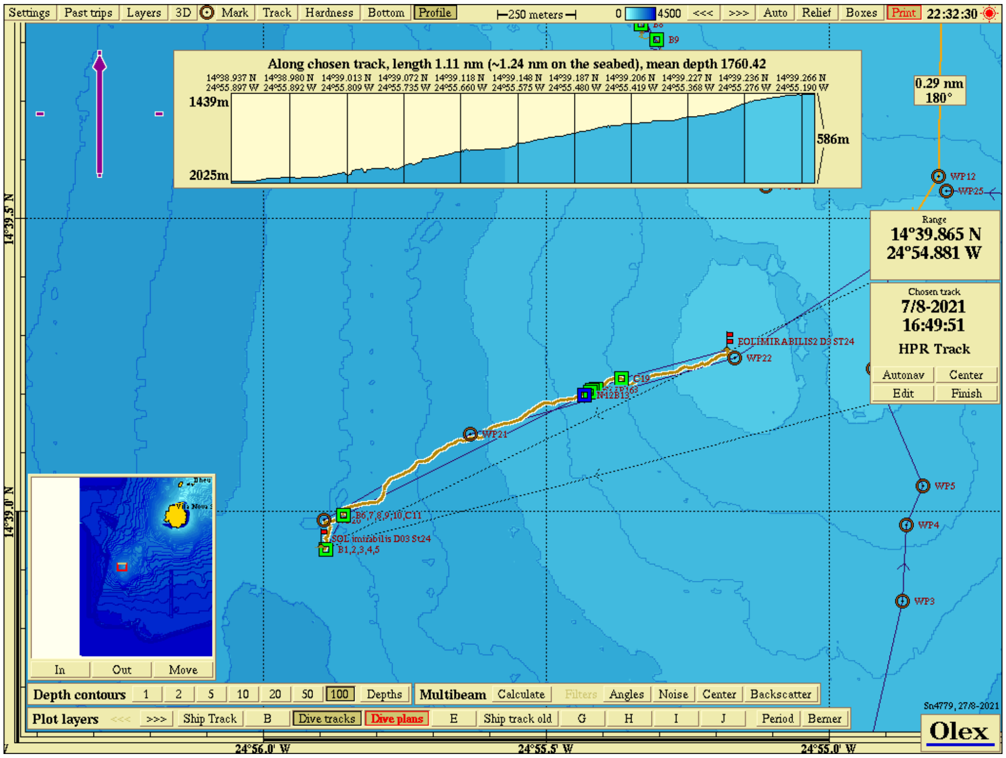
General Dive Details

Campaign	iMirabilis2
Operation Code	iMirabilis2_D03_S24
Vessel	R/V Sarmiento de Gamboa
Institution	CSIC, IEO and EMEPC; iAtlantic project
Operation Supervisor	António Calado
Scientific Coordinator	Covadonga Orejas and Beatriz Vinha
ROV Supervisor	António Calado
ROV Team	António Calado, Andreia Afonso, Bruno Ramos, Miguel Souto, Renato Bettencourt
Type of Operation	ROV Dive – scientific survey (biological sampling and habitat mapping)
Equipment	ROV Luso
Date and Time (UTC)	9th August de 2021 15:16
Duration (HH:mm:ss)	10:12:00

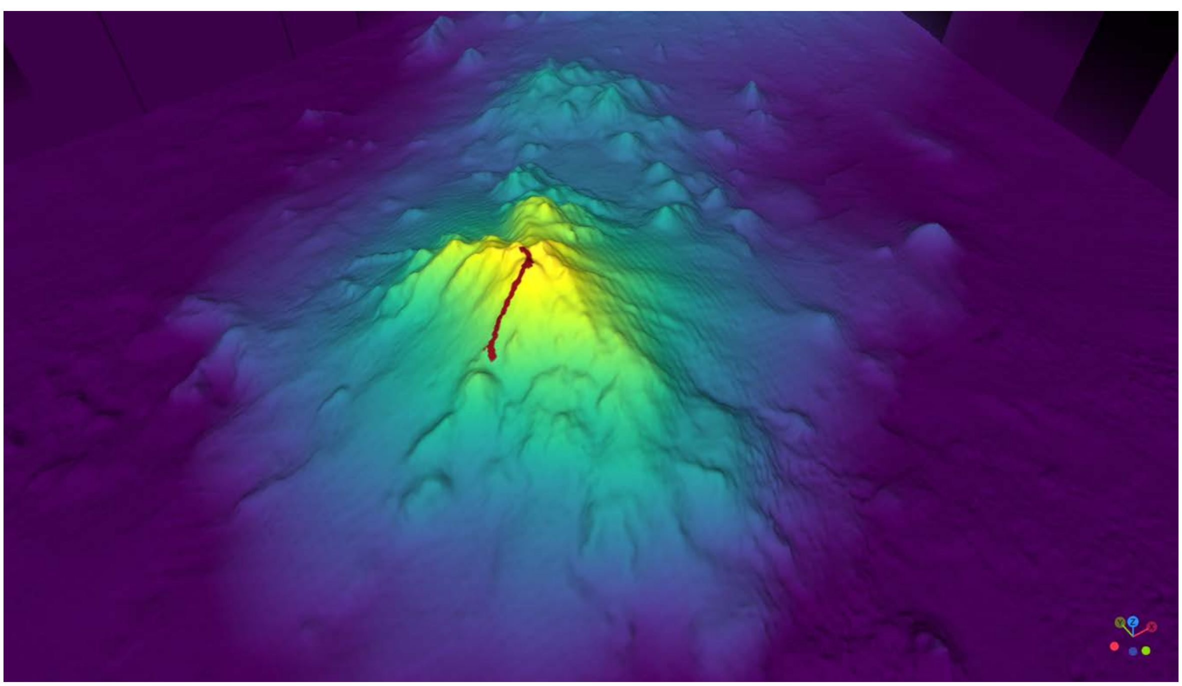
Working Area

Name	SW Cadamosto Seamount
Latitude	14º38’55.1760’’N
Longitude	024º55’54.5880’’W
Depth (m)	2000

Dive Maps



3D Overview with ROV trajectory



Sample List

TYPE OF SAMPLES	TOTAL NUMBER
Biological	5
Push Cores	2
Niskin	4
Suction	10

Data Files

FILE	EQUIPMENT	PARAMETERS		OBSERVATIONS
Imirabilis2_D03_S24_SAIV.txt	SAIV CTD	Conductivity	√	(manufacturer calibration 2019-recommended every 2 years)
		Sound velocity	√	Calculated (manufacturer calibration 2019-recommended every 2 years)
		Temperature	√	(manufacturer calibration 2019-recommended every 2 years)
		Pressure	√	Calibrated before the dive (manufacturer calibration 2019-recommended every 2 years)
	Oxygen sensor	Percentage of oxygen saturation	√	(manufacturer calibration 2019-recommended every 2 years)
	Turbidity sensor	Turbidity	√	(manufacturer calibration 2019-recommended every 2 years)

Imirabilis2_D03_S24_INS_telemetry.txt	IxBlue INS ROV data	ROV heading, roll, pitch	√	
Imirabilis2_D03_S24_HIPAP.txt	Kongsberg HIPAP ROV position system	ROV position	√	
Imirabilis2_D03_S24_ABY_telemetry_1.txt Imirabilis2_D03_S24_ABY_telemetry_2.txt	Compass	Heading	√	
	Gyro	Pitch/roll	√	
	Depth sensor	Depth	√	
	Altimeter	Altitude	√	
Imirabilis2_D03_S24_Contros.txt	CH_4 and CO_2 sensors	CH_4 and CO_2 concentration and pCO_2	√	CH4 last calibration in 2016 and verified in 2020 (manufacturer does not support this sensor anymore). CO2 last calibration in 2021 (recommended calibration – every year)
Imirabilis2_D03_S24_video_raw_09_08_2021_14_47_39.mov to Imirabilis2_D03_S24_video_raw_09_08_2021_23_43_37.mov	UHD camera	Video	√	PRORES video files (3840x2160)
Video_Camera 1_OVERLAY_2021-08-09 15-07-54.458Z.mp4 to Video_Camera 1_OVERLAY_2021-08-10 01-25-50.284Z.mp4	UHD camera	Video	√	MP4 video files(3840x2160)

IMG_1093_luso_iM2.png to IMG_1857_luso_iM2.png IMG_1093_luso.png to IMG_1857_luso.png	Photo Camera	Photo	√	3648x2736px images with metadada in Imirabilis2_D03_Still_Metadata_luso.csv and Imirabilis2_D03_Still_Metadata_luso_iM2.csv (with only Luso logo or with addition of campaign logo)
2021-08-09_15-46-08.205 - Camera Viewer - Camera 1.jpg to 2021-08-09_23-36-36.897 - Camera Viewer - Camera 1.jpg 2021-08-09_15-39-22.940 - Camera Viewer - Camera 1 - video_luso.png to 2021-08-09_23-36-36.897 - Camera Viewer - Camera 1 - video_luso.png 2021-08-09_15-39-22.940 - Camera Viewer - Camera 1 - video_luso_iM2.png to 2021-08-09_23-36-36.897 - Camera Viewer - Camera 1 - video_luso_iM2.png	UHD camera	Still image	√	Name of the file has the suffix: • "- Video.jpg" has overlay info on the image these images come from the video with Overlay showed on the screen during the dive; • "- Video_luso.png" no overlay, but luso logo on the image; • "- Video_luso_iM2.png" no overlay, but luso and campaign logo on the image;

Products

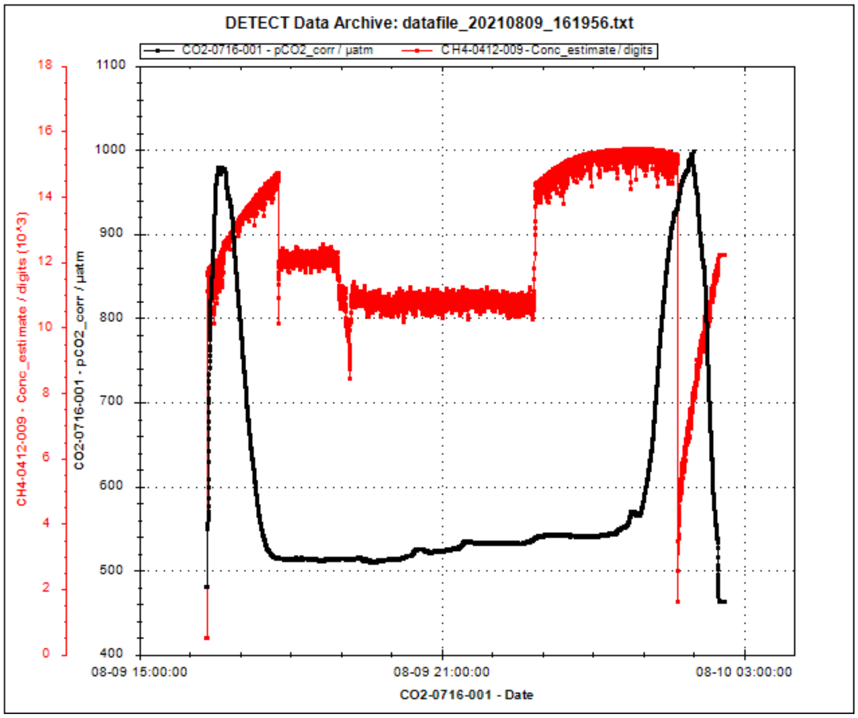
FILE	**OBSERVATIONS**
Imirabilis2_D03_S24_Contros.txt	Contros data
Imirabilis2_D03_S24_SAIV.txt	SAIV data
Imirabilis2_D03_S24_INS_telemetry.txt Imirabilis2_D03_S24_ABY_telemetry_1.txt Imirabilis2_D03_S24_ABY_telemetry_2.txt	Telemetry data
Imirabilis2_D03_S24_HIPAP.txt	Position data
Imirabilis2_D03_S24_ROV_trajectory.prj/qpj/shp/shx/dbf	Shape-file with trajectory
Imirabilis2_D03_S24_QGIS_pic.png	QGIS image with ROV trajectory on bathymetry
Imirabilis2_D03_S24_Olex_map.tif	Olex image with ROV trajectory, profile and samples

Imirabilis2_D03_Still_Metadata_luso.csv and Imirabilis2_D03_Still_Metadata_luso_iM2.csv	Information retrieved using a software downloaded from the internet and not delivered by Kongsberg
Imirabilis2_D03_S24_Contros_graph.png	Contros data graphic
7 videos	Raw UHD videos
61 videos	Abyssal videos with video overlay information
765 images	Images from photo camera
142 images	Still images from video
Imirabilis_D03_S24_ship_1.jpg Imirabilis_D03_S24_ship_2.jpg	DP ship conditions

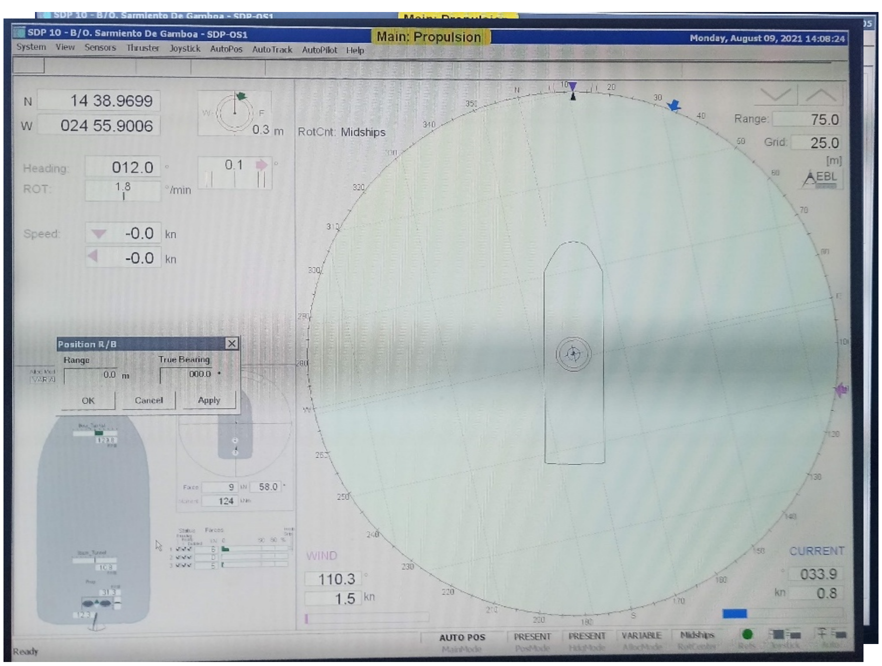
Help Files

FILE	OBSERVATIONS
CONTROS HydroC® CH4 data format.jpg	Imirabilis2_DXX_SXX_Contros.txt data format (CH_4 columns)
CONTROS HydroC® CO2 data format.jpg	Imirabilis2_DXX_SXX_Contros.txt data format (CO_2 columns)
ABY telemetry data format.pdf	Imirabilis2_DXX_SXX_ABY_telemetry.txt data format
Idronaut data format.txt	Imirabilis2_DXX_SXX_Idronaut.txt data format
HIPAP data format.pdf	Imirabilis2_DXX_SXX_HIPAP.txt data format
SAIV data format.txt	imirabilis2_DXX_SXX_SAIV.txt data format
INS_telemetry data format.pdf	Imirabilis2_DXX_SXX_INS_telemetry.txt data format

Data Graphs



Meteorological and Ocean Conditions



Technical Dive Log

Time	DESCRIPTION - AUG 9, 2021	TAGS
13:17:17	Ok. Direct take full license to be tested; HD installed and 4K too. Pressure from idronaut and saiv calibrated. Idronaut PH ad oxygen calibrated. Clock of the SAIV and of the photo camara corrected.	Pre-dive checks
15:08:45	Problem with SAIV probably the download button was clicked during acquisition.	Sensors
15:14:37	Letter on the raw video was because screens needed to be identified.	
15:16:00		Off deck
15:21:51	Contros pumps turned on	Sensors
15:23:21	INS restarted. Problem with depth and position	
15:26:10	Position in the video not showed because EIVA was restarted.	
15:30:09	BR(pilot), AC(Co-Pilot), RB(Winch)	Pilot exchange
16:34:57	A few flicks on the 4K cam	Image
16:49:00		At bottom
17:39:15	AC (Pilot), AA (Co- pilot), BR (Winch)	Pilot exchange
17:40:24	Control for the 4K is not working	Image
20:01:50	AA (Pilot), MS (Co-pilot), AC (Winch)	Pilot exchange
20:07:06	Data from CH4 suspicious.	Sensors
22:02:43	MS (Pilot), RB (Co-pilot), AA (Winch)	Pilot exchange
23:47:46		Off bottom
	AUG 10, 2021	
0:01:06	RB (Pilot), BR (Co-pilot), MS (Winch)	Pilot exchange
1:28:00	Data files from Idronaut are corrupted. It is necessary to talk with the manufacture of the sensor to know if it is possible to retrieve the data.	On deck

iMirabilis2_D04_S31– S Fogo Island

iMirabilis2

TECHNICALDIVEREPORT 11/08/2021

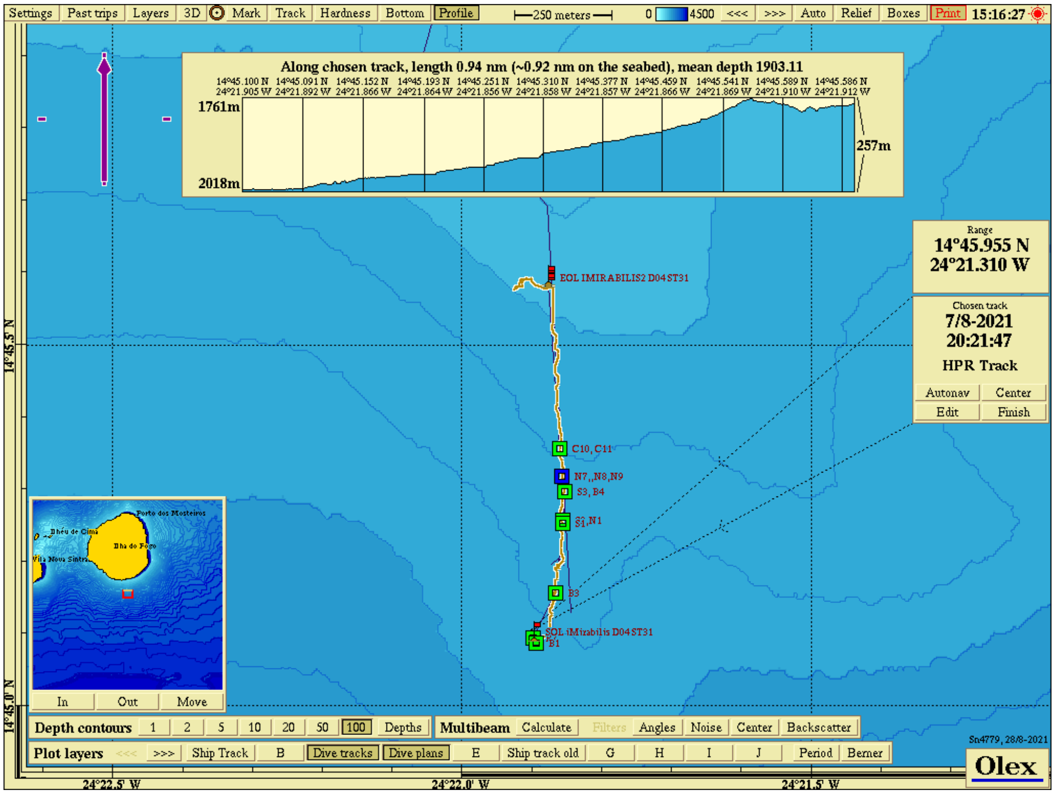
General Dive Details

Campaign	iMirabilis2
OperationCode	iMirabilis2_D04_S31
Vessel	R/V SarmientodeGamboa
Institution	CSIC, IEO and EMEPC; iAtlantic
project**OperationSupervisor**	AntónioCalado
ScientificCoordinator	Covadonga Orejas and Beatriz Vinha
ROV Supervisor	AntónioCalado
ROV Team	AntónioCalado,AndreiaAfonso,BrunoRamos, Miguel Souto,RenatoBettencourt
TypeofOperation	ROVDive– scientificsurvey (biological sampling and habitat mapping)
Equipment	ROV Luso
DateandTime(UTC)	11thAugustde 202108:11
Duration (HH:mm:ss)	07:07:54

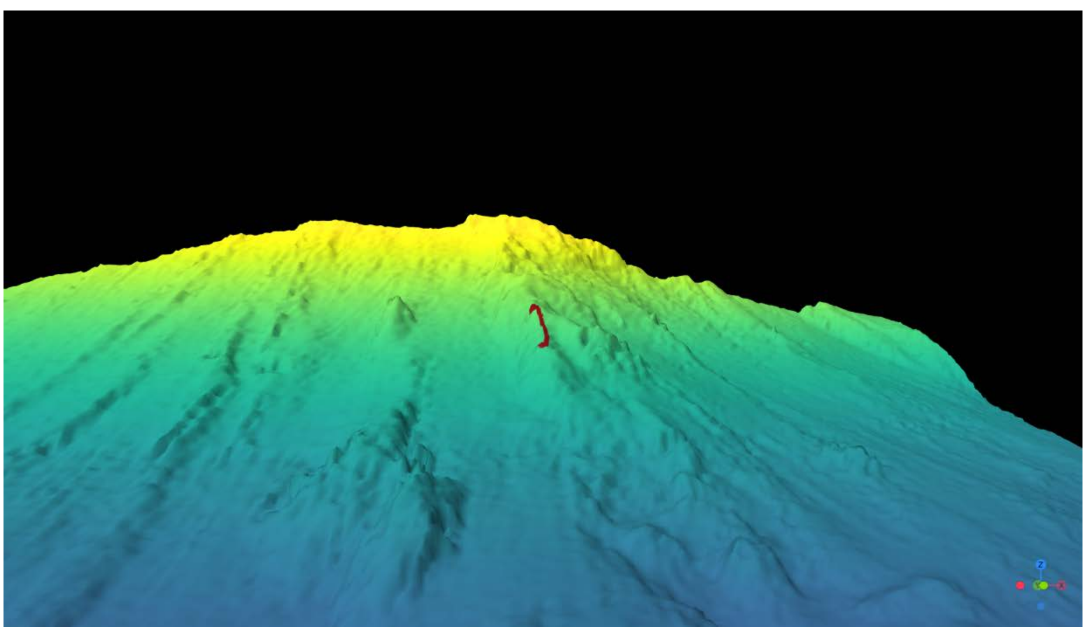
WorkingArea

Name	S Fogo
Island**Latitude**	14º45’05.4780’’N
Longitude	024º21’52.7220’’W
Depth(m)	1990

DiveMaps



3D Overview with ROV trajectory



SampleList

TYPEOFSAMPLES	TOTALNUMBER
Biological	4
Push Cores	2
Niskin	4
Suction	3

DataFiles

FILE	EQUIPMENT	PARAMETERS		OBSERVATIONS
Imirabilis2_D04_S31_SAIV.txt		Conductivity	√	(manufacturer calibration 2019- recommended every 2 years)
		Soundvelocity	√	Calculated (manufacturer calibration 2019- recommended every 2 years)
		Temperature	√	(manufacturer calibration 2019- recommended every 2 years)
		Density	√	Calculated (manufacturer calibration 2019- recommended every 2 years)
		Pressure	√	Calibrated before the dive (manufacturer calibration 2019- recommended every 2 years)
	Oxygen sensor	Percentageof oxygen saturation	√	(manufacturer calibration 2019- recommended every 2 years)

	Turbidity sensor	Turbidity	√	(manufacturer calibration 2019- recommended every 2 years)
Imirabilis2_D04_S31_INS_telemetry.txt	IxBlue INS ROVdata	ROVheading, roll, pitch	√	
Imirabilis2_D04_S31_HIPAP.txt	Kongsberg HIPAPROV position system	ROVposition	√	
Imirabilis2_D04_S31_ABY_telemetry.txt	Compass	Heading	√	
	Gyro	Pitch/roll	√	
	Depth sensor	Depth	√	
	Altimeter	Altitude	√	
Imirabilis2_D04_S31_Idronaut.txt	Idronaut CTD	Salinity	√	Calculated (manufacturer calibration 2019- recommended every 2 years)
		Conductivity	√	(manufacturer calibration 2019- recommended every 2 years)
		Temperature	√	(manufacturer calibration 2019- recommended every 2 years)
		Pressure	√	(manufacturer calibration 2019- recommended every 2 years)

Imirabilis2_D04_S31_Idronaut.txt	Oxygen sensor	Concentration dissolved oxygen and percentageof oxygen saturation	√	Calibratedbefore the dive (manufacturer calibration 2019- recommended every 2 years)
	Fluorescence sensor	Fluorescence	√	(manufacturer calibration 2019- recommended every 2 years)
	Turbidity sensor	Turbidity	√	(manufacturer calibration 2019- recommended every 2 years)
	pHsensor	pH	√	Calibratedbefore the dive (manufacturer calibration 2019- recommended every 2 years)
	Redox potential sensor	Redox potential	√	(manufacturer calibration 2019- recommended every 2 years)
Imirabilis2_D04_S31_Contros.txt	$CH_4$and CO_2sensors	CH_4 and CO_2concentration and pCO_2	√	CH4last calibration in 2016 and verified in 2020(manufacturer doesnotsupport thissensor anymore).CO2 lastcalibrationin 2021(recommended calibration –every year)
UHD Imirabilis2_D04_S31_video_raw_11_08_2021_18_53_15.mov to Imirabilis2_D04_S31_video_raw_12_08_2021_01_35_39.mov **HD** Imirabilis_D04_S31_video_raw_11_08_2021_20_30_51 to Imirabilis2_D04_S31_video_raw_11_08_2021_23_03_14	UHD and HD camera	Video	√	PRORESHQ e PRORES video files(3840x2160; 1980x1020) The UHD files from 20_57_16 to 00_58_00 were acquired without telemetry

Video_Camera 1_OVERLAY_2021-08-11 18-52-05.802Z.mp4 to Video_Camera 1_OVERLAY_2021-08-12 01-55-47.536Z.mp4	UHDcamera	Video	√	MP4 video files(3840x2160) From file 08-11 20-34-46.872Z to 08- 12 01-01-54.863Z the raw resolution was changed from UHD to HD and back from HD to UHD and during capturing
IMG_1875_logo.png toIMG_2560_logo.png IMG_1875_logo.png to IMG_2560_logo.png	Photo Camera	Photo	√	3648x2736pximages with metadatain Imirabilis2_D04_Still_Metadata_luso.csv and Imirabilis2_D04_Still_Metadata_luso_iM2.csv (with only Luso logo or with addition of campaign logo)

2021-08-11_20-26-02.086 - Camera Viewer - Camera 1 - video.jpg to 2021-08-12_00-57-43.296 - Camera Viewer - Camera 1.jpg 2021-08-11_20-26-02.086 - Camera Viewer - Camera 1 - video_logo.png to 2021-08-12_00-57-43.296 - Camera Viewer - Camera 1 - video_logo.png 2021-08-11_20-26-02.086 - Camera Viewer - Camera 1 - video_logo.png to 2021-08-12_00-57-43.296 - Camera Viewer - Camera 1 - video_logo.png	UHDcamera	Still image	√	Name of the file has the suffix: • "- Video.jpg" has overlay info on the image These images comefromthe videowith Overlay showedon the screenduringthe dive; • "-Video_luso.png" no overlay, but luso logo on the image; • "-Video_luso_iM2.png" no overlay, but luso and campaign logo on the image;

Products

FILE	OBSERVATIONS
Imirabilis2_D04_S31_Contros.txt	Controsdata

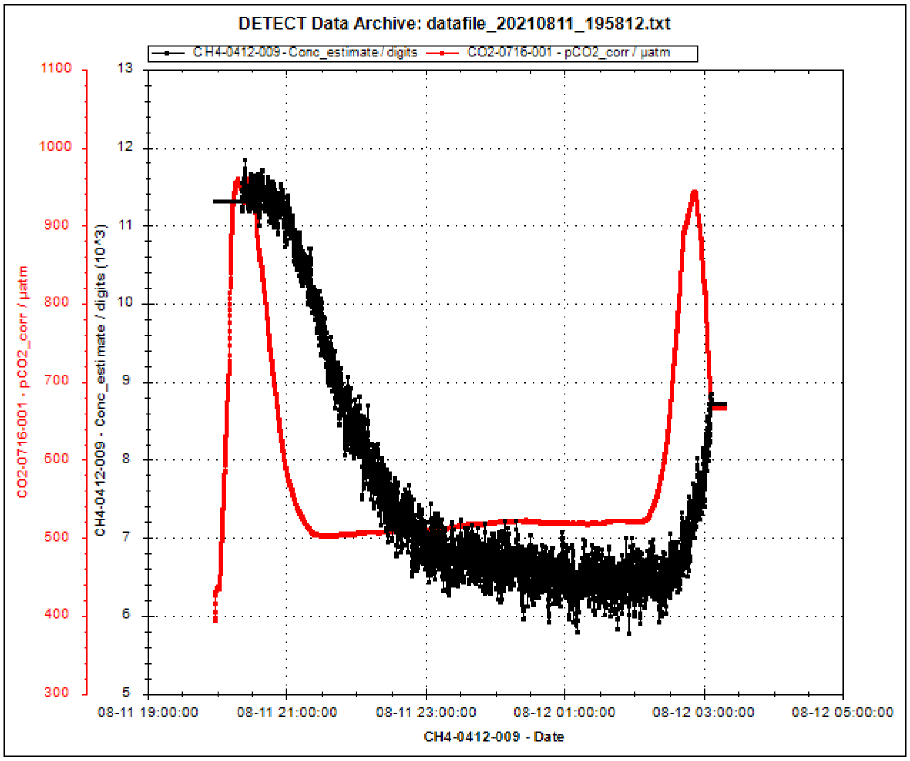
Imirabilis2_D04_S31_Idronaut.TXT	Idronaut data
Imirabilis2_D04_S31_SAIV.txt	SAIV data
Imirabilis2_D04_S31_ABY_telemetry.txt Imirabilis2_D04_S31_INS_telemetry.txt	Telemetry data
Imirabilis2_D04_S31_HIPAP.txt	Position data
Imirabilis2_D04_S31_ROV_trajectory.prj/qpj/shp/shx/dbf	Shape-file withtrajectory
Imirabilis2_D04_S31_QGIS_pic.png	QGISimagewith ROV trajectoryonbathymetry
Imirabilis2_D04_S31_Olex_map.tif	Oleximage with ROVtrajectory,profileand samples
Imirabilis2_D04_Still_Metadata_luso_iM2.csv and Imirabilis2_D04_Still_Metadata_luso.csv	Informationretrievedusinga software downloadedfromthe internetand not deliveredbyKongsberg
Imirabilis2_D04_S31_Contros.png	Controsdata graphic
Imirabilis2_D04_S31_Idronaut_graph.png	Idronautdata graphic
8 UHD/ 2 HD	Raw UHDvideos
44 videos	Abyssal videos with video overlay information
686 images	Images from photo camera
47 images	Still images from video
Imirabilis_D04_S31_ship_1.jpg Imirabilis_D04_S31_ship_2.jpg	DP ship conditions

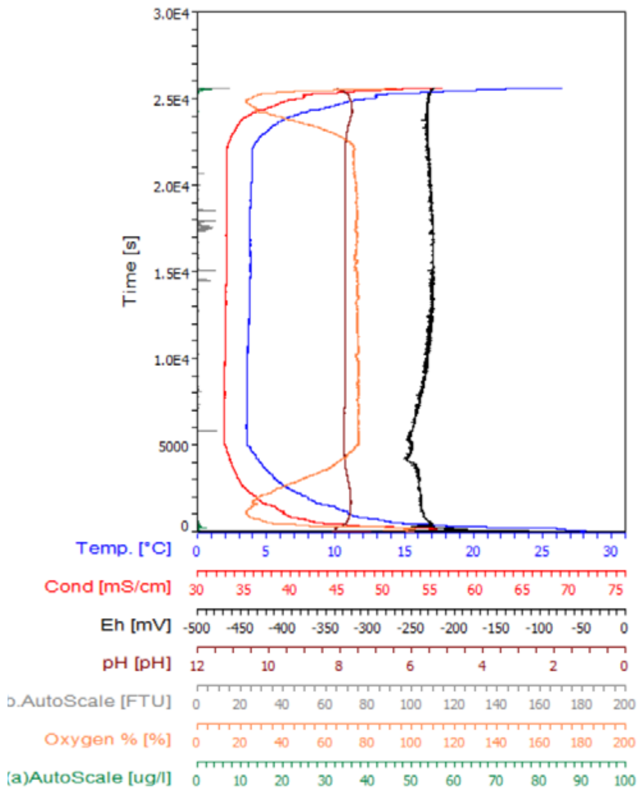
HelpFiles

FILE	OBSERVATIONS
CONTROS HydroC® CH4 data format.jpg	Imirabilis2_DXX_SXX_Contros.txt data format(CH_4columns)
CONTROS HydroC® CO2 data format.jpg	Imirabilis2_DXX_SXX_Contros.txt data format(CO_2columns)
ABY telemetry data format.pdf	Imirabilis2_DXX_SXX_ABY_telemetry.txtdata format
Idronaut data format.txt	Imirabilis2_DXX_SXX_Idronaut.txt data format
HIPAP data format.pdf	Imirabilis2_DXX_SXX_HIPAP.txt data format
SAIV data format.txt	imirabilis2_DXX_SXX_SAIV.txt data format

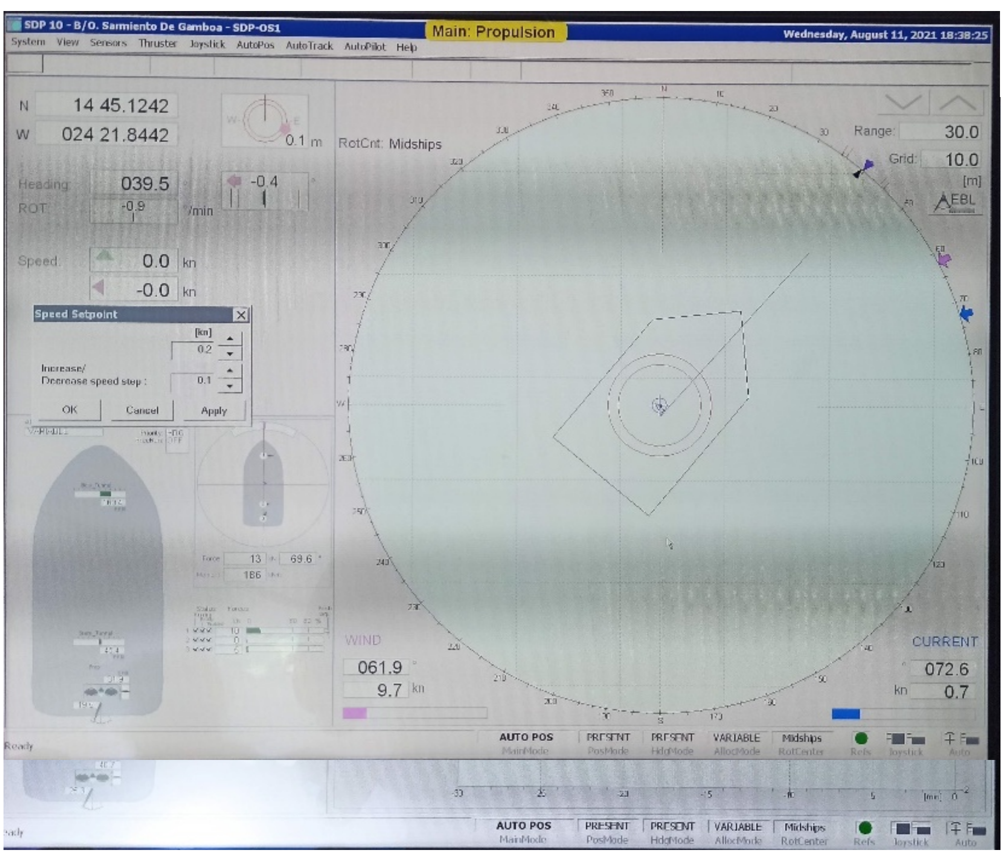
INS_telemetry data format.pdf	Imirabilis2_DXX_SXX_INS_telemetry.txt data format

DataGraphs





Meteorologicaland Ocean Conditions



TechnicalDiveLog

Time	DESCRIPTION - AUG 11, 2021	TAGS
13:15:25	All ok. New video software to record 4K video tested and will be used during the dive.	Pre-dive checks
14:25:30	Idronaut and SAIV pressure sensors calibrated. Oxygen Idronaut sensor calibrated.	Sensors
18:55:05	Some problems with the low light camera that looks at the front of the ROV.	Off deck
19:02:32	INS not receiving the position.	Sensors
19:03:57	INS restarted. Heading in the video stopped being showed.	Sensors
19:04:45	INS did not start. Turned off and on again. INs working again.	Sensors
19:06:59	Telemetry information in the video stopped from being showed.	Sensors
19:08:30	EIVA restarted. Video was not receiving telemetry data.	Sensors
19:11:33	Error opening a video file. Abyssal video with another video being showed.	Sensors
19:24:54	Raw video recording stopped for some seconds; A new files was created.	Sensors
19:44:13	4k still flickering	
19:45:06	RB (Pilot), BR(Copilot), MS(Winch)	Pilot exchange
20:22:43		At bottom
20:39:20	UHD camera disconnected. HD working now. The 4k recording was not stopped during the change but now yes.	Sensors
20:57:43	Direct take software changed back again to 4k. Abyssal and hyperdeck working with HD.	Sensors
21:04:36	BR (Pilot) AC (CoPilot), RB (Winch)	Pilot exchange
23:30:47	AC (Pilot) AA (Co-pilot), BR (Winch)	Pilot exchange
	AUG 12, 2021	
1:03:14	Test the 4k in HD	Off bottom
1:15:52	Stop the recording in hyperdeck; direct take the recording stopped with no apparent explanation	
1:20:30	Reboot pc overlay	
1:27:04	INS turned off: Eiva restarted	
1:30:10	Heading is wrong in the video	
1:41:57	AC (pilot); MS (co-pilot); AA (winch)	Pilot exchange
1:52:31	Turn off contros pumps. Turn off Idronaut, SAIV. and Contros. Stop recording. Turn off still cam. Altimeter and sonar already turned off.	
1:59:07	Testing sharing the direct the video using Anydesk software	
2:03:00		On deck

iMirabilis2_D05_S46– NW Cadamosto Seamount

iMirabilis2

TECHNICALDIVEREPORT 15/08/2021

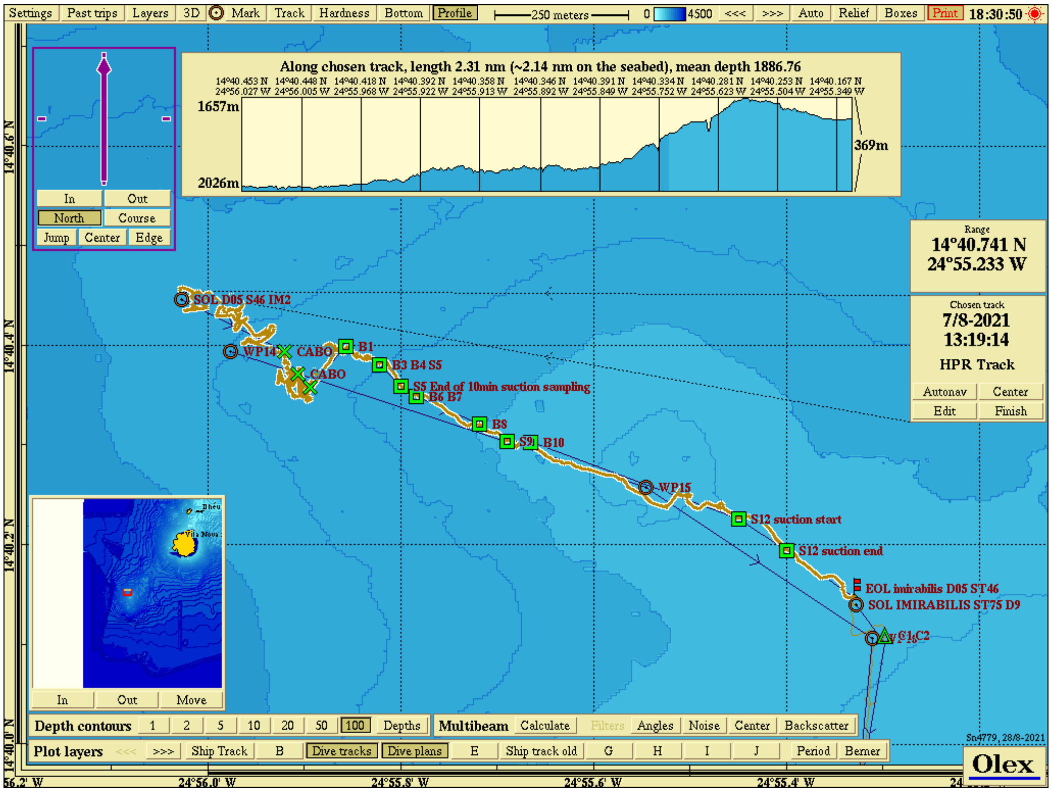
General Dive Details

Campaign	iMirabilis2
OperationCode	iMirabilis2_D05_S46
Vessel	R/V SarmientodeGamboa
Institution	CSIC, IEO and EMEPC; iAtlantic project
OperationSupervisor	AntónioCalado
ScientificCoordinator	Covadonga Orejas and Beatriz Vinha
ROV Supervisor	AntónioCalado
ROV Team	AntónioCalado,AndreiaAfonso,BrunoRamos, Miguel Souto,RenatoBettencourt
TypeofOperation	ROVDive– scientificsurvey (biological sampling and habitat mapping)
Equipment	ROV Luso
DateandTime(UTC)	15thAugustde 202111:44
Duration (HH:mm:ss)	10:47:00

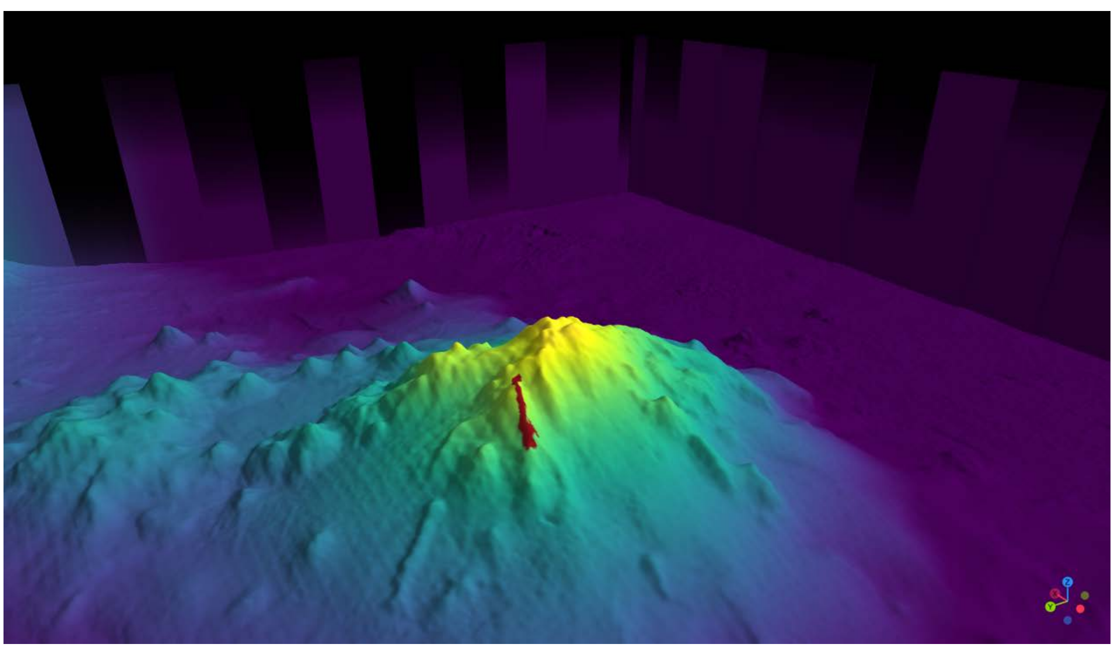
WorkingArea

Name	NW Fogo Cadamosto Seamount
Latitude	14º40’24.7560’’N
Longitude	024º56’01.9440’’W
Depth(m)	2000

DiveMaps



3D Overview with ROV trajectory



SampleList

TYPEOFSAMPLES	TOTALNUMBER
Biological	8
Push Cores	1
Niskin	4
Suction	3

DataFiles

FILE	EQUIPMENT	PARAMETERS		OBSERVATIONS
imirabilis2_D05_S46_SAIV_1.txt	SAIVCTD	Salinity	√	Calculated(manufacturer calibration 2019-recommended every 2 years)
		Conductivity	√	(manufacturer calibration 2019-recommended every 2 years)
		Soundvelocity	√	Calculated (manufacturer calibration 2019-recommended every 2 years)
		Temperature	√	(manufacturer calibration 2019-recommended every 2 years)
		Density	√	Calculated (manufacturer calibration 2019-recommended every 2 years)
		Pressure	√	Calibrated before the dive (manufacturer calibration 2019-recommended every 2 years)

	Oxygen sensor	Concentration dissolvedoxygenand percentageof oxygen saturation	√	(manufacturer calibration 2019-recommended every 2 years)
	Turbidity sensor	Turbidity	√	(manufacturer calibration 2019-recommended every 2 years)
Imirabilis2_D05_S46_INS_telemetry.txt	IxBlue INS ROVdata	ROVheading,roll, pitch	√	
Imirabilis2_D05_S46_HIPAP.txt	Kongsberg HIPAPROV position system	ROVposition	√	
Imirabilis2_D05_S46_ABY_telemetry.txt	Compass	Heading	√	
	Gyro	Pitch/roll	√	
	Depth sensor	Depth	√	
	Altimeter	Altitude	√	
Imirabilis2_D05_S46_Idronaut.TXT	Idronaut CTD	Salinity	√	Calculated (manufacturer calibration 2019-recommended every 2 years)
		Conductivity	√	(manufacturer calibration 2019-recommended every 2 years)
		Temperature	√	(manufacturer calibration 2019-recommended every 2 years)

		Pressure	√	(manufacturer calibration 2019- recommended every 2 years)
	Oxygen sensor	Concentration dissolved oxygen and percentageof oxygen saturation	√	Calibratedbefore the dive (manufacturer calibration 2019- recommended every 2 years)
	Fluorescence sensor	Fluorescence	√	(manufacturer calibration 2019- recommended every 2 years)
	Turbidity sensor	Turbidity	√	(manufacturer calibration 2019- recommended every 2 years)
Imirabilis2_D05_S46_Idronaut.TXT	pHsensor	pH	√	Calibratedbefore the dive (manufacturer calibration 2019- recommended every 2 years)
	Redox potential sensor	Redox potential	√	(manufacturer calibration 2019- recommended every 2 years)
Imirabilis2_D05_S46_Contros.txt	$CH_4$and CO_2sensors	CH_4 and CO_2concentration and pCO_2	√	CH4last calibration in 2016 and verified in 2020(manufacturer doesnotsupport thissensor anymore).CO2 lastcalibrationin 2021(recommended calibration –every year)
UHD Imirabilis_D05_S46_15_08_2021_11_32_32 to Imirabilis_D05_S46_15_08_2021_20_56_48 **HD** Imirabilis_D05_S46_15_08_2021_12_42_48 to Imirabilis2_D05_S46_15_08_2021_22_13_41	UHD and HD camera	Video	√	PRORESHQ and PRORESvideo files(3840x2160; 1920x1080) The UHD files from 19_40_26 to 20_56_48 were acquired without telemetry

Video_Camera 1_OVERLAY_2021-08-15 11-37-19.939Z.mp4to Video_Camera 1_OVERLAY_2021-08-15 22-30-46.271Z.mp4	UHDcamera	Video	√	MP4 video files(3840x2160) From file 08-15 19-34-57.753Z to 08-15 22-30-46.271Z the raw resolution was changed from UHD to HD during capturing
IMG_0386_luso.png to IMG_1062_luso.png IMG_2595_logo_luso_IM2.png to IMG_3636_logo_luso_IM2.png	Photo Camera	Photo	√	3648x2736pximages with metadadain Imirabilis2_D05_S46_Still_Metadata_luso.csv and Imirabilis2_D05_S46_Still_Metadata_luso_iM2.csv (with only Luso logo or with addition of campaign logo)
2021-08-15_14-51-45.968 - Camera Viewer - Camera 1.jpg to 2021-08-15_19-55-35.785 - Camera Viewer - Camera 1.jpg 2021-08-15_14-51-45.968 - Camera Viewer - Camera 1 - video_logo_luso.png to 2021-08-15_19-55-35.785 - Camera Viewer - Camera 1 - video_logo_luso.png 2021-08-15_14-51-45.968 - Camera Viewer - Camera 1 - video_logo_luso_IM2.png to 2021-08-15_19-55-35.785 - Camera Viewer - Camera 1 - video_logo_luso_IM2.png	UHDcamera	Still image	√	Name of the file has the suffix: • “- Video.jpg” has overlay info on the image These images comefromthe videowith Overlay showedon the screenduringthe dive; • “- Video_luso.png” no overlay, but luso logo on the image; • “- Video_luso_iM2.png” no overlay, but luso and campaign logo on the image;

Products

FILE	OBSERVATIONS
Imirabilis2_D05_S46_Contros.txt	Controsdata

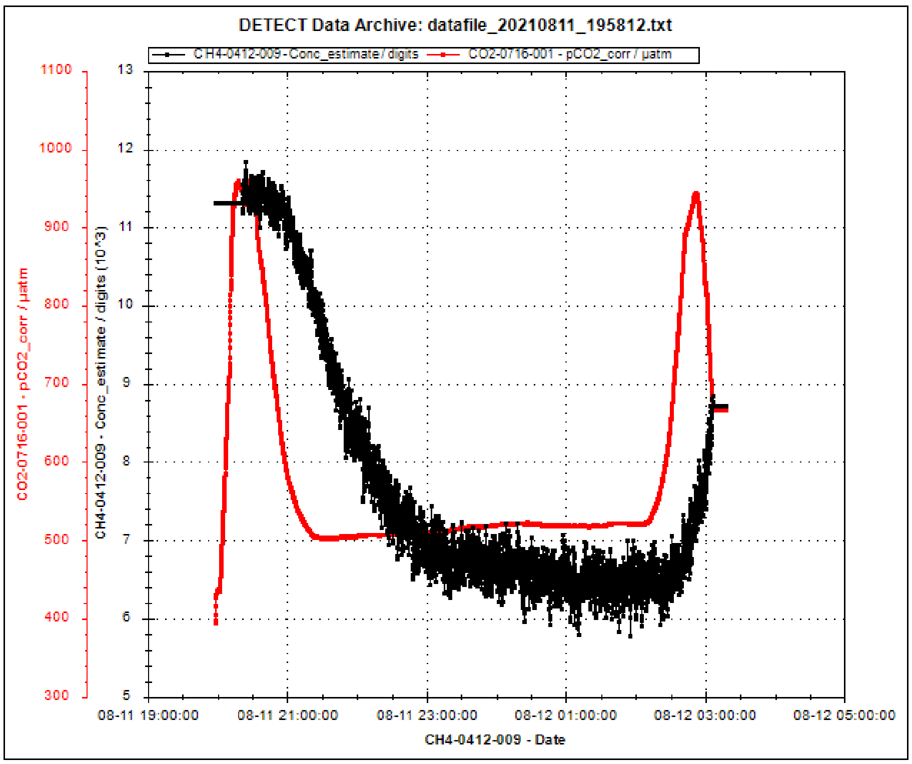
Imirabilis2_D05_S46_Idronaut.TXT	Idronaut data
Imirabilis2_D05_S46_SAIV.txt	SAIV data
Imirabilis2_D05_S46_INS_telemetry.txt Imirabilis2_D05_S46_ABY_telemetry.txt	Telemetry data
Imirabilis2_D05_S46_HIPAP.txt	Position data
Imirabilis2_D05_S46_ROV_trajectory.prj/qpj/shp/shx/dbf	Shape-file withtrajectory
Imirabilis2_D05_S46_QGIS_pic.png	QGISimagewith ROV trajectoryonbathymetry
Imirabilis2_D05_S46_Olex_map.tif	Oleximage with ROVtrajectory,profileand samples
Imirabilis2_D05_S46_Still_Metadata_luso.csv and Imirabilis2_D05_S46_Still_Metadata_luso_iM2.csv	Informationretrievedusinga software downloadedfromthe internetand not deliveredbyKongsberg
Imirabilis2_D05_S46_Contros_graph.png	Controsdata graphic
Imirabilis2_D05_S46_Idronaut_graph.png	Idronautdata graphic
Imirabilis2_D05_S37_SAIV_graph.png	SAIV data graphic
8 HD /4 UHD	Raw UHD/HD videos
62 videos	Abyssal videos with video overlay information
1041 images	Images from photo camera
57 images	Still images from video
Imirabilis_D05_S46_ship_1.JPG Imirabilis_D05_S46_ship_2.JPG	DP ship conditions

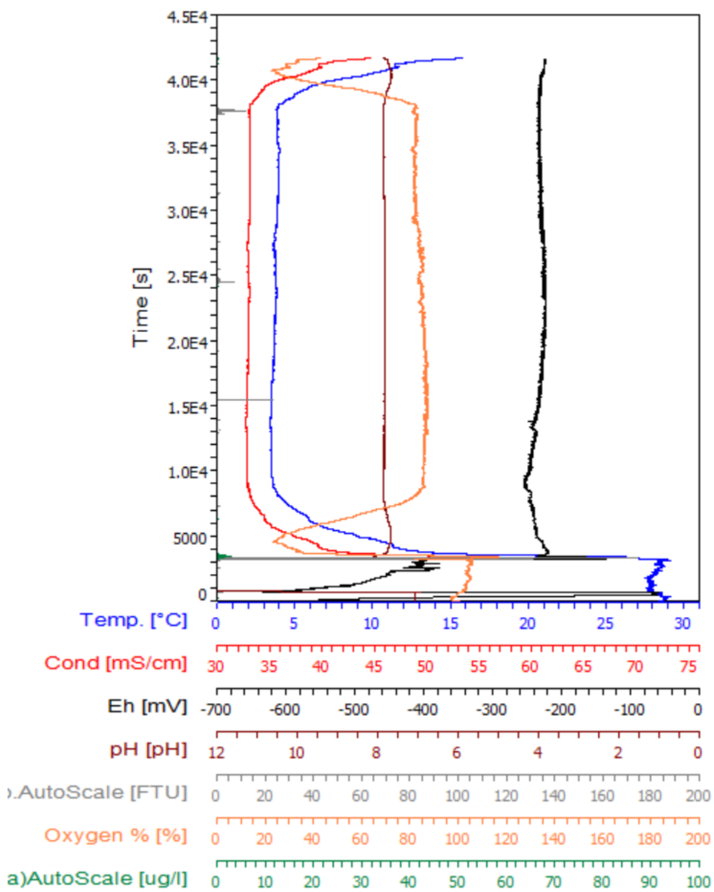
HelpFiles

FILE	**OBSERVATIONS**
CONTROS HydroC® CH4 data format.jpg	Imirabilis2_DXX_SXX_Contros.txt data format(CH_4columns)
CONTROS HydroC® CO2 data format.jpg	Imirabilis2_DXX_SXX_Contros.txt data format(CO_2columns)
ABY telemetry data format.pdf	Imirabilis2_DXX_SXX_ABY_telemetry.txtdata format
Idronaut data format.txt	Imirabilis2_DXX_SXX_Idronaut.txt data format
HIPAP data format.pdf	Imirabilis2_DXX_SXX_HIPAP.txt data format

SAIV data format.txt	imirabilis2_DXX_SXX_SAIV.txt data format
INS_telemetry data format.pdf	Imirabilis2_DXX_SXX_INS_telemetry.txt data format

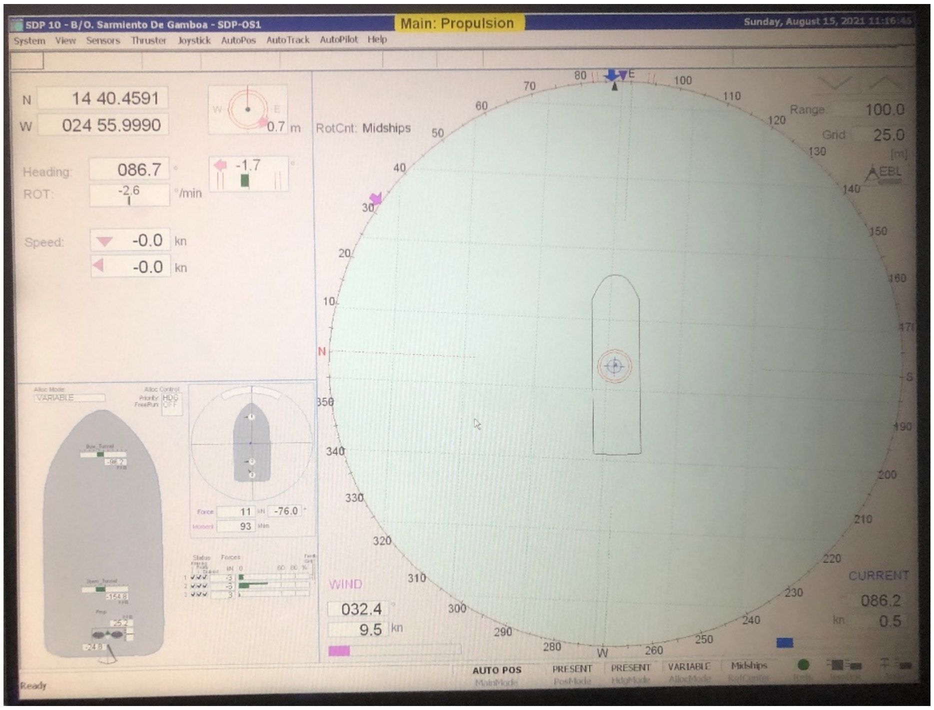
DataGraphs

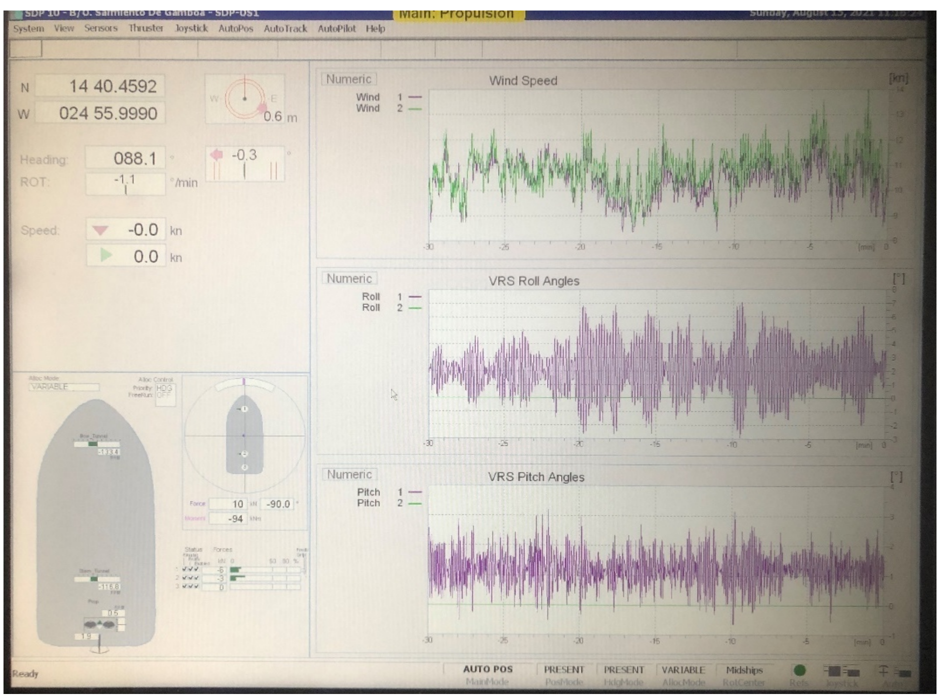



Time [s]
4.5E4
4.0E4
3.5E4
3.0E4
2.5E4
2.0E4
1.5E4
1.0E4
5000
0
Temp. [°C] 0 5 10 15 20 25 30
Cond [mS/cm] 30 35 40 45 50 55 60 65 70 75
Eh [mV] -700 -600 -500 -400 -300 -200 -100 0
pH [pH] 12 10 8 6 4 2 0
).AutoScale [FTU] 0 20 40 60 80 100 120 140 160 180 200
Oxygen % [%] 0 20 40 60 80 100 120 140 160 180 200
a)AutoScale [ug/l] 0 10 20 30 40 50 60 70 80 90 100


Data displayed from: 11:44:31 - 15.Aug-21 (No. 2084) To: 22:23:21 - 15.Aug-21 (No: 21249)
0.0 20.0
0.0 20.0
0.0 20.0
20.0 40.0
0 2000 0.0 50.0 0.0
0 m
33
67
100
133
167
200
233
267
300
333
367
400
433
467
500
533
567
600
633
Select active graphs
OpOx % 97.41
T (FTU) 9.90
S. vel. 1509.67
Density 26.974
mg/l 7.88
Ox %
Temp 15.100
Cond. 43.79
Sal. 35.66
Press 116.0100
Graph base
Press(db)
Time (minutes)
Wide graphs
Show all points
Hide
Close

Meteorologicaland Ocean Conditions





TechnicalDiveLog

Time	DESCRIPTION - AUG 15, 2021	TAGS
13:12:04	Tardis in OFOP is not working fine. The computer's clock was changed to be equal to Olex's clock because it is synchronized with the ship GPS	Computers
13:35:16	Idronaut pressure and oxygen sensors calibrated. SAIV pressure sensor calibrated. SAIV clock is good, don't need to calibrate.	Sensors
10:16:13	Ok. Second try of the dive. Idronaut pH, pressure and O2 calibrated. Data coming into Abyssal changed to go only with the SRV telemetry time stamp	Pre-dive checks
11:44:00	Streaming to bridge being tested.	Off deck
11:46:39	Position was not available for some seconds and now we are waiting to stabilize the position	Sensors
11:48:05	We have position of the ROV	
11:49:08	Camera turned off to see if it starts better again. It was working in air and maybe the high temperature created this issue.	Sensors
11:51:49	Contros pumps turned on.	Sensors
12:00:58	AA (Pilot),RB (Co-Pilot),AC (AC)	Pilot exchange
12:07:33	4k camera turned on again.	
12:09:05	4k camera changed to HD to check if it changes its behaviour for better.	Sensors
12:12:59	Camera turned off again	Sensors
12:13:51	Start recording in HD and it seems to be working better.	Sensors
12:39:44	After several tests the 4k camera is not working and HD seems that it is working better. Start recording again.	Sensors
13:16:51	Recording in Direct take changed to Prores HQ and it was before as ProRes proxy.	Sensors
13:18:00		At bottom
13:23:10	Sonar start recording.	Sensors
14:51:17	MS (Pilot), RB (Co-pilot), AA (Winch)	Pilot exchange
15:12:43	Cable on the seafloor but was hanging on the water column. We moved away	Other
17:02:24	RB (Pilot), BR (Co-pilot), MS (Winch)	Pilot exchange
17:21:43	Flux stopped working.	Sensors
17:31:07	Flux working again.	Sensors
19:17:22	BR (Pilot), AC (Co-pilot), RB (Winch)	Pilot exchange
19:42:15	4K camera in FullHD mode was flickering a lot. We have tried the 4K setting and was flickering as well. We moved to the old FullHD cam. Some breaks in the direct take.	Image
21:20:00		Off bottom
21:29:56	AC (Pilot), AA (Co-pilot), BR (Winch)	Pilot exchange
22:09:57	AC (pilot); MS (co-pilot); AA (winch)	Pilot exchange
22:14:29	Contros pumps turned off	Sensors
22:25:13	SAIV and Idronaut stopped the acquisition to data files	Sensors
22:31:00		On deck
23:01:49	Ok	Post-dive checks

iMirabilis2_D06_S55– S Cadamosto Seamount

iMirabilis2

TECHNICALDIVEREPORT 17/08/2021

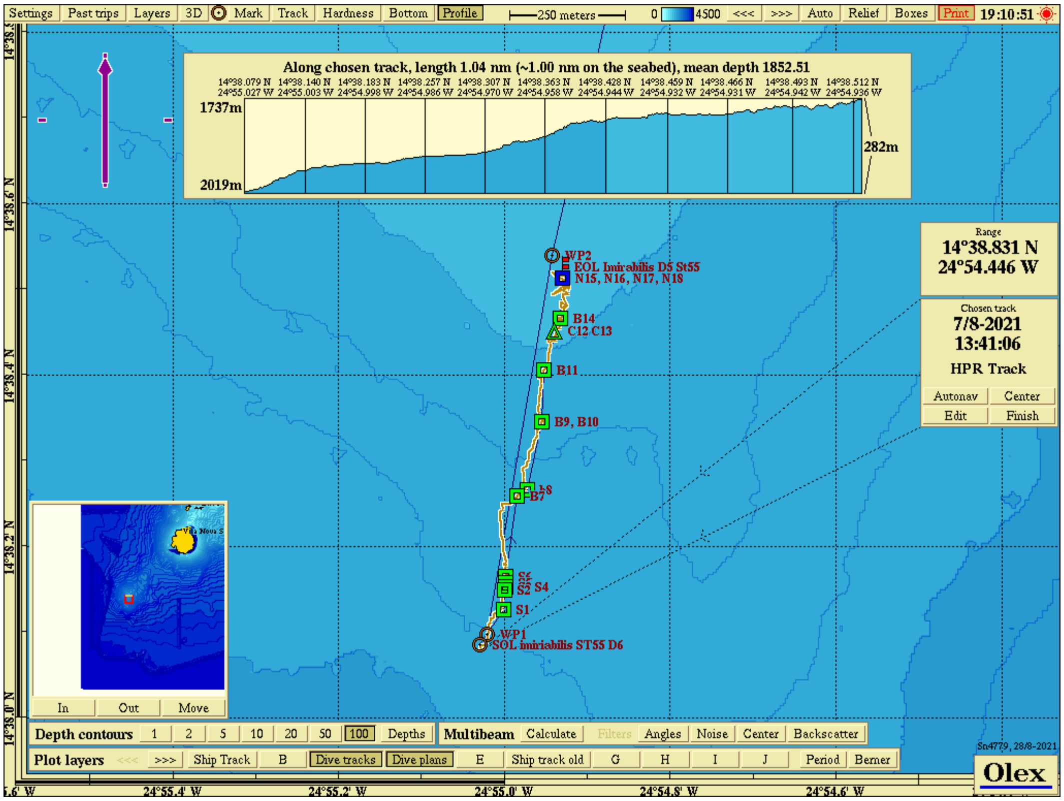
General Dive Details

Campaign iMirabilis2
OperationCode iMirabilis2_D06_S55
Vessel R/V SarmientodeGamboa
Institution CSIC, IEO and EMEPC; iAtlantic
project**OperationSupervisor** AntónioCalado
ScientificCoordinator Covadonga Orejas and Beatriz Vinha
ROV Supervisor AntónioCalado
ROV Team AntónioCalado,AndreiaAfonso,BrunoRamos, Miguel Souto,RenatoBettencourt
TypeofOperation ROVDive– scientificsurvey (biological sampling and habitat mapping)
Equipment ROV Luso
DateandTime(UTC) 17thAugustde 202112:21
Duration (HH:mm:ss) 07:51:00

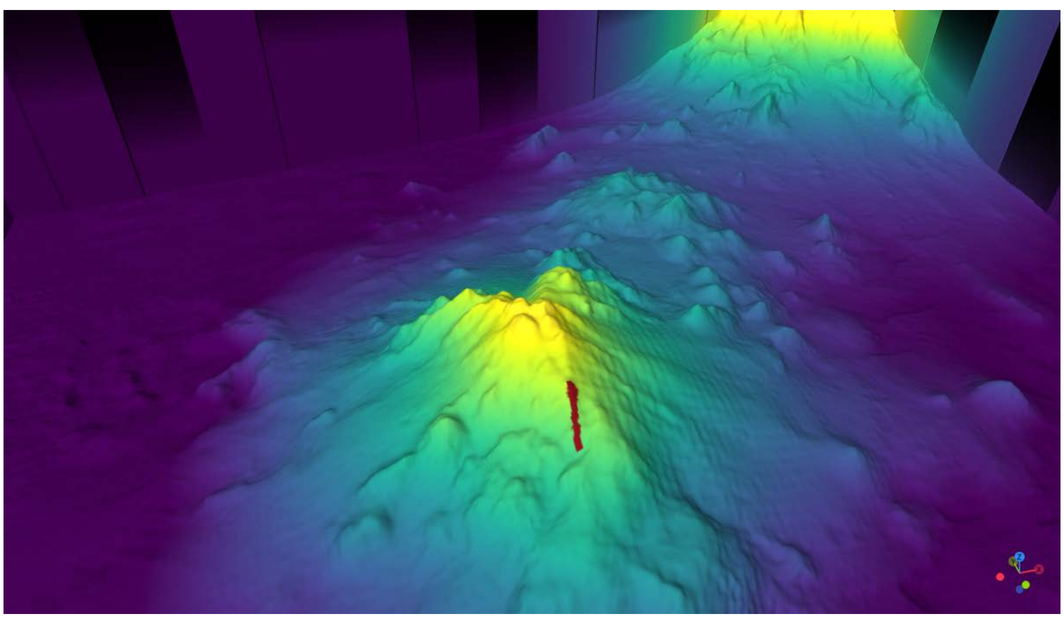
WorkingArea

Name S Cadamosto
Seamount**Latitude** 14º38'03.9180''N
Longitude 024º55'01.8480''W
Depth(m) 2000

DiveMaps



3D Overview with ROV trajectory



SampleList

TYPEOFSAMPLES	TOTALNUMBER
Biological	5
Push Cores	2
Niskin	4
Suction	6

DataFiles

FILE	EQUIPMENT	PARAMETERS		OBSERVATIONS
Imirabilis2_D06_S55_SAIV.txt	SAIVCTD	Salinity	√	Calculated(manufacturer calibration 2019-recommended every 2 years)
		Conductivity	√	(manufacturer calibration 2019-recommended every 2 years)
		Soundvelocity	√	Calculated (manufacturer calibration 2019-recommended every 2 years)
		Temperature	√	(manufacturer calibration 2019-recommended every 2 years)
		Density	√	Calculated (manufacturer calibration 2019-recommended every 2 years)
		Pressure	√	Calibrated before the dive (manufacturer calibration 2019-recommended every 2 years)

	Oxygen sensor	Concentration dissolvedoxyge nand percentageof oxygen saturation	√	(manufacturer calibration 2019-recommended every 2 years)
	Turbidity sensor	Turbidity	√	(manufacturer calibration 2019-recommended every 2 years)
Imirabilis2_D06_S55_INS_telemetry.txt	IxBlue INS ROVdata	ROVheading,roll, pitch	√	
Imirabilis2_D06_S55_HIPAP.txt	Kongsberg HIPAPROV position system	ROVposition	√	
Imirabilis2_D06_S55_ABY_telemetry.txt	Compass	Heading	√	
	Gyro	Pitch/roll	√	
	Depth sensor	Depth	√	
	Altimeter	Altitude	√	
Imirabilis2_D06_S55_Idronaut.TXT	Idronaut CTD	Salinity	√	Calculated (manufacturer calibration 2019-recommended every 2 years)
		Conductivity	√	(manufacturer calibration 2019-recommended every 2 years)
		Temperature	√	(manufacturer calibration 2019-recommended every 2 years)

		Pressure	√	(manufacturer calibration 2019- recommended every 2 years)
	Oxygen sensor	Concentration dissolved oxygen and percentageof oxygen saturation	√	Calibratedbefore the dive (manufacturer calibration 2019- recommended every 2 years)
	Fluorescence sensor	Fluorescence	√	(manufacturer calibration 2019- recommended every 2 years)
	Turbidity sensor	Turbidity	√	(manufacturer calibration 2019- recommended every 2 years)
Imirabilis2_D06_S55_Idronaut.TXT	pHsensor	pH	√	Calibratedbefore the dive (manufacturer calibration 2019- recommended every 2 years)
	Redox potential sensor	Redox potential	√	(manufacturer calibration 2019- recommended every 2 years)
Imirabilis2_D06_S55_Contros.txt	$CH_4$and CO_2sensors	CH_4 and CO_2concentration and pCO_2	√	CH4last calibration in 2016 and verified in 2020(manufacturer doesnotsupport thissensor anymore).CO2 lastcalibrationin 2021(recommended calibration –every year)
UHD Imirabilis2_D06_S55_video_raw_17_8_2021_12_18_38.mov to Imirabilis2_D06_S55_video_raw_17_8_2021_18_29_43.mov **HD** Imirabilis2_D06_S55_video_raw_17_8_2021_12_17_44.movto Imirabilis2_D06_S55_video_raw_17_8_2021_19_54_54.mov	UHD and HDcamera	Video	√	PRORESHQ and PRORESvideo files(3840x2160;1920x1080) The UHD files from 12_18_38 to 19_19_26 were acquired without telemetry

Video_Camera 1_OVERLAY_2021-08-17 12-17-29.959Z.mp4to Video_Camera 1_OVERLAY_2021-08-17 20-10-26.604Z.mp4	UHDcamera	Video	√	MP4 video files(3840x2160)
IMG_2587_logo_luso.pngtoIMG_3345_logo_luso.png IMG_2587_logo_luso_IM2.png toIMG_3345_logo_luso_IM2.png	Photo Camera	Photo	√	3648x2736pximages with metadadain Imirabilis2_D06_S5_Still_Metadata_luso.csv and Imirabilis2_D06_S55_Still_Metadata_luso_iM2.csv (with only Luso logo or with addition of campaign logo)
2021-08-17_13-42-07.148 - Camera Viewer - Camera 1.jpg to 2021-08-17_18-08-45.261 - Camera Viewer - Camera 1.jpg 2021-08-17_13-42-07.148 - Camera Viewer - Camera 1 - video_logo_luso.pngto 2021-08-17_18-08-45.261 - Camera Viewer - Camera 1 - video_logo_luso.png 2021-08-17_13-42-07.148 - Camera Viewer - Camera 1 - video_logo_luso_IM2.png to 2021-08-17_18-08-45.261 - Camera Viewer - Camera 1 - video_logo_luso_IM2.png	UHDcamera	Still image	√	Name of the file has the suffix: • "- Video.jpg" has overlay info on the image These images comefromthe videowith Overlay showedon the screenduringthe dive; • "- Video_luso.png" no overlay, but luso logo on the image; • "- Video_luso_iM2.png" no overlay, but luso and campaign logo on the image;

Products

FILE	OBSERVATIONS
Imirabilis2_D06_S55_Contros.txt	Controsdata
Imirabilis2_D06_S55_Idronaut.TXT	Idronaut data
Imirabilis2_D06_S55_SAIV.txt	SAIV data

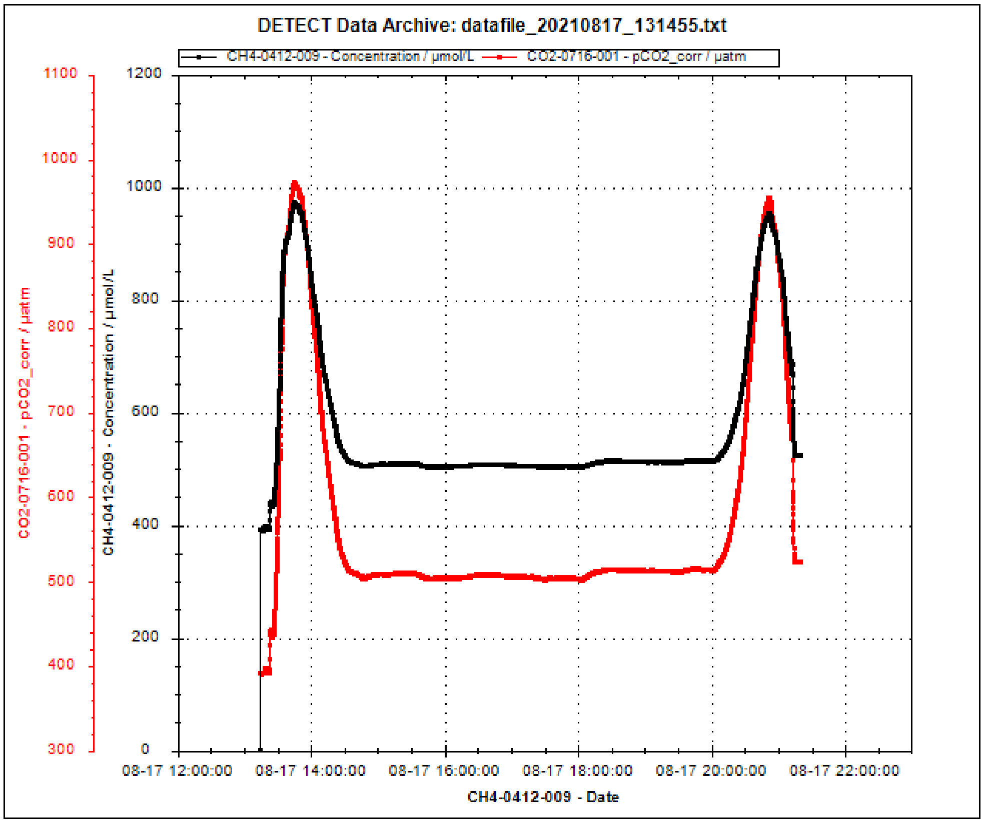
Imirabilis2_D06_S55_INS_telemetry.txt Imirabilis2_D06_S55_ABY_telemetry.txt	Telemetry data
Imirabilis2_D06_S55_HIPAP.txt	Position data
Imirabilis2_D06_S55_ROV_trajectory.prj/qpj/shp/shx/dbf	Shape-file withtrajectory
Imirabilis2_D06_S55_QGIS_pic.png	QGISimagewith ROV trajectoryonbathymetry
Imirabilis2_D06_S55_Olex_map.tif	Oleximage with ROVtrajectory,profileand samples
Imirabilis2_D06_S5_Still_Metadata_luso.csv and Imirabilis2_D06_S55_Still_Metadata_luso_iM2.csv	Informationretrievedusinga software downloadedfromthe internetand not deliveredbyKongsberg
Imirabilis2_D06_S55_Contros_graph.png	Controsdata graphic
Imirabilis2_D06_S55_Idronaut.png	Idronautdata graphic
Imirabilis2_D06_S55_SAIV.png	SAIV data graphic
4HD/8UHD	Raw UHD/HD videos
47 videos	Abyssal videos with video overlay information
758 images	Images from photo camera
61 images	Still images from video
Imirabilis_D06_S55_ship_1.jpg Imirabilis_D06_S55_ship_2.jpg	DP ship conditions

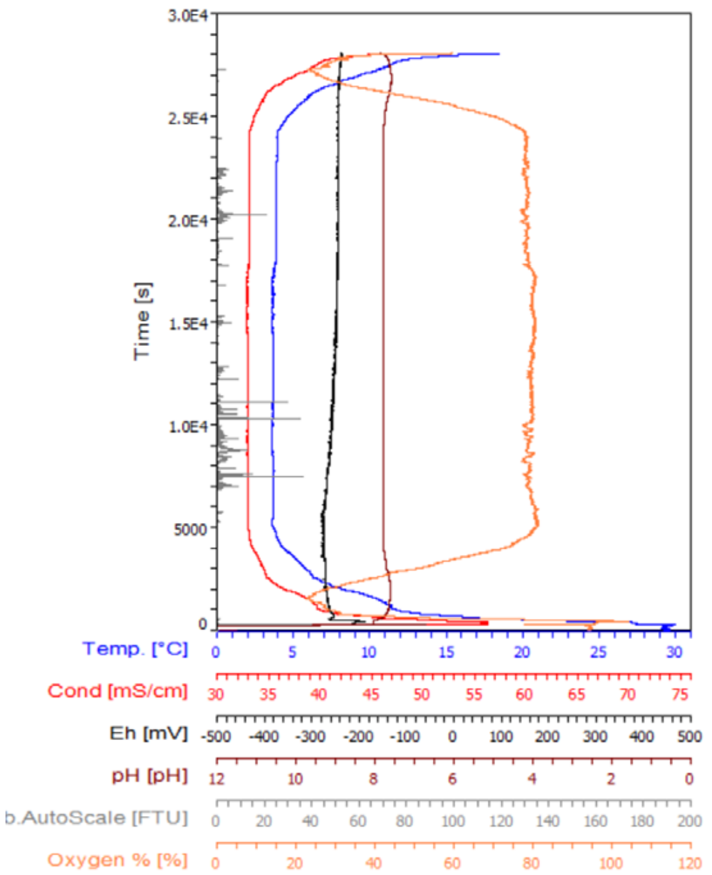
HelpFiles

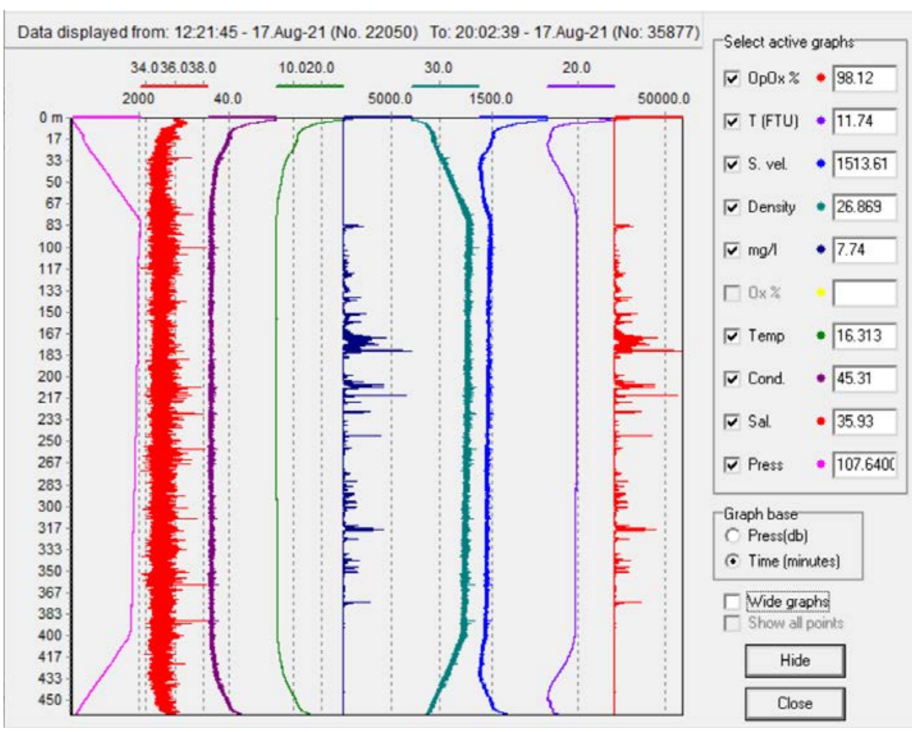
FILE	OBSERVATIONS
CONTROS HydroC® CH4 data format.jpg	Imirabilis2_DXX_SXX_Contros.txt data format(CH_4columns)
CONTROS HydroC® CO2 data format.jpg	Imirabilis2_DXX_SXX_Contros.txt data format(CO_2columns)
ABY telemetry data format.pdf	Imirabilis2_DXX_SXX_ABY_telemetry.txtdata format
Idronaut data format.txt	Imirabilis2_DXX_SXX_Idronaut.txt data format
HIPAP data format.pdf	Imirabilis2_DXX_SXX_HIPAP.txt data format
SAIV data format.txt	imirabilis2_DXX_SXX_SAIV.txt data format

INS_telemetry data format.pdf	Imirabilis2_DXX_SXX_INS_telemetry.txt data format

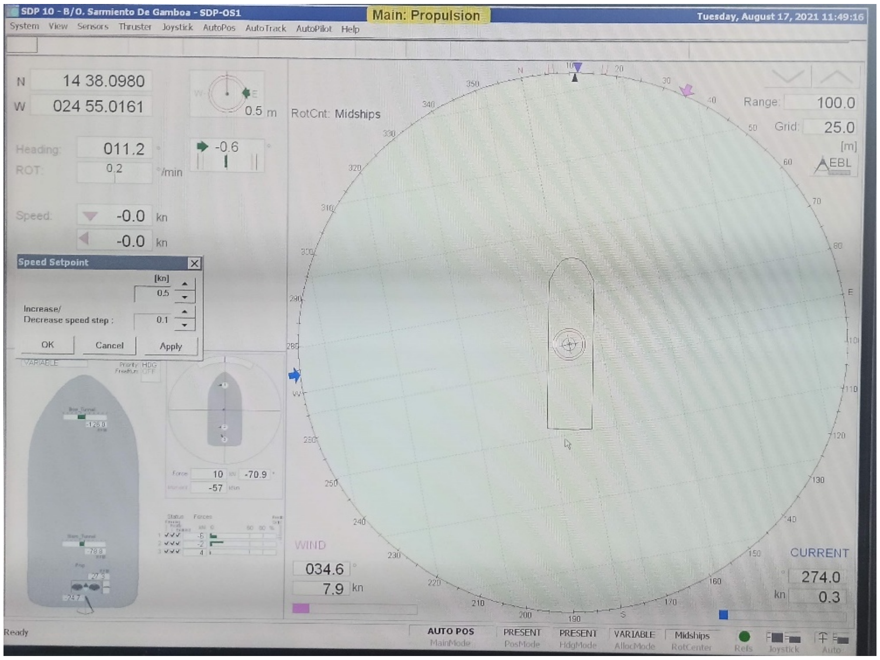
DataGraphs

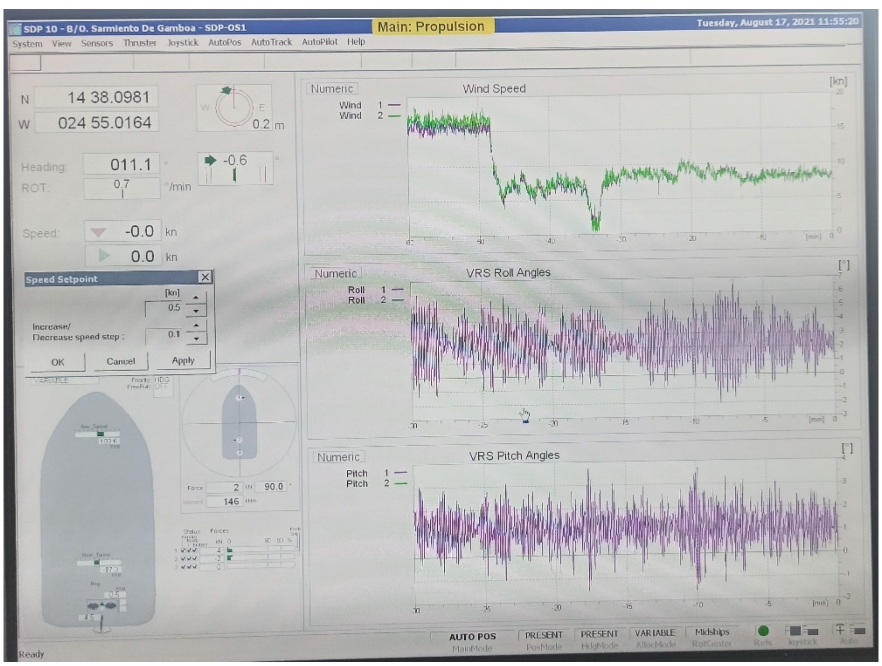



Time [s]
Temp. [°C]
Cond [mS/cm]
Eh [mV]
pH [pH]
b.AutoScale [FTU]
Oxygen % [%]


Data displayed from: 12:21:45 - 17.Aug-21 (No. 22050) To: 20:02:39 - 17.Aug-21 (No: 35877)
Select active graphs
OpOx % 98.12
T (FTU) 11.74
S. vel. 1513.61
Density 26.869
mg/l 7.74
Ox %
Temp 16.313
Cond. 45.31
Sal. 35.93
Press 107.6400
Graph base
Press(db)
Time (minutes)
Wide graphs
Show all points
Hide
Close

Meteorological and Ocean Conditions





TechnicalDiveLog

Time	DESCRIPTION - AUG 16, 2021	TAGS
15:10:48	Ok. 4k connected on the ELB2, but we cannot control it (tx and Rx crossed), recording on blackmagic. HD in the abyssal land we can control it.	Pre-dive checks
16:05:19	Idronaut pressure, pH and oxygen sensors calibrated. SAIV pressure sensor calibrated. Clock of SAIV synchronized.	Sensors
17:12:29	Tried the transect from NW, but it was not good for launching and recovery when you had to do the transect in the 190 direction. Tried also for the south transect where the movement would be north and the best heading was 60-70, but the ship was pushing too much for the thrusters	
	AUG 17, 2021	
10:00:52	Ok. 2nd try on cadamosto s transect	Pre-dive checks
11:28:49	Pressure and oxygen of Idronaut calibrated. Pressure of SAIV calibrated. Clock of SAIV synchronized. Clock of Photo Camera synchronized.	Sensors
12:15:31	Abyssal camera is showing video with a delay. Nw it is better.	Sensors
12:21:00	Testing zoom.	Off deck
12:27:56	Restart INS. It gives an error of inconsistent data. Turn off and turn on again the INS because it does not reboot completely.	
12:31:02	CH4 and CO2 pumps turned on.	Sensors
12:35:28	Heading in the video is not changing. EIVA restarted, Heading was incorrect.	
12:38:17	AC (Pilot), AA (Co-Pilot), BR (Winch)	Pilot exchange
13:41:58		At bottom
14:11:40	Change 4k video recording file. Tried different lights preferences in the camera software. Change the function to cinema 1 in camera software.	
14:16:43	AA (Pilot), MS(Co-Pilot), AC (Winch)	Pilot exchange
15:09:41	Clicked a wrong button in Abyssal software and the identification of the monitor appeared.	
16:15:45	MS (Pilot), RB(Co-Pilot), AA (Winch)	Pilot exchange
18:38:05	RB (Pilot), BR(Co-Pilot), MS (Winch)	Pilot exchange
18:42:57	Breaks on 4k video	Image
18:59:05		Off bottom
19:50:11	AC (pilot); MS (co-pilot); AA (winch)	Pilot exchange
20:02:27	Contros pumps turned off	Sensors
20:03:32	Idronaut and SAIV turned off	Sensors
20:12:00	Some 4k video had lost frames. This is not flicks in the video, this is frames that are sent to the computer but the computer cannot capture/process it because there are too much frames per second.	On deck
	AUG 28, 2021	
0:20:51	Ok	Post-dive checks

iMirabilis2_D07_S64 – NE Cadamosto Seamount

iMirabilis2

TECHNICAL DIVE REPORT 19/08/2021

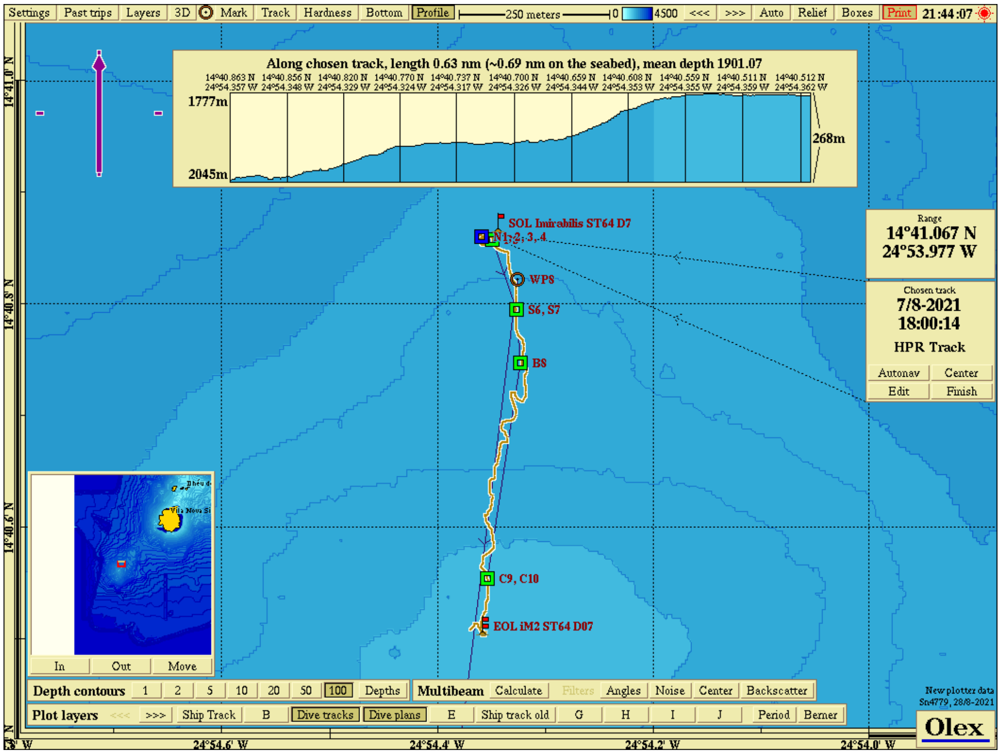
General Dive Details

Campaign	iMirabilis2
Operation Code	iMirabilis2_D07_S64
Vessel	R/V Sarmiento de Gamboa
Institution	CSIC, IEO and EMEPC; iAtlantic project
Operation Supervisor	António Calado
Scientific Coordinator	Covadonga Orejas and Beatriz Vinha
ROV Supervisor	António Calado
ROV Team	António Calado, Andreia Afonso, Bruno Ramos, Miguel Souto, Renato Bettencourt
Type of Operation	ROV Dive – scientific survey (biological sampling and habitat mapping)
Equipment	ROV Luso
Date and Time (UTC)	19th August de 2021 16:20
Duration (HH:mm:ss)	08:20:35

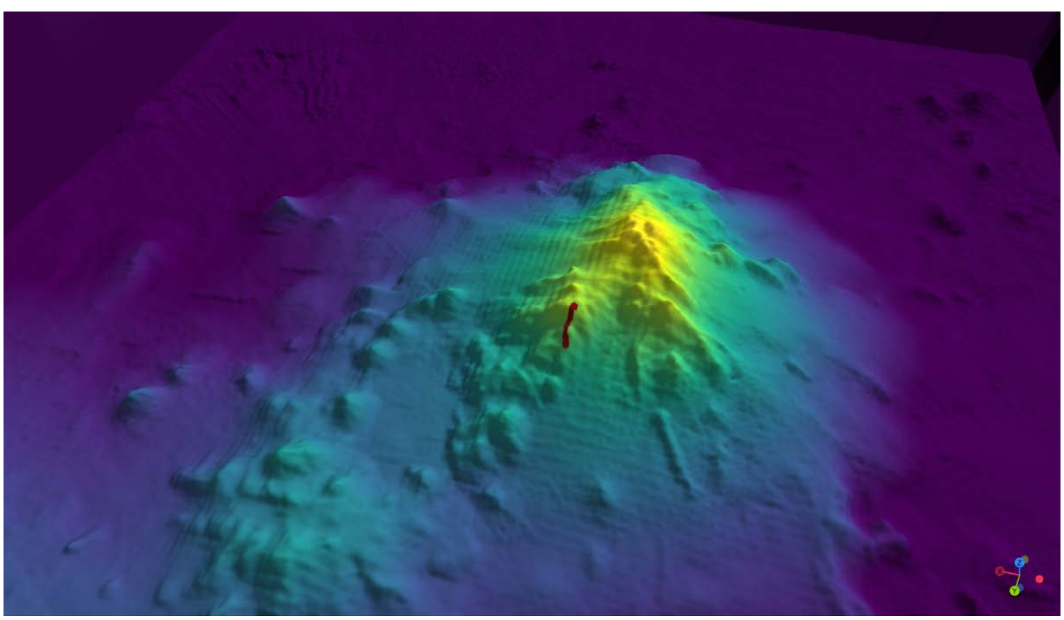
Working Area

Name	NE Cadamosto Seamount
Latitude	14º40’46.8980’’N
Longitude	024º54’52.5540’’W
Depth (m)	2000

Dive Maps



3D Overview with ROV trajectory



Sample List

TYPE OF SAMPLES	TOTAL NUMBER
Biological	2
Push Cores	2
Niskin	4
Suction	2

Data Files

FILE	EQUIPMENT	PARAMETERS		OBSERVATIONS
Imirabilis2_D07_S64_SAIV.txt	SAIV CTD	Salinity	√	Calculated (manufacturer calibration 2019- recommended every 2 years)
		Conductivity	√	(manufacturer calibration 2019- recommended every 2 years)
		Sound velocity	√	Calculated (manufacturer calibration 2019- recommended every 2 years)
		Temperature	√	(manufacturer calibration 2019- recommended every 2 years)
		Density	√	Calculated (manufacturer calibration 2019- recommended every 2 years)
		Pressure	√	Calibrated before the dive (manufacturer calibration 2019- recommended every 2 years)
	Oxygen sensor	Concentration dissolved oxygen and percentage of oxygen saturation	√	(manufacturer calibration 2019- recommended every 2 years)

	Turbidity sensor	Turbidity	√	(manufacturer calibration 2019- recommended every 2 years)
Imirabilis2_D07_S64_INS_telemetry.txt	IxBlue INS ROVdata	ROV heading, roll, pitch	√	
Imirabilis2_D07_S64_HIPAP.txt	Kongsberg HIPAP ROV position system	ROV position	√	
Imirabilis2_D07_S64_ABY_telemetry.txt	Compass	Heading	√	
	Gyro	Pitch/roll	√	
	Depth sensor	Depth	√	
	Altimeter	Altitude	√	
Imirabilis2_D07_S64_Idronaut.TXT	Idronaut CTD	Salinity	√	Calculated (manufacturer calibration 2019- recommended every 2 years)
		Conductivity	√	(manufacturer calibration 2019- recommended every 2 years)
		Temperature	√	(manufacturer calibration 2019- recommended every 2 years)
		Pressure	√	(manufacturer calibration 2019- recommended every 2 years)
	Oxygen sensor	Concentration dissolved oxygen and percentage of oxygen saturation	√	Calibrated before the dive (manufacturer calibration 2019- recommended every 2 years)

Imirabilis2_D07_S64_Idronaut.TXT	Fluorescence sensor	Fluorescence	√	(manufacturer calibration 2019- recommended every 2 years)
	Turbidity sensor	Turbidity	√	(manufacturer calibration 2019- recommended every 2 years)
	pH sensor	pH	√	Calibrated before the dive (manufacturer calibration 2019- recommended every 2 years)
	Redox potential sensor	Redox potential	√	(manufacturer calibration 2019- recommended every 2 years)
Imirabilis2_D07_S64_Contros.txt	CH_4 and CO_2 sensors	CH_4 and CO_2 concentration and pCO_2	√	CH4 last calibration in 2016 and verified in 2020 (manufacturer does not support this sensor anymore). CO2 last calibration in 2021 (recommended calibration – every year)
UHD Imirabilis2_D07_S64_video_raw_19_08_2021_17_55_57.mov to Imirabilis2_D07_S64_video_raw_19_08_2021_23_13_22.mov **HD** Imirabilis_D07_S64_video_raw_19_08_2021_16_13_51.mov	UHD, HD camera	Video	√	PRORES HQ and PRORES video files (3840x2160;1920x1080)
Video_Camera 1_OVERLAY_2021-08-19 16-13-11.394Z.mp4 to Video_Camera 1_OVERLAY_2021-08-20 00-25-41.110Z.mp4	UHD, HD camera	Video	√	MP4 video files(3840x2160; 1920x1080)
IMG_3360_logo_luso_IM2.png to IMG_4289_logo_luso_IM2.png IMG_3360_logo_luso.png to IMG_4289_logo_luso.png	Photo Camera	Photo	√	3648x2736px images with metadada in Imirabilis2_D07_S64_Still_Metadata.csv (with only Luso logo or with addition of campaign logo)

2021-08-19_16-17-41.602 - Camera Viewer - Camera 1.jpg to 2021-08-19_21-46-50.218 - Camera Viewer - Camera 1.jpg 2021-08-19_16-17-41.602 - Camera Viewer - Camera 1 - video_logo_luso.png to 2021-08-19_21-46-50.218 - Camera Viewer - Camera 1 - video_logo_luso.png 2021-08-19_16-17-41.602 - Camera Viewer - Camera 1 - video_logo_luso_IM2.png to 2021-08-19_21-46-50.218 - Camera Viewer - Camera 1 - video_logo_luso_IM2.png	UHD, HD camera	Still image	√	Name of the file has the suffix: • "- Video.jpg" has overlay info on the image These images come from the video with Overlay showed on the screen during the dive; • "- Video_luso.png" no overlay, but luso logo on the image; • "- Video_luso_iM2.png" no overlay, but luso and campaign logo on the image;

Products

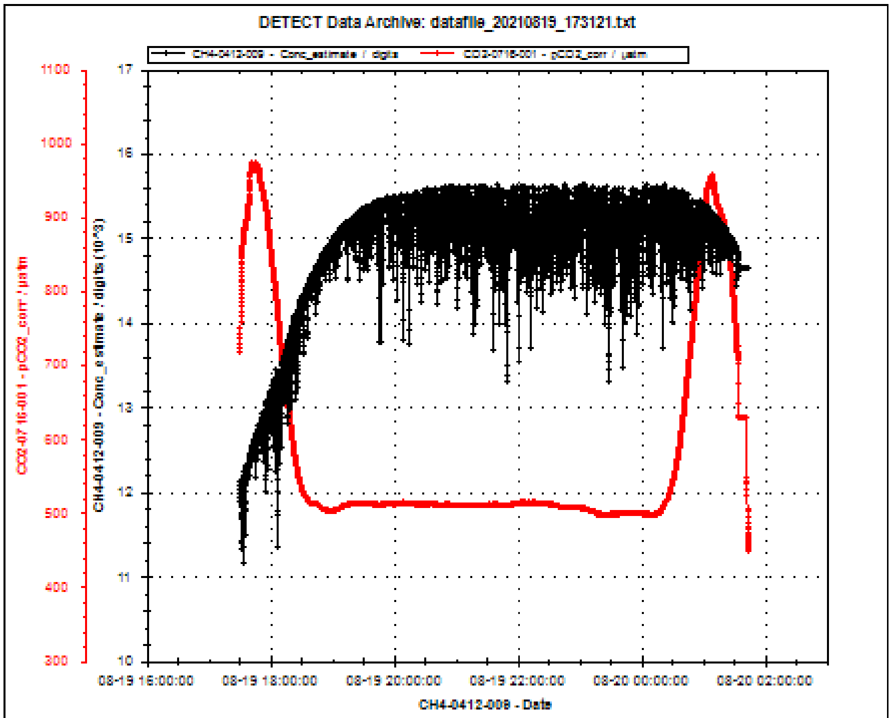
FILE	OBSERVATIONS
Imirabilis2_D07_S64_Contros.txt	Contros data
Imirabilis2_D07_S64_Idronaut.TXT	Idronaut data
Imirabilis2_D07_S64_SAIV.txt	SAIV data
Imirabilis2_D07_S64_INS_telemetry.txt Imirabilis2_D07_S64_ABY_telemetry.txt	Telemetry data
Imirabilis2_D07_S64_HIPAP.txt	Position data
Imirabilis2_D07_S64_ROV_trajectory.prj/qpj/shp/shx/dbf	Shape-file with trajectory
Imirabilis2_D07_S64_QGIS_pic.png	QGIS image with ROV trajectory on bathymetry
Imirabilis2_D07_S64_Olex_map.tif	Olex image with ROV trajectory, profile and samples
Imirabilis2_D07_S64_Still_Metadata.csv	Information retrieved using a software downloaded from the internet and not delivered by Kongsberg

Imirabilis2_D07_S64_Contros_graph.png	Contros data graphic
Imirabilis2_D07_S64_Idronaut_graph.png	Idronaut data graphic
Imirabilis2_D07_S64_SAIV_graph.png	SAIV data graphic
1 HD / 6 UHD	Raw UHD/HD videos
50 videos	Abyssal videos with video overlay information
930 images	Images from photo camera
86 images	Still images from video
Imirabilis_D07_S64_ship_1.JPG Imirabilis_D07_S64_ship_2.JPG	DP ship conditions

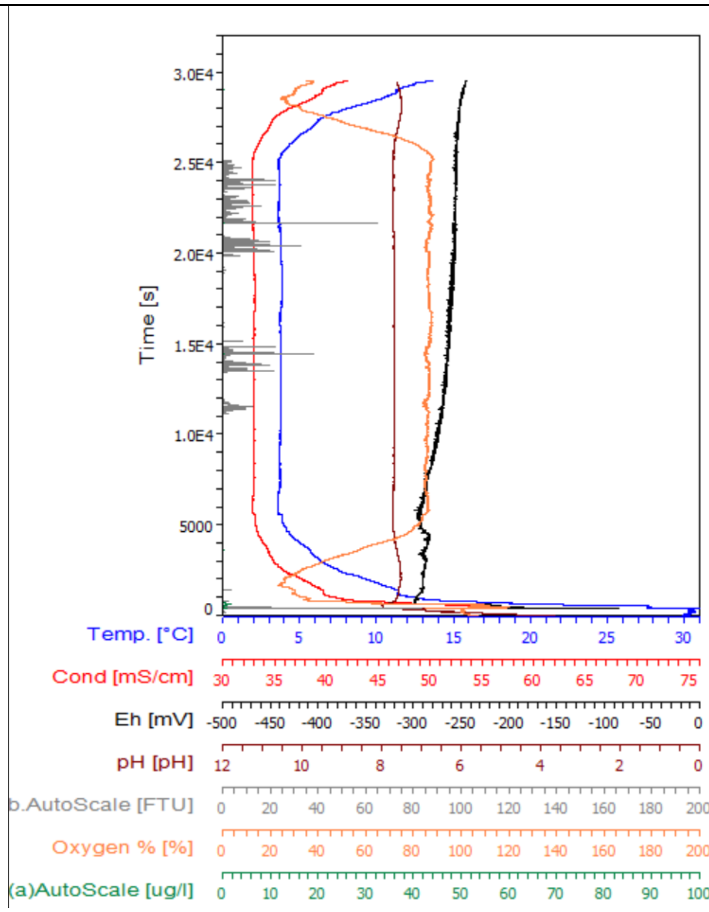
Help Files

FILE	OBSERVATIONS
CONTROS HydroC® CH4 data format.jpg	Imirabilis2_DXX_SXX_Contros.txt data format (CH_4 columns)
CONTROS HydroC® CO2 data format.jpg	Imirabilis2_DXX_SXX_Contros.txt data format (CO_2 columns)
ABY telemetry data format.pdf	Imirabilis2_DXX_SXX_ABY_telemetry.txt data format
Idronaut data format.txt	Imirabilis2_DXX_SXX_Idronaut.txt data format
HIPAP data format.pdf	Imirabilis2_DXX_SXX_HIPAP.txt data format
SAIV data format.txt	imirabilis2_DXX_SXX_SAIV.txt data format
INS_telemetry data format.pdf	Imirabilis2_DXX_SXX_INS_telemetry.txt data format

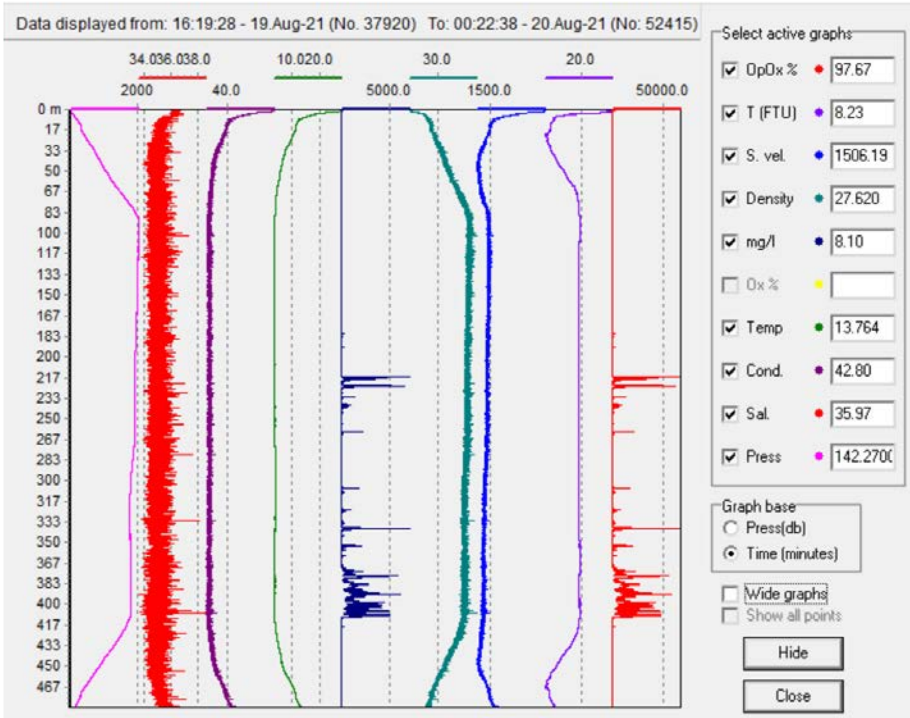
Data Graphs



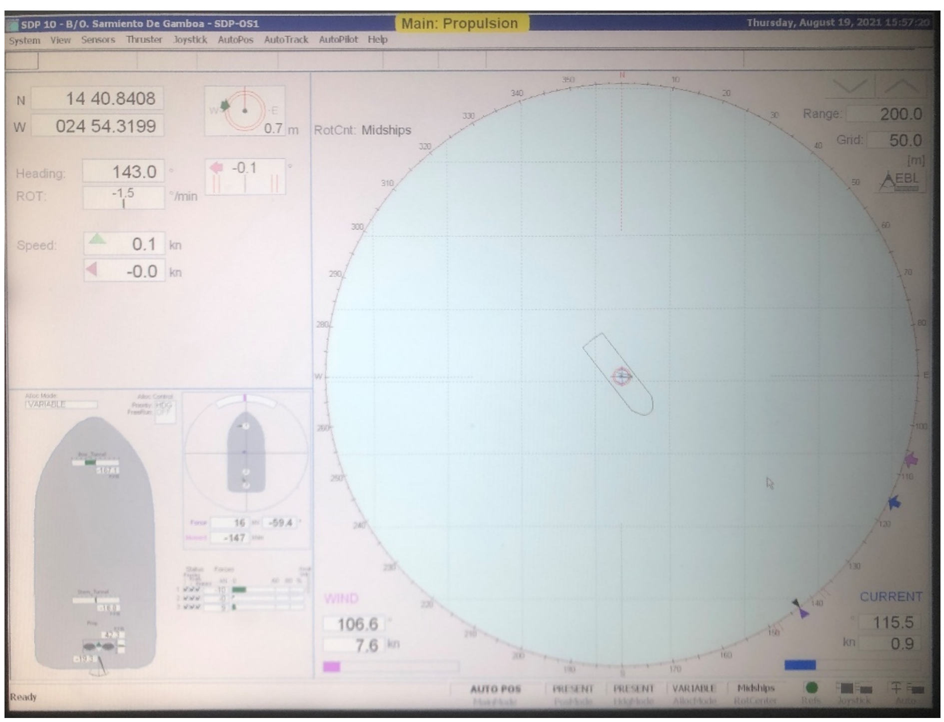
DETECT Data Archive: datafile_20210819_173121.txt
CH4-0412-009 - Conc_estimate / digits
CO2-0716-001 - pCO2_corr / µatm
CO2-0716-001 - pCO2_corr / µatm
CH4-0412-009 - Conc_estimate / digits (10^3)
1100
1000
900
800
700
600
500
400
300
17
16
15
14
13
12
11
10
08-19 16:00:00
08-19 18:00:00
08-19 20:00:00
08-19 22:00:00
08-20 00:00:00
08-20 02:00:00
CH4-0412-009 - Date

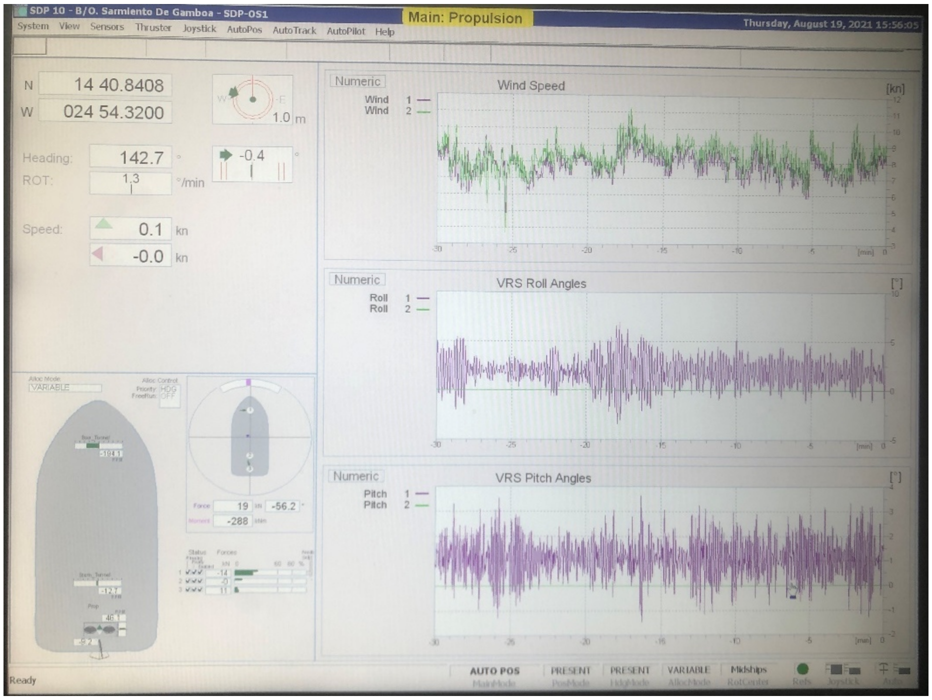


Time [s]
3.0E4
2.5E4
2.0E4
1.5E4
1.0E4
5000
0
Temp. [°C] 0 5 10 15 20 25 30
Cond [mS/cm] 30 35 40 45 50 55 60 65 70 75
Eh [mV] -500 -450 -400 -350 -300 -250 -200 -150 -100 -50 0
pH [pH] 12 10 8 6 4 2 0
b.AutoScale [FTU] 0 20 40 60 80 100 120 140 160 180 200
Oxygen % [%] 0 20 40 60 80 100 120 140 160 180 200
(a)AutoScale [ug/l] 0 10 20 30 40 50 60 70 80 90 100



Meteorological and Ocean Conditions





Technical Dive Log

Time	DESCRIPTION – AUG 19, 2021	TAGS
15:02:55	Idronaut pressure, oxygen and pH calibrated. Clock of SAIV synchronized. Pressure of SAIV calibrated	Sensors
16:06:36	Monitor resolution changed for HD, because before pictures were taken using UHD resolution and probably video also.	
16:15:14	Position in the Overlay probably wrong. Next position will be right.	
16:16:27	Time in OFOP logger was not checked. Need to be checked afterwards.	
16:20:00		Off deck
16:22:47	Heading in overlay is not equal to the heading in INS. Restart INS.EIVA restarted. INS was not the problem.	Sensors
16:30:50	Contros pumps turned on now and the logging also.	Sensors
16:32:59	Station number in the video changed from 66 to 64	Other
16:35:04	RB(Pilot), BR(Co-Pilot), MS(Winch)	Pilot exchange
16:52:19	Direct take configured only to send stream to the bridge (not recording in local drive)	Image
17:18:57	4K working again (temperature 9ºc).	Image
17:28:01	Recording changed from HD to 4K	Image
17:58:29	BR (Pilot), AC (Co-pilot), RB (Winch)	Pilot exchange
18:18:00		At bottom
20:25:09	AC (Pilot), AA (Co-Pilot), BR (Winch)	Pilot exchange
23:10:00		Off bottom
23:11:08	T4 not communicating, coming up.	

23:11:35	AA (Pilot), MS (Co-Pilot), AC (Winch)	Pilot exchange
	AUG 20, 2021	
0:13:34	Contros pumps turned off	Sensors
0:18:15	AC (Pilot), MS (Co-Pilot), AA (Winch)	Pilot exchange
0:24:07	SAIV and Idronaut turned off. Photo camera turned off.	Sensors
0:40:35		On deck
0:48:33	T4 not communicating. All other things are ok.	Post-dive checks

iMirabilis2_D08_S74 – NW Cadamosto Seamount-aborted

iMirabilis2

TECHNICAL DIVE REPORT 21/08/2021

General Dive Details

Campaign	iMirabilis2
Operation Code	iMirabilis2_D08_S74
Vessel	R/V Sarmiento de Gamboa
Institution	CSIC, IEO and EMEPC; iAtlantic project
Operation Supervisor	António Calado
Scientific Coordinator	Covadonga Orejas and Beatriz Vinha
ROV Supervisor	António Calado
ROV Team	António Calado, Andreia Afonso, Bruno Ramos, Miguel Souto, Renato Bettencourt
Type of Operation	ROV Dive – scientific survey (biological sampling and habitat mapping)
Equipment	ROV Luso
Date and Time (UTC)	21th August de 2021 11:15
Duration (HH:mm:ss)	00:21:01

Working Area

Name	NW Cadamosto Seamount
Latitude	**No ROV position**
Longitude	**No ROV position**
Depth (m)	1700

Sample List

TYPE OF SAMPLES	TOTAL NUMBER
Biological	0
Push Cores	0
Niskin	0
Suction	0

Data Files

FILE	EQUIPMENT	PARAMETERS		OBSERVATIONS
Imirabilis2_D08_S74_SAIV.txt	SAIV CTD	Salinity	√	Calculated (manufacturer calibration 2019- recommended every 2 years)
		Conductivity	√	(manufacturer calibration 2019- recommended every 2 years)
		Sound velocity	√	Calculated (manufacturer calibration 2019- recommended every 2 years)
		Temperature	√	(manufacturer calibration 2019- recommended every 2 years)
		Density	√	Calculated (manufacturer calibration 2019- recommended every 2 years)
		Pressure	√	Calibrated before the dive (manufacturer calibration 2019- recommended every 2 years)
	Oxygen sensor	Concentration dissolved oxygen and percentage of oxygen saturation	√	(manufacturer calibration 2019- recommended every 2 years)

	Turbidity sensor	Turbidity	√	(manufacturer calibration 2019- recommended every 2 years)
Imirabilis2_D08_S74_INS_telemetry.txt	IxBlue INS ROVdata	ROV heading, roll, pitch	√	
Imirabilis2_D08_S74_ABY_telemetry.txt	Compass	Heading	√	
	Gyro	Pitch/roll	√	
	Depth sensor	Depth	√	
	Altimeter	Altitude	√	
Imirabilis2_D08_S74_Idronaut.TXT	Idronaut CTD	Salinity	√	Calculated (manufacturer calibration 2019- recommended every 2 years)
		Conductivity	√	(manufacturer calibration 2019- recommended every 2 years)
		Temperature	√	(manufacturer calibration 2019- recommended every 2 years)
		Pressure	√	(manufacturer calibration 2019- recommended every 2 years)
	Oxygen sensor	Concentration dissolved oxygen and percentage of oxygen saturation	√	Calibrated before the dive (manufacturer calibration 2019- recommended every 2 years)
Imirabilis2_D08_S74_Idronaut.TXT	Fluorescence sensor	Fluorescence	√	(manufacturer calibration 2019- recommended every 2 years)

	Turbidity sensor	Turbidity	✓	(manufacturer calibration 2019-recommended every 2 years)
	pH sensor	pH	✓	Calibrated before the dive (manufacturer calibration 2019-recommended every 2 years)
	Redox potential sensor	Redox potential	✓	(manufacturer calibration 2019-recommended every 2 years)
Imirabilis2_D08_S74_Contros.txt	CH_4 and CO_2 sensors	CH_4 and CO_2 concentration and pCO_2	✓	CH4 last calibration in 2016 and verified in 2020 (manufacturer does not support this sensor anymore). CO2 last calibration in 2021 (recommended calibration – every year)
Video_Camera 1_OVERLAY_2021-08-21 11-08-01.010Z.mp4 to Video_Camera 1_OVERLAY_2021-08-21 11-29-30.372Z.mp4	UHD camera	Video	✓	MP4 video files(3840x2160)

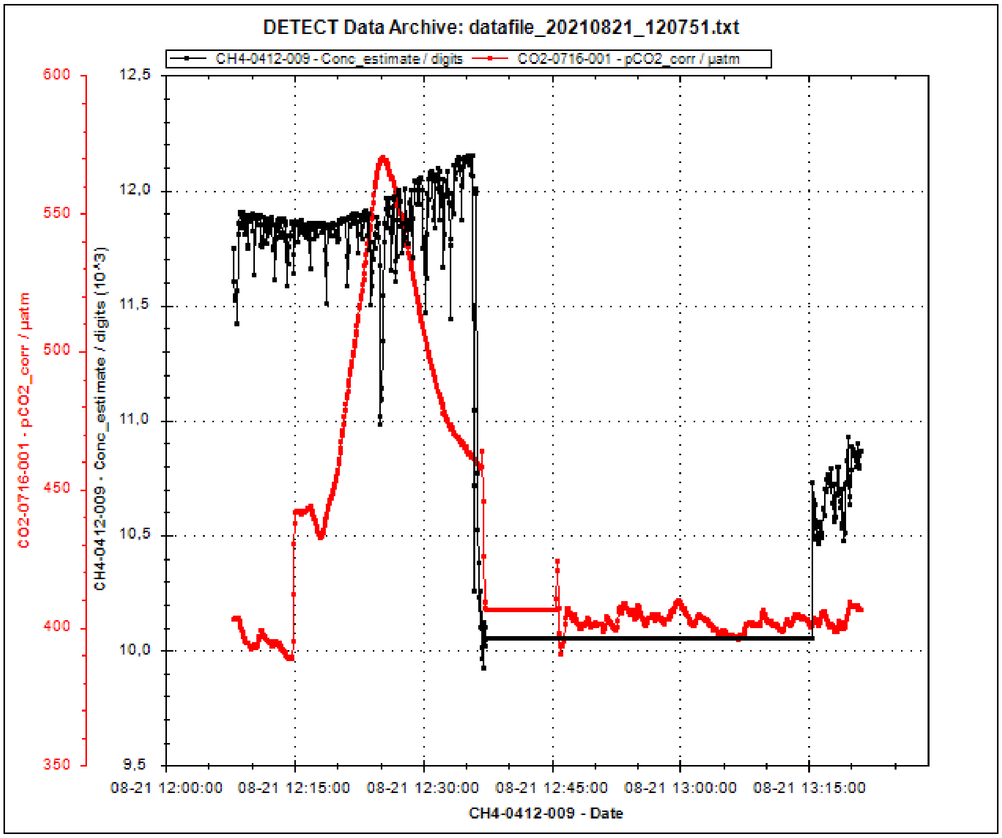
Products

FILE	OBSERVATIONS
Imirabilis2_D08_S74_Contros.txt	Contros data
Imirabilis2_D08_S74_Idronaut.TXT	Idronaut data
Imirabilis2_D08_S74_SAIV.txt	SAIV data
Imirabilis2_D08_S74_INS_telemetry.txt Imirabilis2_D08_S74_ABY_telemetry.txt	Telemetry data
Imirabilis2_D08_S74_Contros_graph.png	Contros data graphic
Imirabilis2_D08_S74_Idronaut_graph.png	Idronaut data graphic
Imirabilis2_D08_S7_SAIV_graph.png	SAIV data graphic
3 videos	Abyssal videos with video overlay information
Imirabilis_D08_S74_ship_1.JPG Imirabilis_D08_S74_ship_2.JPG	DP ship conditions

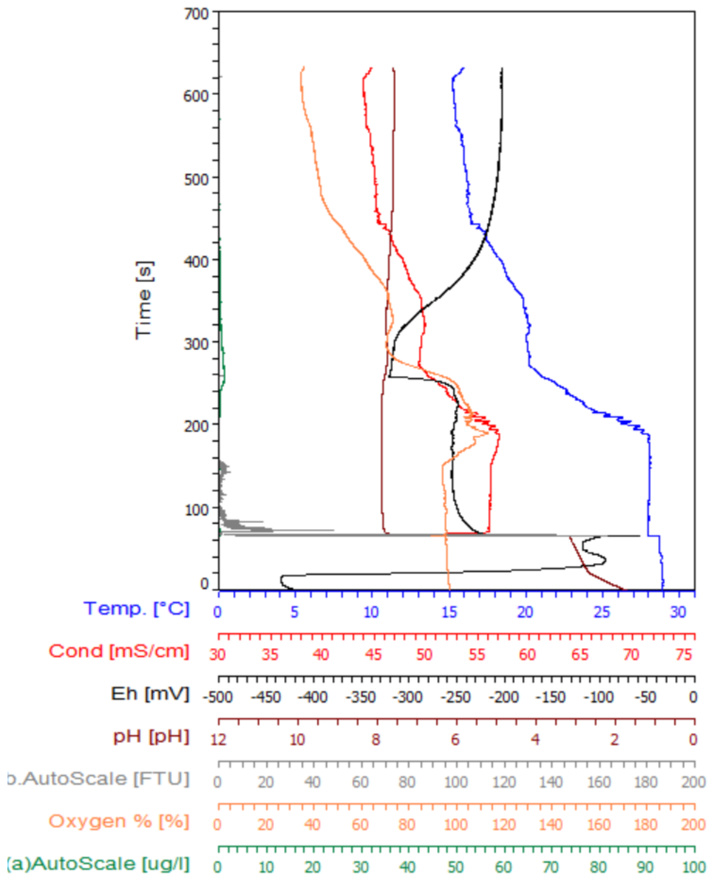
Help Files

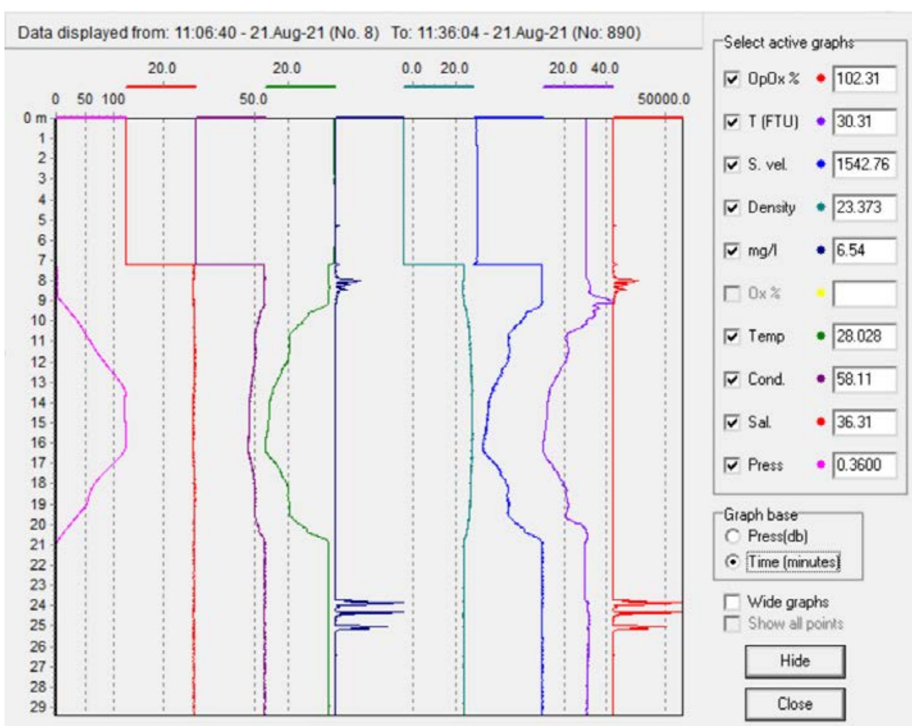
FILE	OBSERVATIONS
CONTROS HydroC® CH4 data format.jpg	Imirabilis2_DXX_SXX_Contros.txt data format (CH_4 columns)
CONTROS HydroC® CO2 data format.jpg	Imirabilis2_DXX_SXX_Contros.txt data format (CO_2 columns)
ABY telemetry data format.pdf	Imirabilis2_DXX_SXX_ABY_telemetry.txt data format
Idronaut data format.txt	Imirabilis2_DXX_SXX_Idronaut.txt data format
SAIV data format.txt	imirabilis2_DXX_SXX_SAIV.txt data format
INS_telemetry data format.pdf	Imirabilis2_DXX_SXX_INS_telemetry.txt data format

Data Graphs

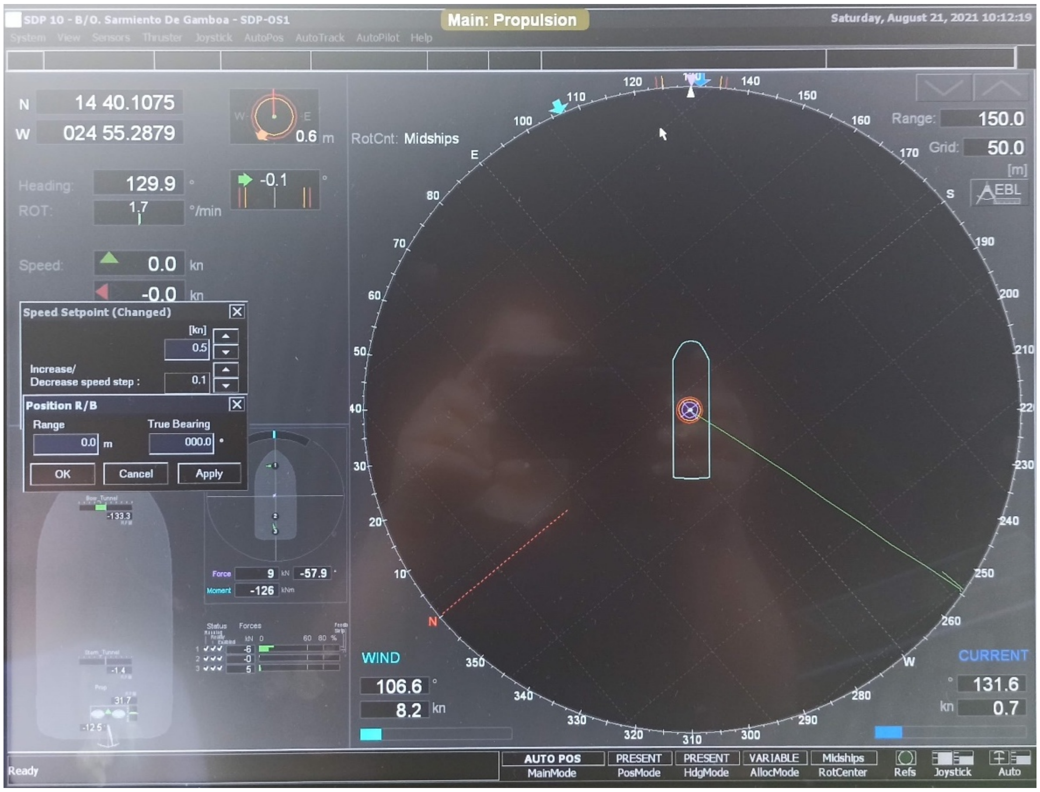


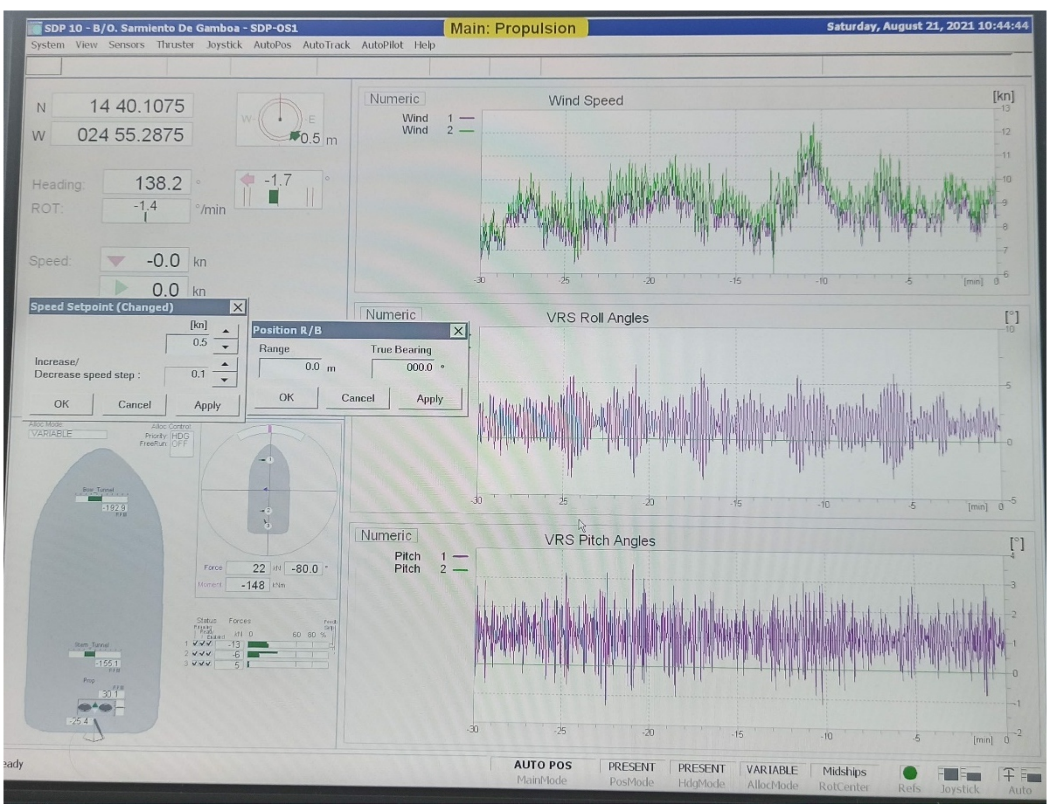
DETECT Data Archive: datafile_20210821_120751.txt
CH4-0412-009 - Conc_estimate / digits
CO2-0716-001 - pCO2_corr / µatm
CO2-0716-001 - pCO2_corr / µatm
CH4-0412-009 - Conc_estimate / digits (10^3)
600
550
500
450
400
350
12,5
12,0
11,5
11,0
10,5
10,0
9,5
08-21 12:00:00
08-21 12:15:00
08-21 12:30:00
08-21 12:45:00
08-21 13:00:00
08-21 13:15:00
CH4-0412-009 - Date


Time [s]
700
600
500
400
300
200
100
0
Temp. [°C] 0 5 10 15 20 25 30
Cond [mS/cm] 30 35 40 45 50 55 60 65 70 75
Eh [mV] -500 -450 -400 -350 -300 -250 -200 -150 -100 -50 0
pH [pH] 12 10 8 6 4 2 0
b.AutoScale [FTU] 0 20 40 60 80 100 120 140 160 180 200
Oxygen % [%] 0 20 40 60 80 100 120 140 160 180 200
(a)AutoScale [ug/l] 0 10 20 30 40 50 60 70 80 90 100


Data displayed from: 11:06:40 - 21.Aug-21 (No. 8) To: 11:36:04 - 21.Aug-21 (No: 890)
20.0
20.0
0.0 20.0
20.0 40.0
0 50 100
50.0
50000.0
0 m
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29
Select active graphs
OpOx % 102.31
T (FTU) 30.31
S. vel. 1542.76
Density 23.373
mg/l 6.54
Ox %
Temp 28.028
Cond. 58.11
Sal. 36.31
Press 0.3600
Graph base
Press(db)
Time (minutes)
Wide graphs
Show all points
Hide
Close

Meteorological and Ocean Conditions





Technical Dive Log

Time	DESCRIPTION – AUG 21, 2021	TAGS
9:25:09	Idronaut calibrated pH; Pressure from Idronaut calibrated. Clock from SAIV calibrated. Oxygen from Idronaut calibrated.	Sensors
9:52:42	Ok; last bleed of T4	Pre-dive checks
11:15:00		Off deck
11:23:09	No position, coming up.	
11:36:02		On deck

Estrutura de Missão Para a Extensão da Plataforma Continental

Luso

EMEPC

PORTUGAL

iMirabilis2_D09_S75 – NW Cadamosto Seamount

iMirabilis2

TECHNICAL DIVE REPORT 21/08/2021

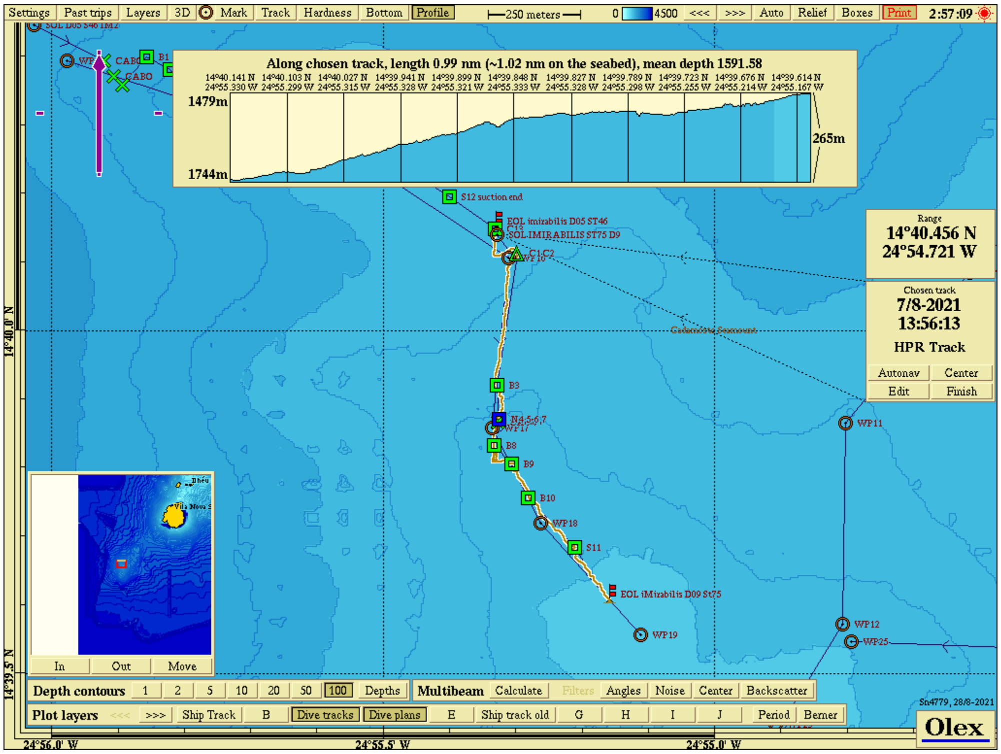
General Dive Details

Campaign	iMirabilis2
Operation Code	iMirabilis2_D09_S75
Vessel	R/V Sarmiento de Gamboa
Institution	CSIC, IEO and EMEPC; iAtlantic project
Operation Supervisor	António Calado
Scientific Coordinator	Covadonga Orejas and Beatriz Vinha
ROV Supervisor	António Calado
ROV Team	António Calado, Andreia Afonso, Bruno Ramos, Miguel Souto, Renato Bettencourt
Type of Operation	ROV Dive – scientific survey (biological sampling and habitat mapping)
Equipment	ROV Luso
Date and Time (UTC)	**21**th August de 2021 12:26
Duration (HH:mm:ss)	07:43:13

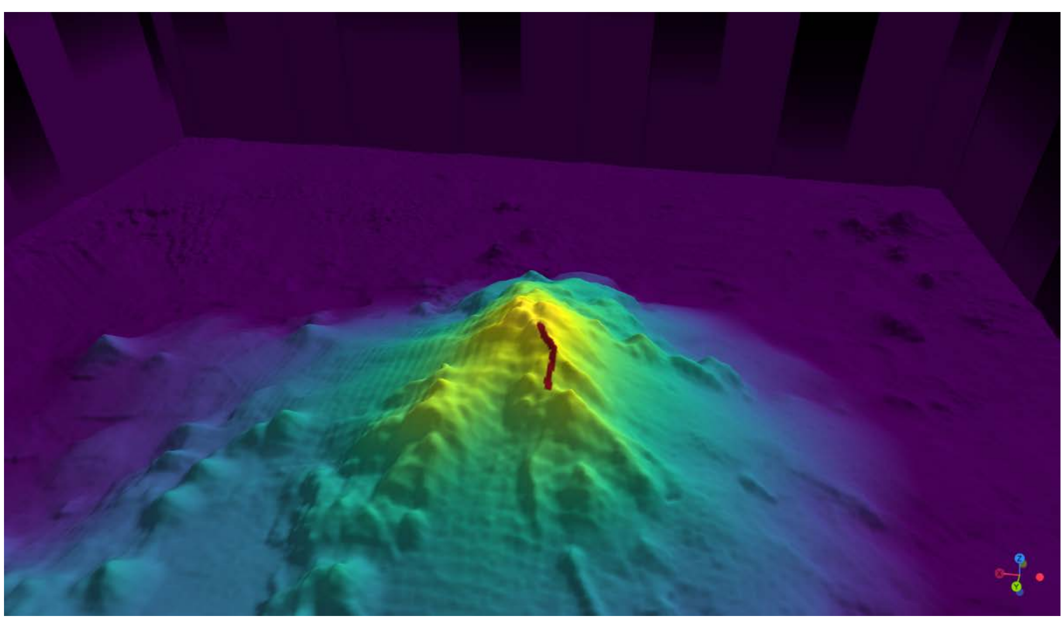
Working Area

Name	NW Cadamosto Seamount
Latitude	14º40'08.7840''N
Longitude	024º55'19.3980''W
Depth (m)	1700

Dive Maps



3D Overview with ROV trajectory



Sample List

TYPE OF SAMPLES	TOTAL NUMBER
Biological	4
Push Cores	2
Niskin	4
Suction	1

Data Files

FILE	EQUIPMENT	PARAMETERS		OBSERVATIONS
Imirabilis2_D09_S75_SAIV.txt	SAIV CTD	Salinity	√	Calculated (manufacturer calibration 2019- recommended every 2 years)
		Conductivity	√	(manufacturer calibration 2019- recommended every 2 years)
		Sound velocity	√	Calculated (manufacturer calibration 2019- recommended every 2 years)
		Temperature	√	(manufacturer calibration 2019- recommended every 2 years)
		Density	√	Calculated (manufacturer calibration 2019- recommended every 2 years)
		Pressure	√	Calibrated before the dive (manufacturer calibration 2019- recommended every 2 years)
	Oxygen sensor	Concentration dissolved oxygen and percentage of oxygen saturation	√	(manufacturer calibration 2019- recommended every 2 years)

	Turbidity sensor	Turbidity	√	(manufacturer calibration 2019- recommended every 2 years)
Imirabilis2_D09_S75_INS_telemetry.txt	IxBlue INS ROVdata	ROV heading, roll, pitch	√	
Imirabilis2_D09_S75_HIPAP.txt	Kongsberg HIPAP ROV position system	ROV position	√	
Imirabilis2_D09_S75_ABY_telemetry.txt	Compass	Heading	√	
	Gyro	Pitch/roll	√	
	Depth sensor	Depth	√	
	Altimeter	Altitude	√	
Imirabilis2_D09_S75_Idronaut_1.TXT Imirabilis2_D09_S75_Idronaut_2.TXT	Idronaut CTD	Salinity	√	Calculated (manufacturer calibration 2019- recommended every 2 years)
		Conductivity	√	(manufacturer calibration 2019- recommended every 2 years)
		Temperature	√	(manufacturer calibration 2019- recommended every 2 years)
		Pressure	√	(manufacturer calibration 2019- recommended every 2 years)
	Oxygen sensor	Concentration dissolved oxygen and percentage of oxygen saturation	√	Calibrated before the dive (manufacturer calibration 2019- recommended every 2 years)

Imirabilis2_D09_S75_Idronaut_1.TXT Imirabilis2_D09_S75_Idronaut_2.TXT	Fluorescence sensor	Fluorescence	√	(manufacturer calibration 2019- recommended every 2 years)
	Turbidity sensor	Turbidity	√	(manufacturer calibration 2019- recommended every 2 years)
	pH sensor	pH	√	Calibrated before the dive (manufacturer calibration 2019- recommended every 2 years)
	Redox potential sensor	Redox potential	√	(manufacturer calibration 2019- recommended every 2 years)
Imirabilis2_D09_S75_Contros.txt	CH_4 and CO_2 sensors	CH_4 and CO_2 concentration and pCO_2	√	CH4 last calibration in 2016 and verified in 2020 (manufacturer does not support this sensor anymore). CO2 last calibration in 2021 (recommended calibration – every year)
Imirabilis2_D09_S75_video_raw_21_08_2021_11_13_35.mov Imirabilis2_D09_S75_video_raw_21_08_2021_17_51_16.mov	UHD camera	Video	√	PRORES video files (3840x2160)
Video_Camera 1_OVERLAY_2021-08-21 12-25-35.213Z.mp4 to Video_Camera 1_OVERLAY_2021-08-21 20-06-57.132Z.mp4	UHD camera	Video	√	MP4 video files(3840x2160; 1920x1080)
IMG_4315_logo_luso.png to IMG_4582_logo_luso.png IMG_4315_logo_luso_IM2.png to IMG_4582_logo_luso_IM2.png	Photo Camera	Photo	√	3648x2736px images with metadada in Imirabilis2_D09_S75_Still_Metadata_luso.csv and Imirabilis2_D09_S75_Still_Metadata_luso_iM2.csv (with only Luso logo or with addition of campaign logo)

2021-08-21_14-03-04.492 - Camera Viewer - Camera 1.jpg to 2021-08-21_19-26-18.946 - Camera Viewer - Camera 1.jpg 2021-08-21_14-03-04.492 - Camera Viewer - Camera 1 - video_logo_luso.png to 2021-08-21_19-26-18.946 - Camera Viewer - Camera 1 - video_logo_luso.png 2021-08-21_14-03-04.492 - Camera Viewer - Camera 1 - video_logo_luso_IM2.png to 2021-08-21_19-26-18.946 - Camera Viewer - Camera 1 - video_logo_luso_IM2.png	UHD, HD camera	Still image	√	Name of the file has the suffix: • "- Video.jpg" has overlay info on the image These images come from the video with Overlay showed on the screen during the dive; • "- Video_luso.png" no overlay, but luso logo on the image; • "- Video_luso_iM2.png" no overlay, but luso and campaign logo on the image;

Products

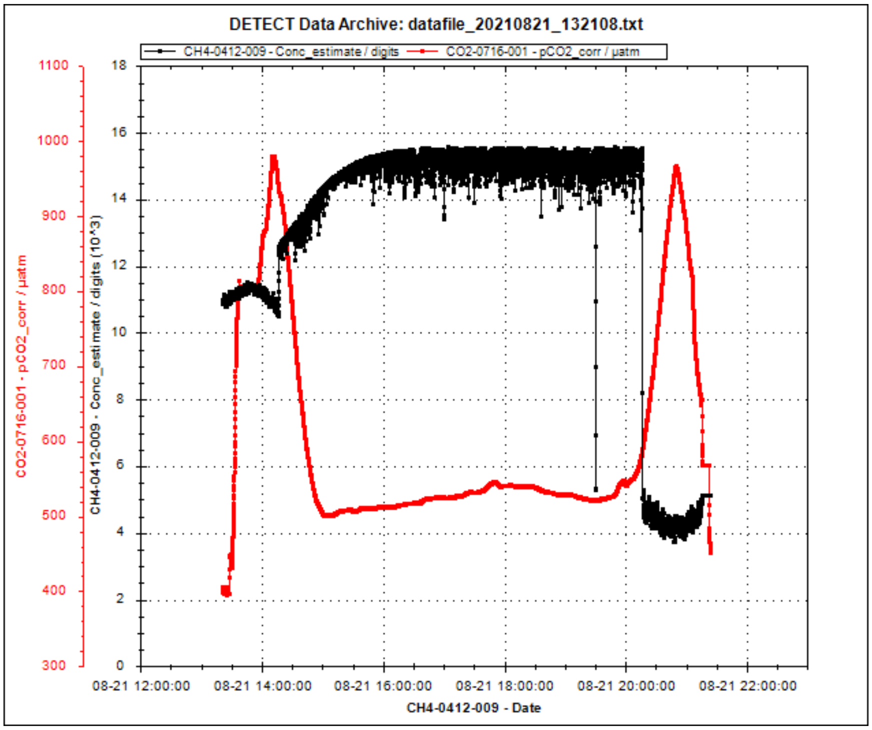
FILE	OBSERVATIONS
Imirabilis2_D09_S75_Contros.txt	Contros data
Imirabilis2_D09_S75_Idronaut_1.TXT Imirabilis2_D09_S75_Idronaut_2.TXT	Idronaut data
Imirabilis2_D09_S75_SAIV.txt	SAIV data
Imirabilis2_D09_S75_INS_telemetry.txt Imirabilis2_D09_S75_ABY_telemetry.txt	Telemetry data
Imirabilis2_D09_S75_HIPAP.txt	Position data
Imirabilis2_D09_S75_ROV_trajectory.prj /qpj/shp/shx/dbf	Shape-file with trajectory
Imirabilis2_D09_S75_QGIS_pic.png	QGIS image with ROV trajectory on bathymetry
Imirabilis2_D09_S75_Olex_map.tif	Olex image with ROV trajectory, profile and samples

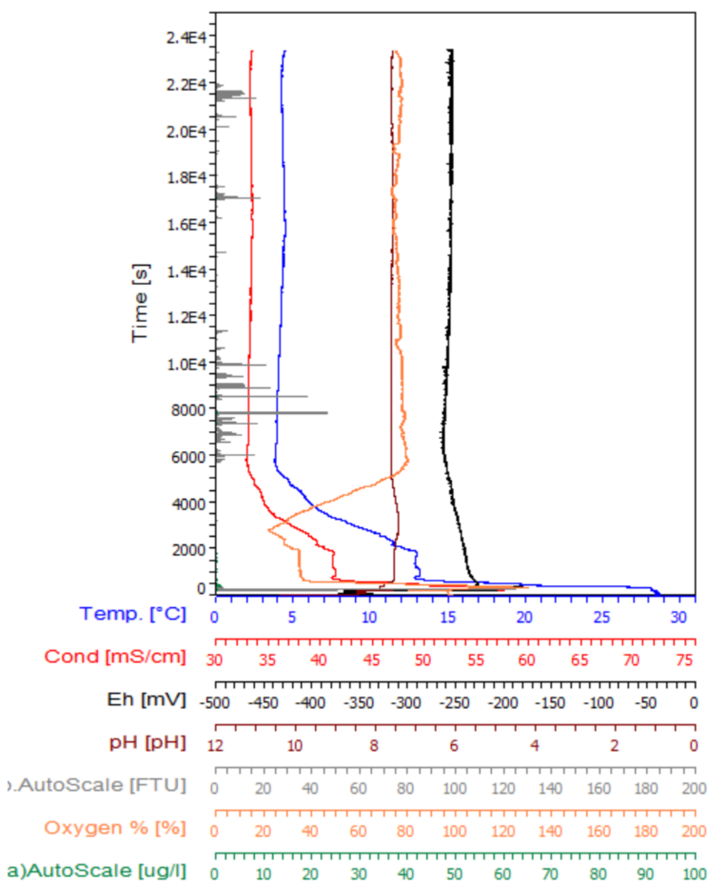
Imirabilis2_D09_S75_Still_Metadata_luso.csv Imirabilis2_D09_S75_Still_Metadata_luso_iM2.csv	Information retrieved using a software downloaded from the internet and not delivered by Kongsberg
Imirabilis2_D09_S75_Contros_graph.png	Contros data graphic
Imirabilis2_D09_S75_Idronaut_1_graph.png Imirabilis2_D09_S75_Idronaut_2_graph.png	Idronaut data graphic
Imirabilis2_D09_S75_SAIV_graph.png	SAIV data graphic
6 videos	Raw UHD videos
46 videos	Abyssal videos with video overlay information
267 images	Images from photo camera
186 images	Still images from video
Imirabilis_D09_S75_ship_1.JPG Imirabilis_D09_S75_ship_2.JPG	DP ship conditions

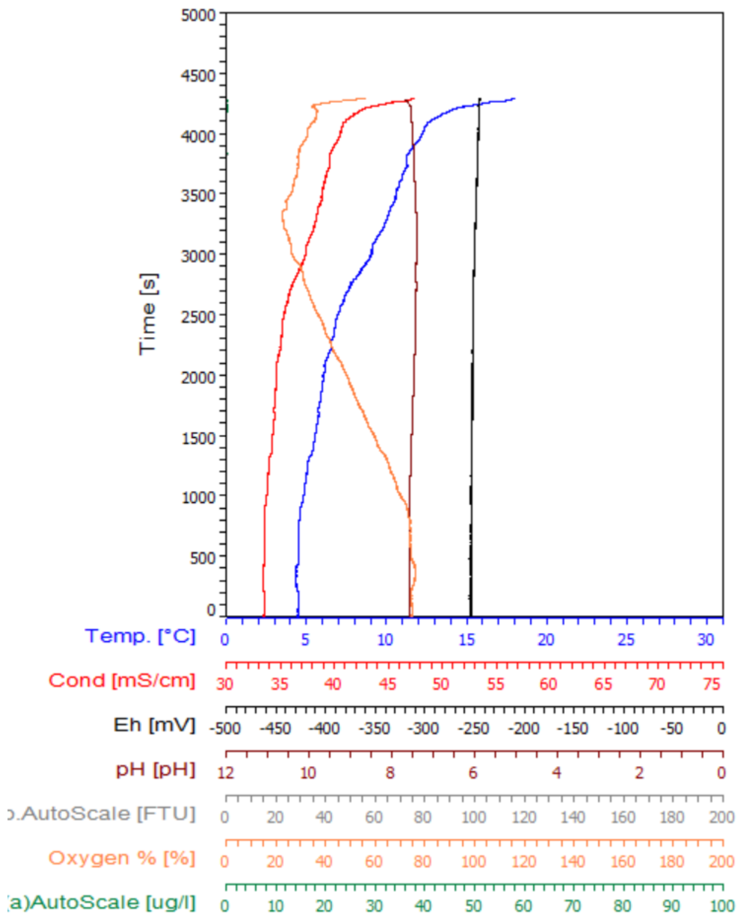
Help Files

FILE	OBSERVATIONS
CONTROS HydroC® CH4 data format.jpg	Imirabilis2_DXX_SXX_Contros.txt data format (CH_4 columns)
CONTROS HydroC® CO2 data format.jpg	Imirabilis2_DXX_SXX_Contros.txt data format (CO_2 columns)
ABY telemetry data format.pdf	Imirabilis2_DXX_SXX_ABY_telemetry.txt data format
Idronaut data format.txt	Imirabilis2_DXX_SXX_Idronaut.txt data format
HIPAP data format.pdf	Imirabilis2_DXX_SXX_HIPAP.txt data format
SAIV data format.txt	imirabilis2_DXX_SXX_SAIV.txt data format
INS_telemetry data format.pdf	Imirabilis2_DXX_SXX_INS_telemetry.txt data format

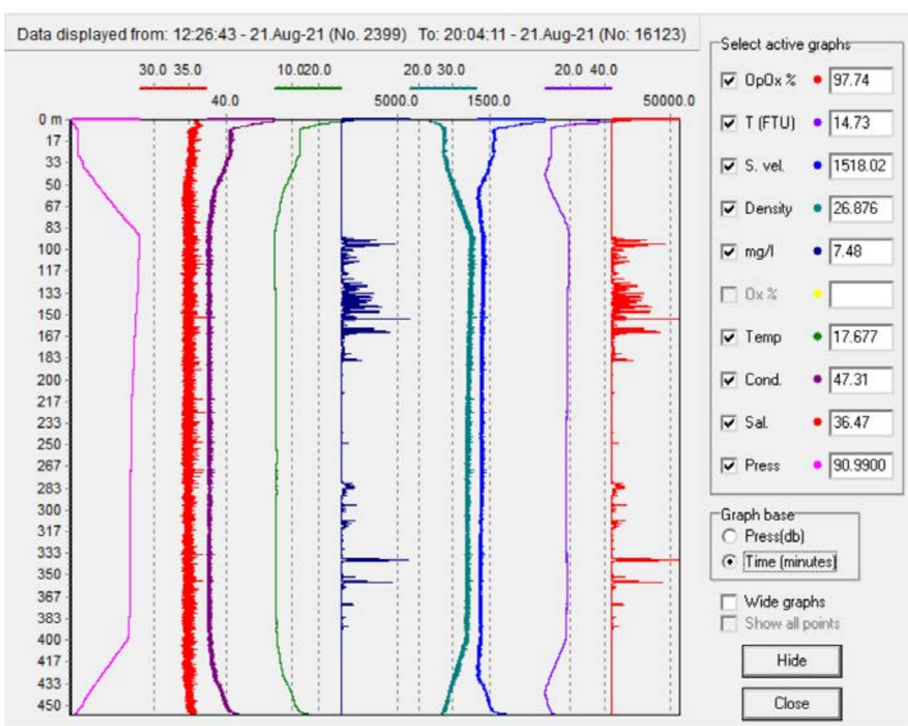
Data Graphs


DETECT Data Archive: datafile_20210821_132108.txt
CH4-0412-009 - Conc_estimate / digits
CO2-0716-001 - pCO2_corr / µatm
CO2-0716-001 - pCO2_corr / µatm
CH4-0412-009 - Conc_estimate / digits (10^3)
CH4-0412-009 - Date
08-21 12:00:00
08-21 14:00:00
08-21 16:00:00
08-21 18:00:00
08-21 20:00:00
08-21 22:00:00


Time [s]
Temp. [°C]
Cond [mS/cm]
Eh [mV]
pH [pH]
).AutoScale [FTU]
Oxygen % [%]
a)AutoScale [ug/l]

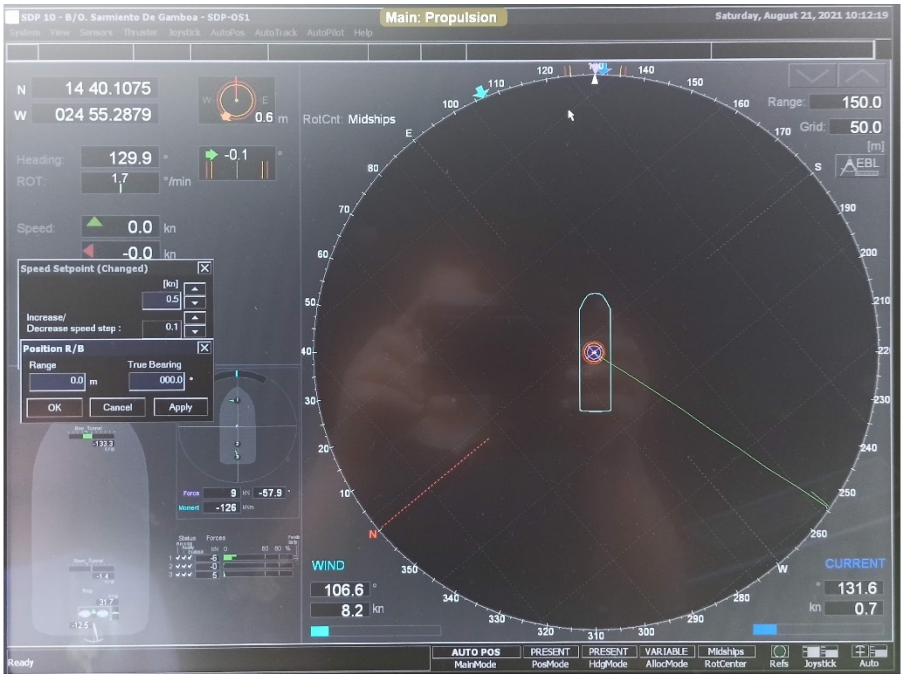


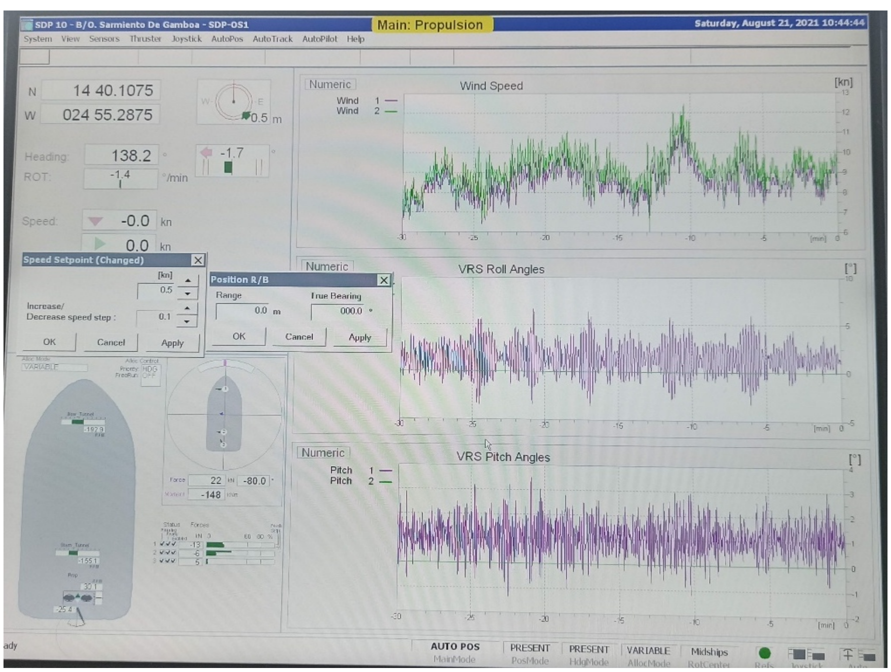
Time [s]
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Temp. [°C] 0 5 10 15 20 25 30
Cond [mS/cm] 30 35 40 45 50 55 60 65 70 75
Eh [mV] -500 -450 -400 -350 -300 -250 -200 -150 -100 -50 0
pH [pH] 12 10 8 6 4 2 0
AutoScale [FTU] 0 20 40 60 80 100 120 140 160 180 200
Oxygen % [%] 0 20 40 60 80 100 120 140 160 180 200
a)AutoScale [ug/l] 0 10 20 30 40 50 60 70 80 90 100



Data displayed from: 12:26:43 - 21.Aug-21 (No. 2399) To: 20:04:11 - 21.Aug-21 (No: 16123)
30.0 35.0
40.0
10.0 20.0
5000.0
20.0 30.0
1500.0
20.0 40.0
50000.0
0 m
17
33
50
67
83
100
117
133
150
167
183
200
217
233
250
267
283
300
317
333
350
367
383
400
417
433
450
Select active graphs
OpOx % 97.74
T (FTU) 14.73
S. vel. 1518.02
Density 26.876
mg/l 7.48
Ox %
Temp 17.677
Cond. 47.31
Sal. 36.47
Press 90.9900
Graph base
Press(db)
Time (minutes)
Wide graphs
Show all points
Hide
Close

Meteorological and Ocean Conditions





Technical Dive Log

Time	DESCRIPTION - AUG 21, 2021	TAGS
12:20:01	Trying again with the same HIPAP, cleaned the connectors, also installed another beacon.	
12:22:59	Data files of Data mon from EIVA are the same for dive 8.	
12:26:50		Off deck
12:29:26	We have position. Hipap working again.	
12:30:13	INS not working well with the HIPAP. Restarting. INS working good now.	
12:32:02	EIVA not wokring well. Restarted. Working good now.	
12:37:59	Water turned off by the vessel and it is very hot (55 ºC). Stopped. Cooling it with anoher water hoose	LARS
12:54:19	Going down again. LARS is at 40 ºC.	LARS
13:01:18	AA (Pilot), MS (Co-Pilot), AC (Winch)	Pilot exchange
13:56:56		At bottom
14:14:14	MS (Pilot), RB (Co-Pilot), AA (Winch)	Pilot exchange
15:50:41	Video interruption by opening a foto	Image
16:19:22	still camera turned off because the image was always turning off, probably because of the metal cable that we came across and was doing some force on it	Image
16:34:30	RB (Pilot) BR (Co-Pilot), MS (Winch)	Pilot exchange
17:29:07	Error on sonar. Restart sonar and ok.	Sensors
18:32:31	BR (Pilot) AC (Co-Pilot), RB (Winch)	Pilot exchange
19:02:49		Off bottom
19:54:25	AC (Pilot),MS (Co-Pilot), AA (Winch)	Pilot exchange
20:03:38	Contros pumps turned off. Idronaut, SAIV and DVL turned off	Sensors
20:10:03		On deck
	AUG 22, 2021	
6:04:11	Video of photo camera not working	Post-dive checks

iMirabilis2_D10_S77– SEBrava Island

iMirabilis2

TECHNICALDIVEREPORT 22/08/2021

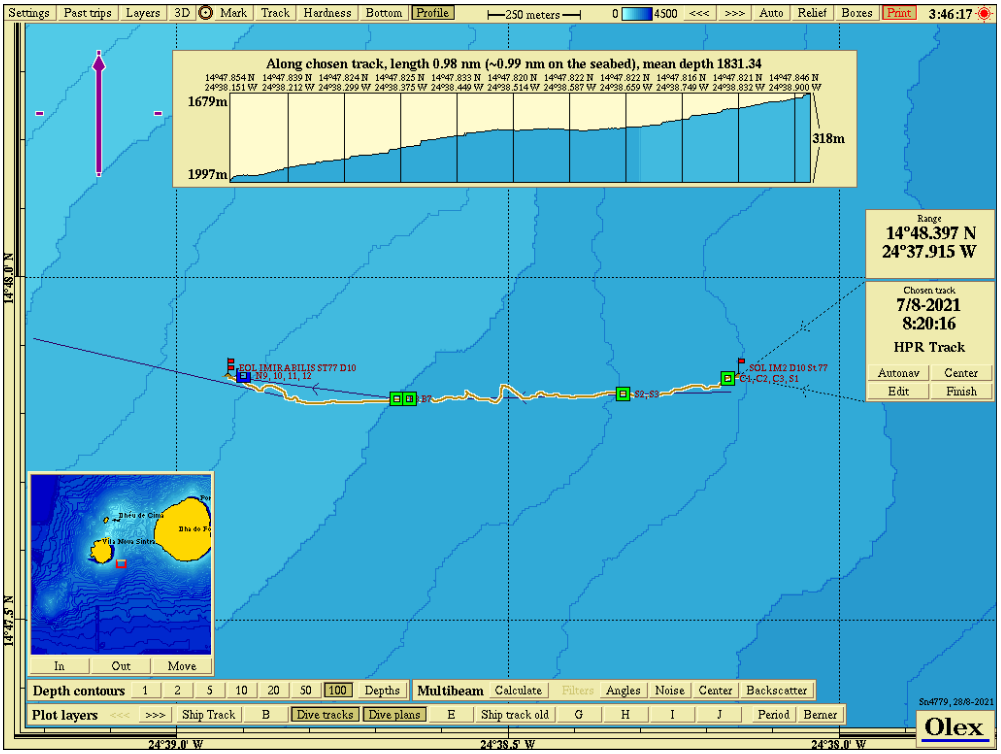
General Dive Details

Campaign	iMirabilis2
OperationCode	iMirabilis2_D10_S77
Vessel	R/V SarmientodeGamboa
Institution	CSIC, IEO and EMEPC; iAtlantic project
OperationSupervisor	AntónioCalado
ScientificCoordinator	Covadonga Orejasand Beatriz Vinha
ROV Supervisor	AntónioCalado
ROV Team	AntónioCalado,AndreiaAfonso,BrunoRamos, Miguel Souto,RenatoBettencourt
TypeofOperation	ROVDive– scientificsurvey (biological sampling and habitat mapping)
Equipment	ROVLuso
DateandTime(UTC)	**22**thAugustde 202106:50
Duration (HH:mm:ss)	07:59:58

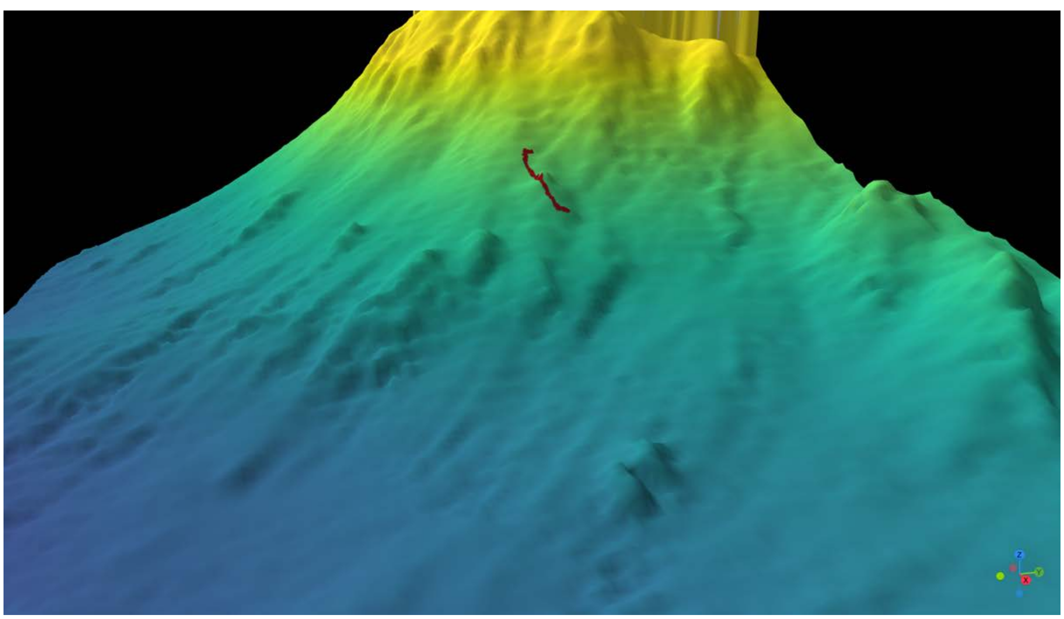
WorkingArea

Name	SEBrava Island
Latitude	14º47’52.6860’’N
Longitude	024º38’08.4780’’W
Depth(m)	2000

DiveMaps



3D Overview with ROV trajectory



SampleList

TYPEOFSAMPLES	TOTALNUMBER
Biological	2
Push Cores	3
Niskin	4
Suction	3

DataFiles

FILE	EQUIPMENT	PARAMETERS		OBSERVATIONS
Imirabilis2_D10_S77_SAIV.txt	SAIVCTD	Salinity	√	Calculated(manufacturer calibration 2019-recommended every 2 years)
		Conductivity	√	(manufacturer calibration 2019-recommended every 2 years)
		Soundvelocity	√	Calculated (manufacturer calibration 2019-recommended every 2 years)
		Temperature	√	(manufacturer calibration 2019-recommended every 2 years)
		Density	√	Calculated (manufacturer calibration 2019-recommended every 2 years)
		Pressure	√	Calibrated before the dive (manufacturer calibration 2019-recommended every 2 years)
	Oxygen sensor	Concentration dissolvedoxygenand percentageof oxygen saturation	√	(manufacturer calibration 2019-recommended every 2 years)

	Turbidity sensor	Turbidity	√	(manufacturer calibration 2019-recommended every 2 years)
Imirabilis2_D10_S77_INS_telemetry.txt	IxBlue INS ROVdata	ROVheading,roll, pitch	√	
Imirabilis2_D10_S77_HIPAP.txt	Kongsberg HIPAPROV position system	ROVposition	√	
Imirabilis2_D10_S77_ABY_telemetry.txt	Compass	Heading	√	
	Gyro	Pitch/roll	√	
	Depth sensor	Depth	√	
	Altimeter	Altitude	√	
Imirabilis2_D10_S77_Idronaut.TXT	IdronautCTD	Salinity	√	Calculated (manufacturer calibration 2019-recommended every 2 years)
		Conductivity	√	(manufacturer calibration 2019-recommended every 2 years)
		Temperature	√	(manufacturer calibration 2019-recommended every 2 years)
		Pressure	√	(manufacturer calibration 2019-recommended every 2 years)
	Oxygen sensor	Concentration dissolved oxygen and percentageof oxygen saturation	√	Calibratedbefore the dive (manufacturer calibration 2019-recommended every 2 years)

	Fluorescence sensor	Fluorescence	√	(manufacturer calibration 2019- recommended every 2 years)
	Turbidity sensor	Turbidity	√	(manufacturer calibration 2019- recommended every 2 years)
Imirabilis2_D10_S77_Idronaut.TXT	pHsensor	pH	√	Calibratedbefore the dive (manufacturer calibration 2019- recommended every 2 years)
	Redox potential sensor	Redox potential	√	(manufacturer calibration 2019- recommended every 2 years)
Imirabilis2_D10_S77_Contros.txt	$CH_4$and CO_2sensors	CH_4 and CO_2concentration and pCO_2	√	CH4last calibration in 2016 and verified in 2020(manufacturer doesnotsupport thissensor anymore).CO2 lastcalibrationin 2021(recommended calibration –every year)
UHD Imirabilis2_D10_S77_video_raw_22_08_2021_06_53_13.movto Imirabilis2_D10_S77_video_raw_12_10_22.mov	UHD camera	Video	√	PRORESvideo files(3840x2160)
Video_Camera 1_OVERLAY_2021-08-22 06-56-40.621Z.mp4to Video_Camera 1_OVERLAY_2021-08-22 14-40-09.408Z.mp4	UHDcamera	Video	√	MP4 video files(3840x2160)

2021-08-22_08-20-19.986 - Camera Viewer - Camera 1.jpgt o 2021-08-22_13-21-19.995 - Camera Viewer - Camera 1.jpg 2021-08-22_08-20-19.986 - Camera Viewer - Camera 1 - video_logo_luso.pngto 2021-08-22_13-21-19.995 - Camera Viewer - Camera 1 - video_logo_luso.png 2021-08-22_08-20-19.986 - Camera Viewer - Camera 1 - video_logo_luso_IM2.pngto 2021-08-22_13-21-19.995 - Camera Viewer - Camera 1 - video_logo_luso_IM2.png	UHDcamera	Still image	√	Name of the file has the suffix: • "- Video.jpg" has overlay info on the image These images comefromthe videowith Overlay showedon the screenduringthe dive; • "- Video_luso.png" no overlay, but luso logo on the image; • "- Video_luso_iM2.png" no overlay, but luso and campaign logo on the image;

Products

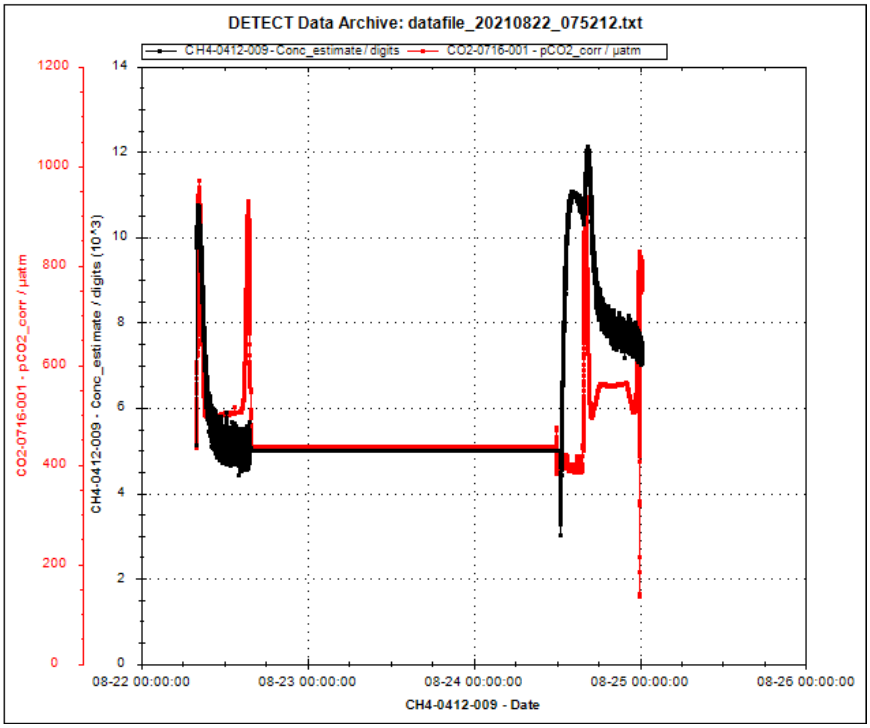
FILE	OBSERVATIONS
Imirabilis2_D10_S77_Contros.txt	Controsdata
Imirabilis2_D10_S77_Idronaut.TXT	Idronaut data
Imirabilis2_D10_S77_SAIV.txt	SAIV data
Imirabilis2_D10_S77_INS_telemetry.txt Imirabilis2_D10_S77_ABY_telemetry.txt	Telemetry data
Imirabilis2_D10_S77_HIPAP.txt	Position data
Imirabilis2_D10_S77_ROV_trajectory.prj/qpj/shp/shx/dbf	Shape-file withtrajectory
Imirabilis2_D10_S77_QGIS_pic.png	QGISimagewith ROV trajectoryonbathymetry
Imirabilis2_D10_S77_Olex_map.tif	Oleximage with ROVtrajectory,profileand samples
Imirabilis2_D10_S77_Contros_graph.png	Controsdata graphic
Imirabilis2_D10_S77_Idronaut_graph.png	Idronautdata graphic
Imirabilis2_D10_S77_SAIV_graph.png	SAIV data graphic
6 UHD/ 1HD	Raw UHD videos
46 videos	Abyssal videos with video overlay information

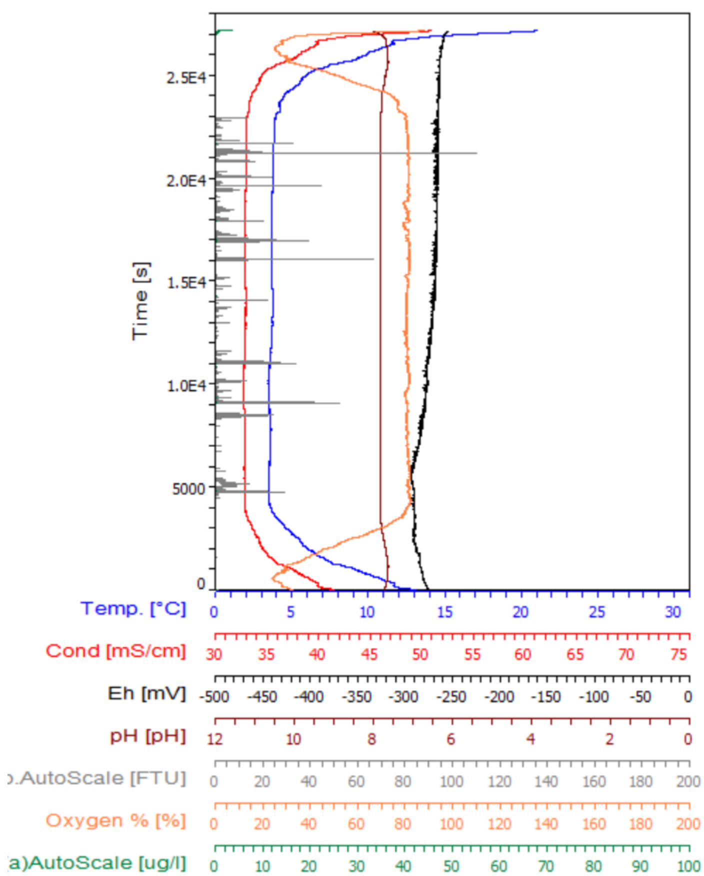
80 images	Still images from video
Imirabilis_D10_S77_ship_1.JPG Imirabilis_D10_S77_ship_2.JPG	DP ship conditions

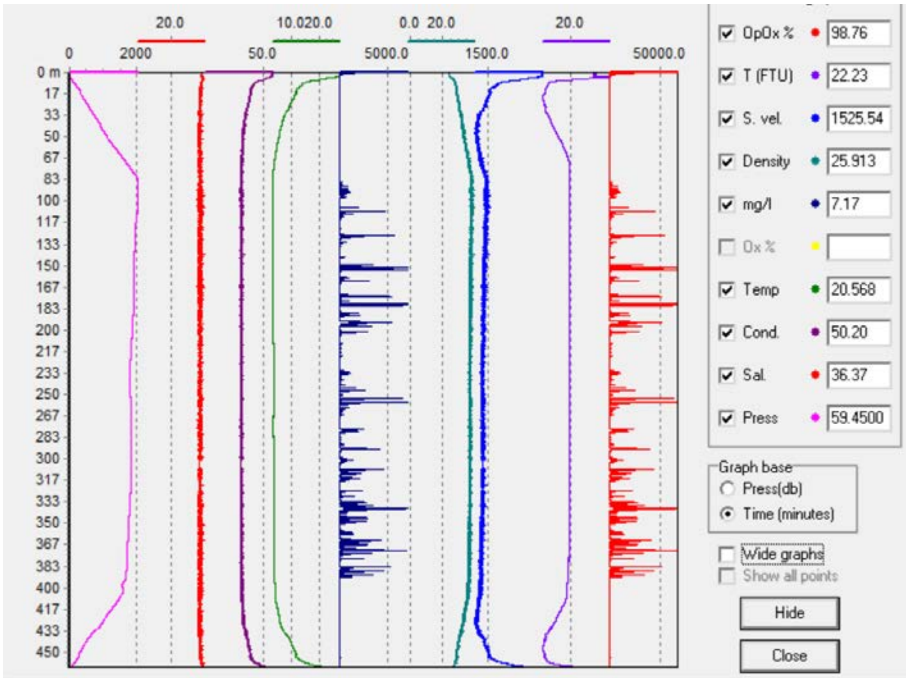
HelpFiles

FILE	OBSERVATIONS
CONTROS HydroC® CH4 data format.jpg	Imirabilis2_DXX_SXX_Contros.txt data format(CH_4columns)
CONTROS HydroC® CO2 data format.jpg	Imirabilis2_DXX_SXX_Contros.txt data format(CO_2columns)
ABY telemetry data format.pdf	Imirabilis2_DXX_SXX_ABY_telemetry.txtdata format
Idronaut data format.txt	Imirabilis2_DXX_SXX_Idronaut.txt data format
HIPAP data format.pdf	Imirabilis2_DXX_SXX_HIPAP.txt data format
SAIV data format.txt	imirabilis2_DXX_SXX_SAIV.txt data format
INS_telemetry data format.pdf	Imirabilis2_DXX_SXX_INS_telemetry.txt data format

DataGraphs


DETECT Data Archive: datafile_20210822_075212.txt
CH4-0412-009 - Conc_estimate / digits
CO2-0716-001 - pCO2_corr / µatm
CO2-0716-001 - pCO2_corr / µatm
CH4-0412-009 - Conc_estimate / digits (10^3)
CH4-0412-009 - Date
08-22 00:00:00
08-23 00:00:00
08-24 00:00:00
08-25 00:00:00
08-26 00:00:00


Time [s]
Temp. [°C]
Cond [mS/cm]
Eh [mV]
pH [pH]
).AutoScale [FTU]
Oxygen % [%]
a)AutoScale [ug/l]



Meteorologicaland Ocean Conditions

TechnicalDiveLog

Time	DESCRIPTION - AUG 22, 2021	TAGS
6:02:56	SAIV clock synchronized. SAIV pressure sensor calibrated. Idronaut pressure, pH and oxygen sensors calibrated.	Sensors
6:04:39	Ok	Pre-dive checks
6:50:02		Off deck
6:53:57	INS restarted. Nor working well with the depth and sound velocity data.	
6:55:13	EIVA restarted.	
7:00:58	Contros pumps turned on and data acquisition in the Contros software also. The logging only started now.	
7:03:03	INS and EIVA restarted, because INs was not working well with the position data and EIVA with the INS data afterwards	
7:06:38	Idronaut CTD not acquiring data well. Restarted and acquiring data well now	
7:12:29	BR (Pilot), AC (Co-pilot), RB (Winch)	Pilot exchange
7:55:21	AC (PILOT); AA (co-pilot); BR (winch)	Pilot exchange
8:20:15		At bottom
10:01:12	small leak in the pump retainer	LARS
10:02:16	AA (Pilot), MS (Co-Pilot), AC (Winch)	Pilot exchange
12:01:03	MS (Pilot), RB (Co-Pilot), AA (Winch)	Pilot exchange
13:30:19		Off bottom
13:55:07	RB (Pilot), BR (Co-Pilot), MS (Winch)	Pilot exchange
14:28:27	AC (Pilot); MS (co-pilot); AA (winch)	Pilot exchange
14:36:36	Contros pumps turned off.	Sensors

14:36:36	SAIV and Idronautturned off.	Sensors
14:50:00		On deck
15:00:00	Photo camera is not working. A cable during the previous dive touch it. We don't know if this caused the issue.	Post-dive checks

iMirabilis2_D11_S83 – E Cadamosto Seamount Base

iMirabilis2

TECHNICAL DIVE REPORT 24/08/2021

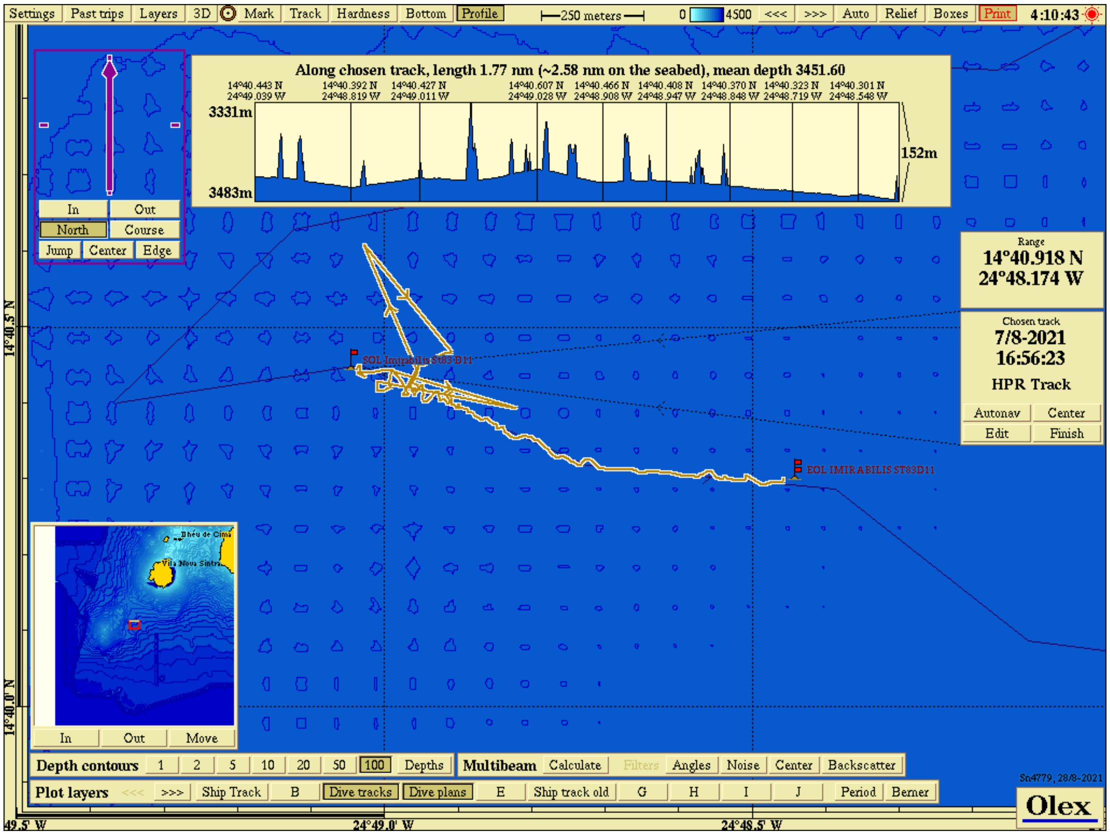
General Dive Details

Campaign	iMirabilis2
Operation Code	iMirabilis2_D11_S83
Vessel	R/V Sarmiento de Gamboa
Institution	CSIC, IEO and EMEPC; iAtlantic project
Operation Supervisor	António Calado
Scientific Coordinator	Covadonga Orejas and Beatriz Vinha
ROV Supervisor	António Calado
ROV Team	António Calado, Andreia Afonso, Bruno Ramos, Miguel Souto, Renato Bettencourt
Type of Operation	ROV Dive – scientific survey (habitat mapping and still images during a transect); testing an eDNA sampler, ROCSI from NOC
Equipment	ROV Luso
Date and Time (UTC)	**24**th August de 2021 14:45
Duration (HH:mm:ss)	08:35:04

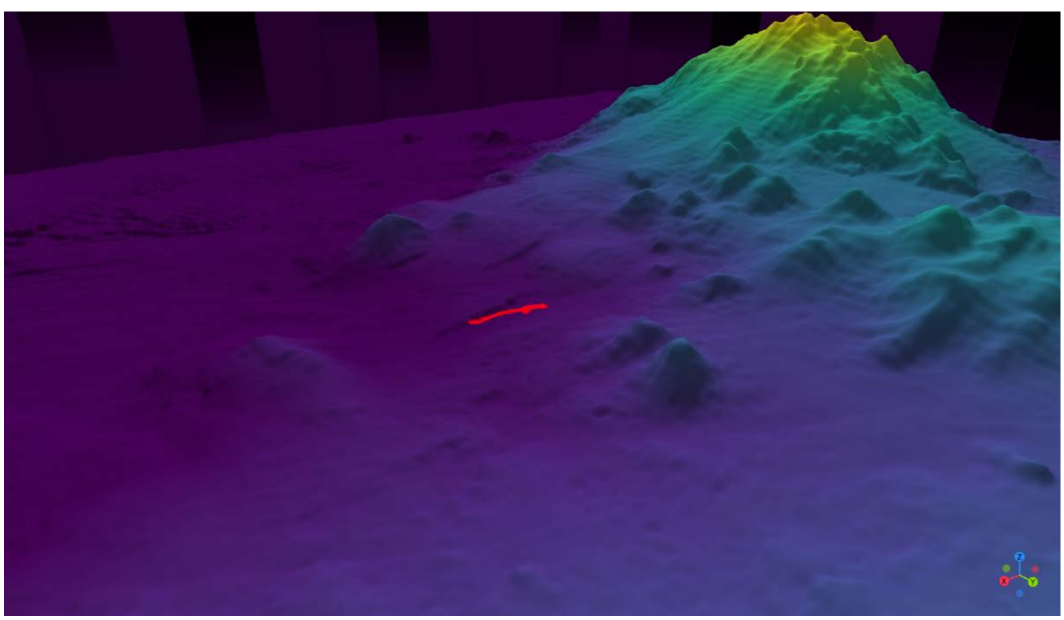
Working Area

Name	E Cadamosto Seamount base
Latitude	14º40’29.4240’’N
Longitude	024º49’04.3320’’W
Depth (m)	3400

Dive Maps



3D Overview with ROV trajectory



Sample List

TYPE OF SAMPLES	TOTAL NUMBER
Biological	0
Push Cores	0
Niskin	0
Suction	0

Data Files

FILE	EQUIPMENT	PARAMETERS		OBSERVATIONS
Imirabilis2_D11_S83_SAIV.txt	SAIV CTD	Salinity	√	Calculated (manufacturer calibration 2019- recommended every 2 years)
		Conductivity	√	(manufacturer calibration 2019- recommended every 2 years)
		Sound velocity	√	Calculated (manufacturer calibration 2019- recommended every 2 years)
		Temperature	√	(manufacturer calibration 2019- recommended every 2 years)
		Density	√	Calculated (manufacturer calibration 2019- recommended every 2 years)
		Pressure	√	Calibrated before the dive (manufacturer calibration 2019- recommended every 2 years)
	Oxygen sensor	Concentration dissolved oxygen and percentage of oxygen saturation	√	(manufacturer calibration 2019- recommended every 2 years)

	Turbidity sensor	Turbidity	√	(manufacturer calibration 2019- recommended every 2 years)
Imirabilis2_D11_S83_INS_telemetry.txt	IxBlue INS ROVdata	ROV heading, roll, pitch	√	
Imirabilis2_D11_S83_HIPAP.txt	Kongsberg HIPAP ROV position system	ROV position	√	
Imirabilis2_D11_S83_ABY_telemetry.txt	Compass	Heading	√	
	Gyro	Pitch/roll	√	
	Depth sensor	Depth	√	
	Altimeter	Altitude	√	
Imirabilis2_D11_S83_Idronaut.TXT	Idronaut CTD	Salinity	√	Calculated (manufacturer calibration 2019- recommended every 2 years)
		Conductivity	√	(manufacturer calibration 2019- recommended every 2 years)
		Temperature	√	(manufacturer calibration 2019- recommended every 2 years)
		Pressure	√	(manufacturer calibration 2019- recommended every 2 years)
	Oxygen sensor	Concentration dissolved oxygen and percentage of oxygen saturation	√	Calibrated before the dive (manufacturer calibration 2019- recommended every 2 years)

Imirabilis2_D11_S83_Idronaut.TXT	Fluorescence sensor	Fluorescence	√	(manufacturer calibration 2019- recommended every 2 years)
	Turbidity sensor	Turbidity	√	(manufacturer calibration 2019- recommended every 2 years)
	pH sensor	pH	√	Calibrated before the dive (manufacturer calibration 2019- recommended every 2 years)
	Redox potential sensor	Redox potential	√	(manufacturer calibration 2019- recommended every 2 years)
UHD Imirabilis2_D11_S83_video_raw_24_08_2021_15_10_19.mov to Imirabilis2_D11_S83_video_raw_24_08_2021_18_42_02.mov	UHD camera	Video	√	PRORES video files (3840x2160)
Video_Camera 1_OVERLAY_2021-08-24 14-43-15.591Z.mp4 to Video_Camera 1_OVERLAY_2021-08-24 23-19-05.068Z.mp4	UHD camera	Video	√	MP4 video files(3840x2160)
IMG_4665_logo_luso.png to IMG_6540_logo_luso.png IMG_4665_logo_luso_IM2.png to IMG_6540_logo_luso_IM2.png	Photo Camera	Photo	√	3648x2736px images with metadada in Imirabilis2_D11_S83_Still_Metadata_luso.csv and Imirabilis2_D11_S83_Still_Metadata_luso.csv (with only Luso logo or with addition of campaign logo)

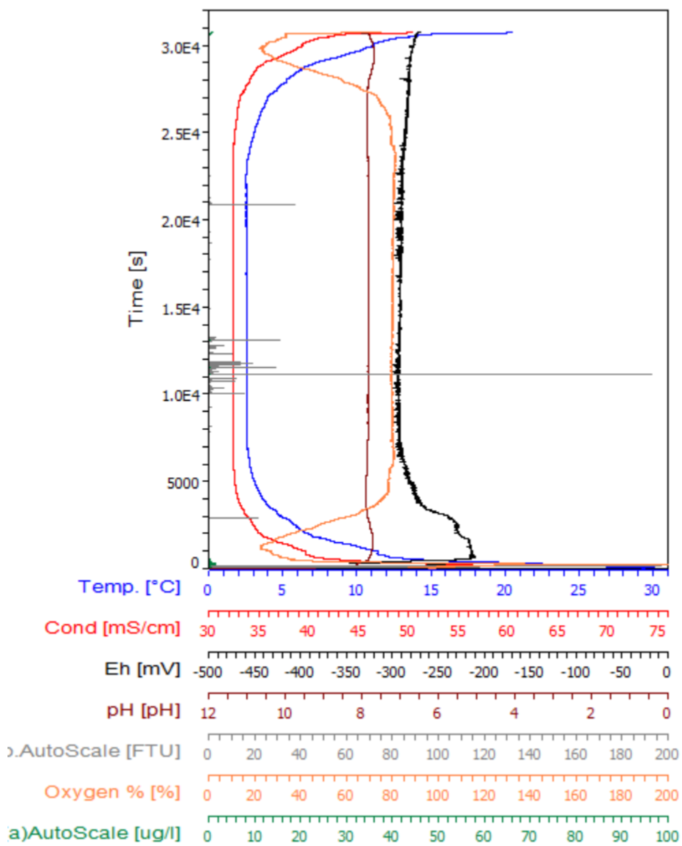
Products

FILE	OBSERVATIONS
Imirabilis2_D11_S83_Idronaut.TXT	Idronaut data
Imirabilis2_D11_S83_SAIV.txt	SAIV data
Imirabilis2_D11_S83_INS_telemetry.txt Imirabilis2_D11_S83_ABY_telemetry.txt	Telemetry data
Imirabilis2_D11_S83_HIPAP.txt	Position data
Imirabilis2_D11_S83_ROV_trajectory.prj/qpj/shp/shx/dbf	Shape-file with trajectory
Imirabilis2_D11_S83_QGIS_pic.png	QGIS image with ROV trajectory on bathymetry
Imirabilis2_D11_S83_Olex_map.tif	Olex image with ROV trajectory, profile and samples
Imirabilis2_D11_S83_Idronaut_graph.png	Idronaut data graphic
Imirabilis2_D11_S83_SAIV_graph.png	SAIV data graphic
Imirabilis2_D11_S83_Still_Metadata_Iuso.csv Imirabilis2_D11_S83_Still_Metadata_Iuso_iM2.csv	Information retrieved using a software downloaded from the internet and not delivered by Kongsberg
3 videos	Raw UHD videos
52 videos	Abyssal videos with video overlay information
1871 images	Images from photo camera
Imirabilis_D11_S83_ship_1.JPG Imirabilis_D11_S83_ship_2.JPG	DP ship conditions

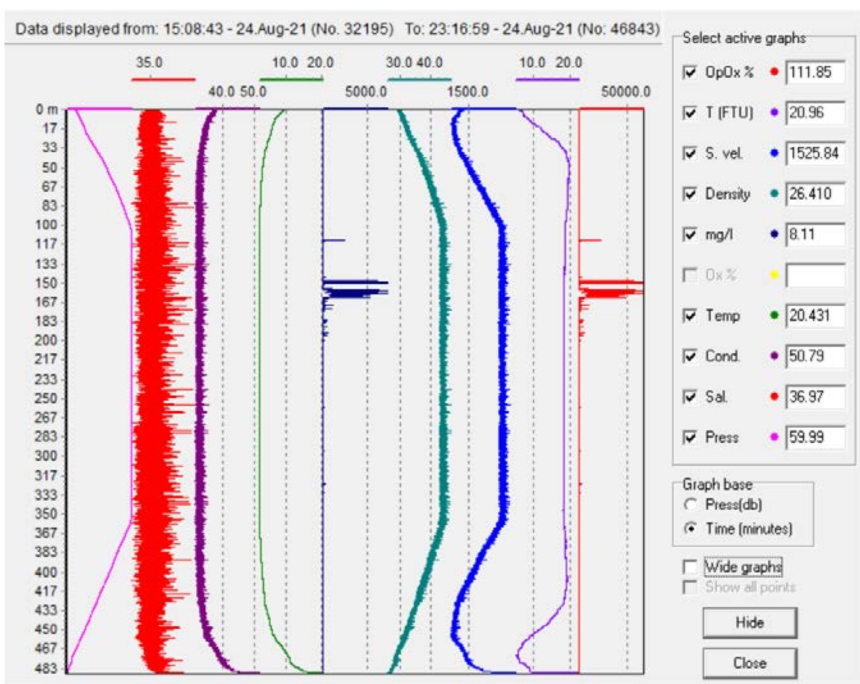
Help Files

FILE	OBSERVATIONS
ABY telemetry data format.pdf	Imirabilis2_DXX_SXX_ABY_telemetry.txt data format
Idronaut data format.txt	Imirabilis2_DXX_SXX_Idronaut.txt data format
HIPAP data format.pdf	Imirabilis2_DXX_SXX_HIPAP.txt data format
SAIV data format.txt	imirabilis2_DXX_SXX_SAIV.txt data format
INS_telemetry data format.pdf	Imirabilis2_DXX_SXX_INS_telemetry.txt data format

Data Graphs

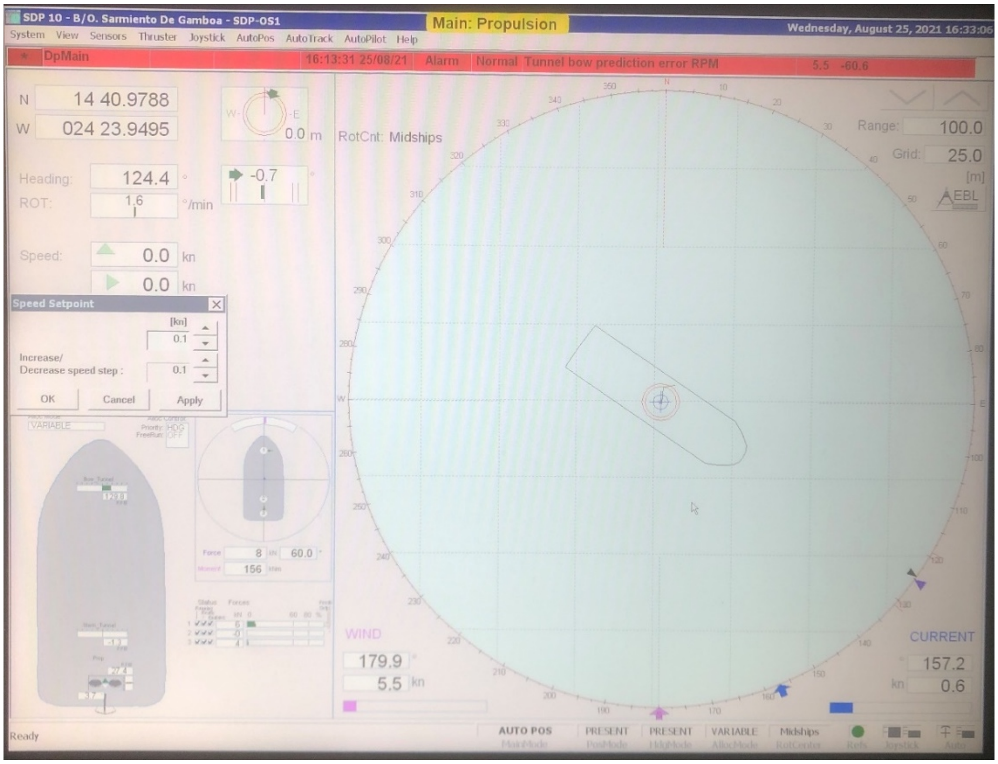


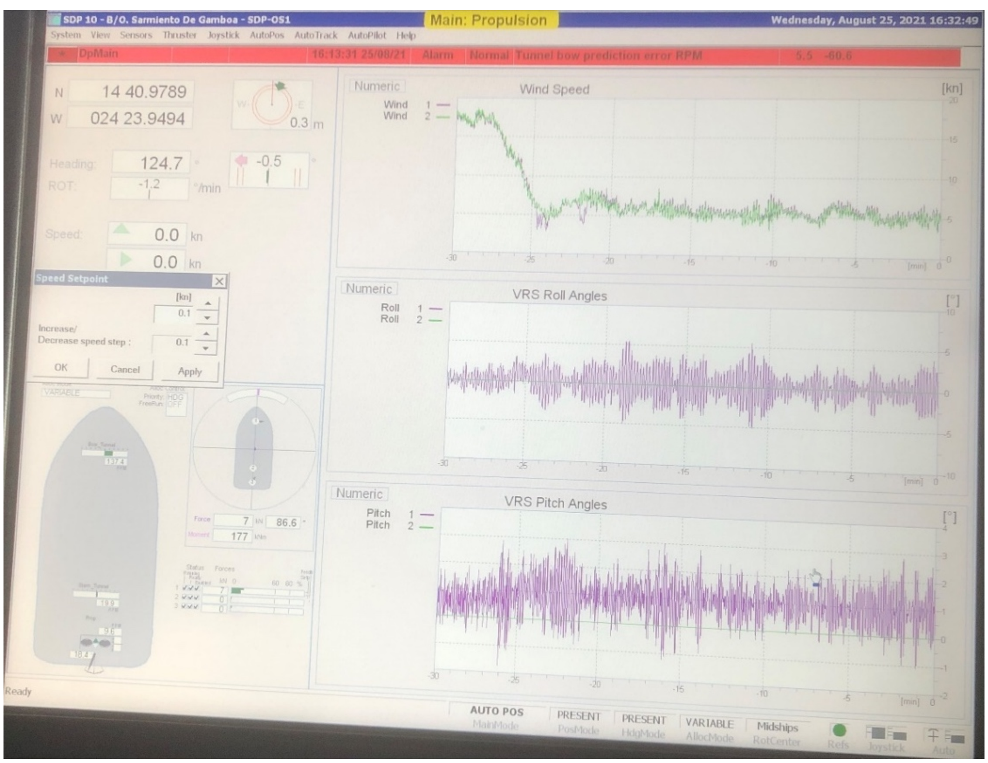
Time [s]
3.0E4
2.5E4
2.0E4
1.5E4
1.0E4
5000
0
Temp. [°C] 0 5 10 15 20 25 30
Cond [mS/cm] 30 35 40 45 50 55 60 65 70 75
Eh [mV] -500 -450 -400 -350 -300 -250 -200 -150 -100 -50 0
pH [pH] 12 10 8 6 4 2 0
).AutoScale [FTU] 0 20 40 60 80 100 120 140 160 180 200
Oxygen % [%] 0 20 40 60 80 100 120 140 160 180 200
a)AutoScale [ug/l] 0 10 20 30 40 50 60 70 80 90 100



Data displayed from: 15:08:43 - 24.Aug-21 (No. 32195) To: 23:16:59 - 24.Aug-21 (No: 46843)
35.0
10.0 20.0
30.0 40.0
10.0 20.0
40.0 50.0
5000.0
1500.0
50000.0
0 m
17
33
50
67
83
100
117
133
150
167
183
200
217
233
250
267
283
300
317
333
350
367
383
400
417
433
450
467
483
Select active graphs
OpOx % 111.85
T (FTU) 20.96
S. vel. 1525.84
Density 26.410
mg/l 8.11
Ox %
Temp 20.431
Cond. 50.79
Sal. 36.97
Press 59.99
Graph base
Press(db)
Time (minutes)
Wide graphs
Show all points
Hide
Close

Meteorological and Ocean Conditions





Technical Dive Log

Time	DESCRIPTION – AUG 24, 2021	TAGS
10:59:09	SAIV pressure calibrated. SAIV clock synchronized. Idronaut and oxygen sensors calibrated.	Sensors
11:03:51	Ok. Andrew's still camera and strobes from the lander installed in the front of the ROV to acquire photos during a transect, looking down. Our still camera also installed in the same structure. ROCSI mounted in the ROV, with batteries, in the back of the big sampling drawer. Halogen front light mounted on the skid pointing down to eliminate de shadow created by the ROV	Pre-dive checks
14:38:46	Photo camera from Andrew turned on.	
14:45:00		Off deck
14:48:37	Contros pumps turned on	Sensors
14:50:34	Capturing 4k not working well. A lot of breaks.	
14:51:52	INS not receiving well the data. Restarted.	
14:53:46	EIVA not receiving well the data from INS. Restarted.	
15:03:30	RB (Pilot), BR (Co-pilot), MS (Winch)	Pilot exchange
15:16:17	INS not receiving well the data. Restarted.	Sensors
15:17:05	EIVA not receiving well the data from INS. Restarted.	Sensors
15:52:53	INS-DVL calibration. INS and EIVA restarted.	Sensors
15:58:00	Some Losses of hipap position.	Sensors
16:17:43	Corrected the station number from 84 to 83 in the overlay.	Image
16:40:30	BR (Pilot), AC (Co-pilot), RB (Winch)	Pilot exchange
16:54:51		At bottom
17:36:52	Positioning System Unstable in the last minute	Sensors
17:39:09	With the Positioning Information more stable we will come to the back of the vessel to remove as much as we can the umbilical we have in water	Sensors
18:37:00	AC (Pilot), AA (Co-pilot), BR (Winch)	Pilot exchange
20:26:34	AA (Pilot), MS (Co-Pilot), AC (Winch)	Pilot exchange
21:04:06		Off bottom
22:28:26	MS (Pilot), RB (Co-Pilot), AA (Winch)	Pilot exchange
23:00:12	AC (Pilot), MS (Co-Pilot), AA (Winch)	Pilot exchange
23:15:02	Contros pumps turned off.	Sensors
23:19:19	Record stopped by mistake	Image
23:20:04		On deck
	AUG 25, 2021	
0:30:01	ROCSI didn't work. Made a cable and let dry the resin by night to power it from the ROV with a traco installed to down from 24V to 12V. Contros not record during this dive, pilots forgot to log the data.	Post-dive checks

iMirabilis2_D12_S87 – S Fogo Island, Abyssal Area

iMirabilis2

TECHNICAL DIVE REPORT 25/08/2021

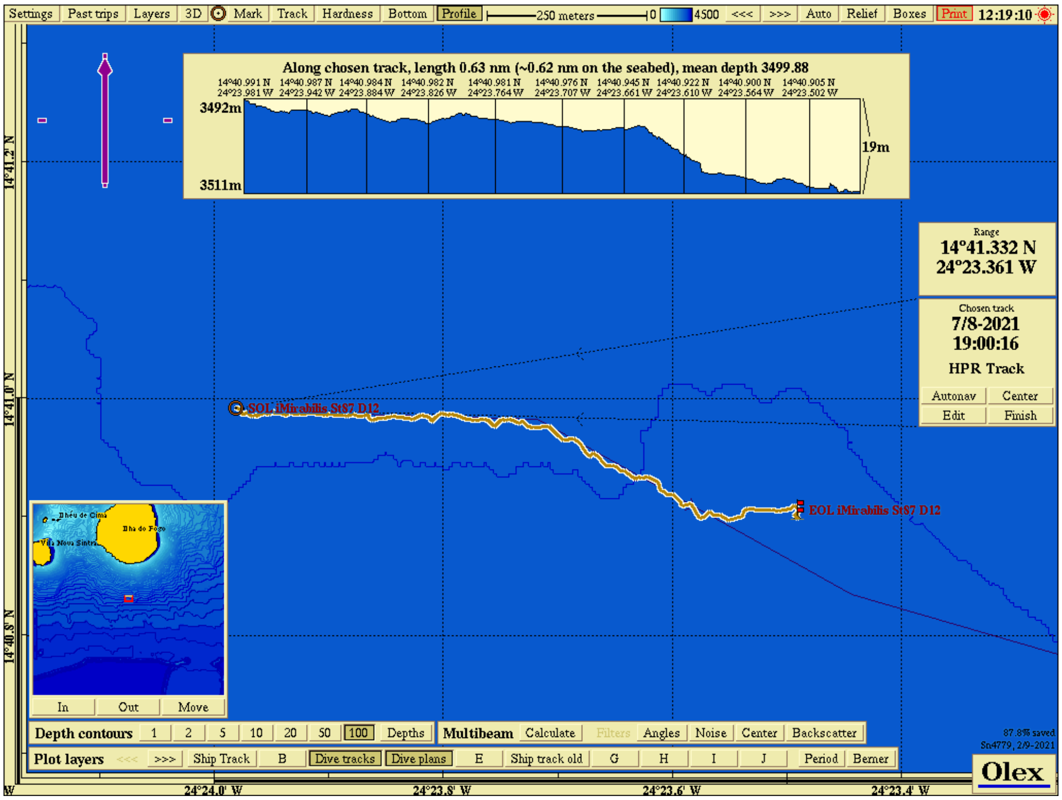
General Dive Details

Campaign	iMirabilis2
Operation Code	iMirabilis2_D12_S87
Vessel	R/V Sarmiento de Gamboa
Institution	CSIC, IEO and EMEPC; iAtlantic project
Operation Supervisor	António Calado
Scientific Coordinator	Covadonga Orejas and Beatriz Vinha
ROV Supervisor	António Calado
ROV Team	António Calado, Andreia Afonso, Bruno Ramos, Miguel Souto, Renato Bettencourt
Type of Operation	ROV Dive – scientific survey (habitat mapping and still images during a transect); testing an eDNA sampler, ROCSI from NOC
Equipment	ROV Luso
Date and Time (UTC)	**24**th August de 2021 17:00
Duration (HH:mm:ss)	07:44:32

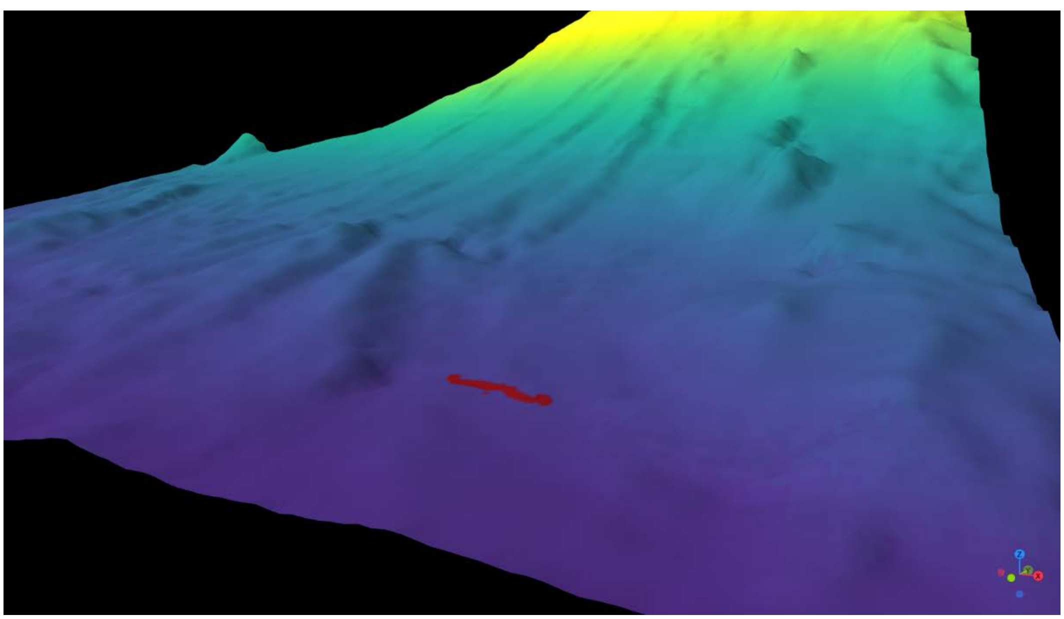
Working Area

Name	S Fogo Island, Abyssal Area
Latitude	14º40’59.5080’’N
Longitude	024º23’55.2360’’W
Depth (m)	3500

Dive Maps



3D Overview with ROV trajectory



Sample List

TYPE OF SAMPLES	TOTAL NUMBER
Biological	0
Push Cores	0
Niskin	0
Suction	0

Data Files

FILE	EQUIPMENT	PARAMETERS		OBSERVATIONS
Imirabilis2_D12_S87_SAIV.txt	SAIV CTD	Salinity	√	Calculated (manufacturer calibration 2019- recommended every 2 years)
		Conductivity	√	(manufacturer calibration 2019- recommended every 2 years)
		Sound velocity	√	Calculated (manufacturer calibration 2019- recommended every 2 years)
		Temperature	√	(manufacturer calibration 2019- recommended every 2 years)
		Density	√	Calculated (manufacturer calibration 2019- recommended every 2 years)
		Pressure	√	Calibrated before the dive (manufacturer calibration 2019- recommended every 2 years)
	Oxygen sensor	Concentration dissolved oxygen and percentage of oxygen saturation	√	(manufacturer calibration 2019- recommended every 2 years)
	Turbidity sensor	Turbidity	√	(manufacturer calibration 2019- recommended every 2 years)

Imirabilis2_D12_S87_INS_telemetry.txt	IxBlue INS ROVdata	ROV heading, roll, pitch	√	
Imirabilis2_D12_S87_HIPAP.txt	Kongsberg HIPAP ROV position system	ROV position	√	
Imirabilis2_D12_S87_ABY_telemetry.txt	Compass	Heading	√	
	Gyro	Pitch/roll	√	
	Depth sensor	Depth	√	
	Altimeter	Altitude	√	
Imirabilis2_D12_S87_Idronaut.TXT	Idronaut CTD	Salinity	√	Calculated (manufacturer calibration 2019- recommended every 2 years)
		Conductivity	√	(manufacturer calibration 2019- recommended every 2 years)
		Temperature	√	(manufacturer calibration 2019- recommended every 2 years)
		Pressure	√	(manufacturer calibration 2019- recommended every 2 years)
	Oxygen sensor	Concentration dissolved oxygen and percentage of oxygen saturation	√	Calibrated before the dive (manufacturer calibration 2019- recommended every 2 years)
	Fluorescence sensor	Fluorescence	√	(manufacturer calibration 2019- recommended every 2 years)
Imirabilis2_D12_S87_Idronaut.TXT	Turbidity sensor	Turbidity	√	(manufacturer calibration 2019- recommended every 2 years)

	pH sensor	pH	√	Calibrated before the dive (manufacturer calibration 2019-recommended every 2 years)
	Redox potential sensor	Redox potential	√	(manufacturer calibration 2019-recommended every 2 years)
Imirabilis2_D12_S87_Contros.txt	CH_4 and CO_2 sensors	CH_4 and CO_2 concentration and pCO_2	√	CH4 last calibration in 2016 and verified in 2020 (manufacturer does not support this sensor anymore). CO2 last calibration in 2021 (recommended calibration – every year)
HD Imirabilis2_D12_S87_video_raw_25_08_2021_18_19_16.mov to Imirabilis2_D12_S87_video_raw_25_08_2021_23_24_02.mov **UHD** Imirabilis2_D12_S87_video_raw_25_08_2021_18_13_43.mov to Imirabilis2_D12_S87_Video_raw_25_08_2021_17_34_33.mov	UHD, HD camera	Video	√	PRORES HQ and PRORES video files (3840x2160;1920x1080)
Video_Camera 1_OVERLAY_2021-08-25 16-57-52.411Z.mp4 to Video_Camera 1_OVERLAY_2021-08-26 00-39-48.539Z.mp4	UHD, HD camera	Video	√	MP4 video files(3840x2160; 1920x1080)
2021-08-25_19-25-11.088 - Camera Viewer - Camera 1.jpg to 2021-08-25_22-15-33.726 - Camera Viewer - Camera 1.jpg 2021-08-25_19-25-11.088 - Camera Viewer - Camera 1 - video_logo_luso.png to 2021-08-25_22-15-33.726 - Camera Viewer - Camera 1 - video_logo_luso.png 2021-08-25_19-25-11.088 - Camera Viewer - Camera 1 - video_logo_luso_IM2.png to 2021-08-25_22-15-33.726 - Camera Viewer - Camera 1 - video_logo_luso_IM2.png	UHD, HD camera	Still image	√	Name of the file has the suffix: • "- Video.jpg" has overlay info on the image These images come from the video with Overlay showed on the screen during the dive; • "- Video_luso.png" no overlay, but luso logo on the image; • "- Video_luso_iM2.png" no overlay, but luso and campaign logo on the image;

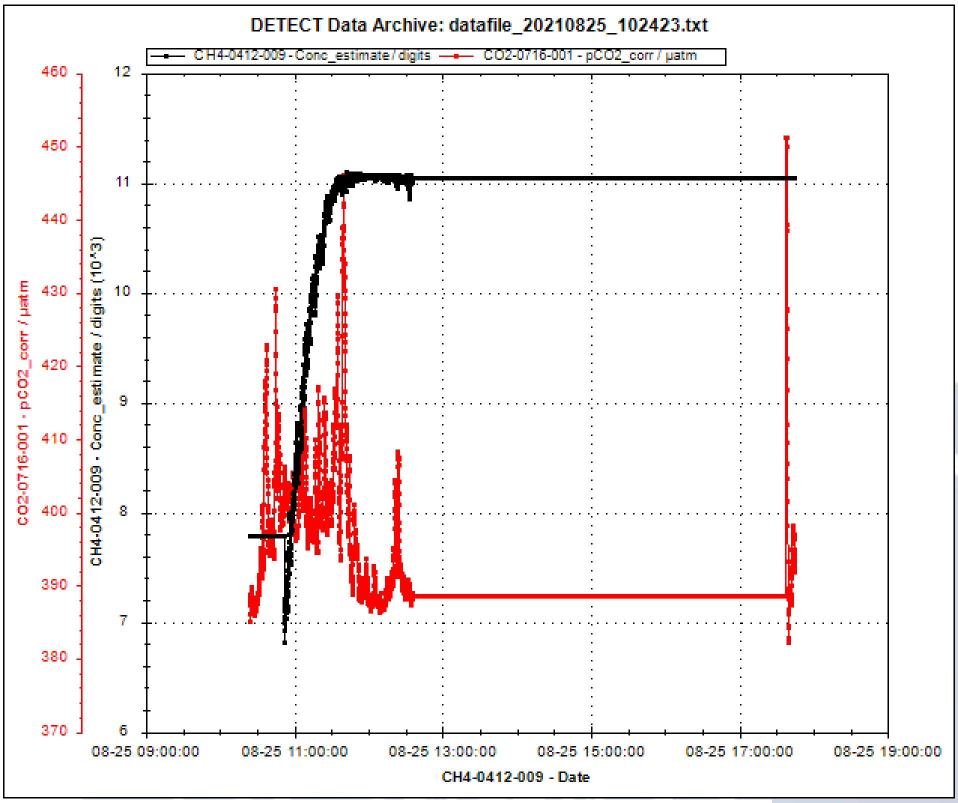
Products

FILE	OBSERVATIONS
Imirabilis2_D12_S87_Contros.txt	Contros data
Imirabilis2_D12_S87_Idronaut.TXT	Idronaut data
Imirabilis2_D12_S87_SAIV.txt	SAIV data
Imirabilis2_D12_S87_INS_telemetry.txt Imirabilis2_D12_S87_ABY_telemetry.txt	Telemetry data
Imirabilis2_D12_S87_HIPAP.txt	Position data
Imirabilis2_D12_S87_ROV_trajectory.prj/qpj/shp/shx/dbf	Shape-file with trajectory
Imirabilis2_D12_S87_QGIS_pic.png	QGIS image with ROV trajectory on bathymetry
Imirabilis2_D12_S87_Olex_map.tif	Olex image with ROV trajectory, profile and samples
Imirabilis2_D12_S87_Contros_graph.png	Contros data graphic
Imirabilis2_D12_S87_Idronaut_graph.png	Idronaut data graphic
Imirabilis2_D12_S87_SAIV_graph.png	SAIV data graphic
3UHD / 5HD	Raw UHD, HD videos
50 videos	Abyssal videos with video overlay information
69 images	Still images from video

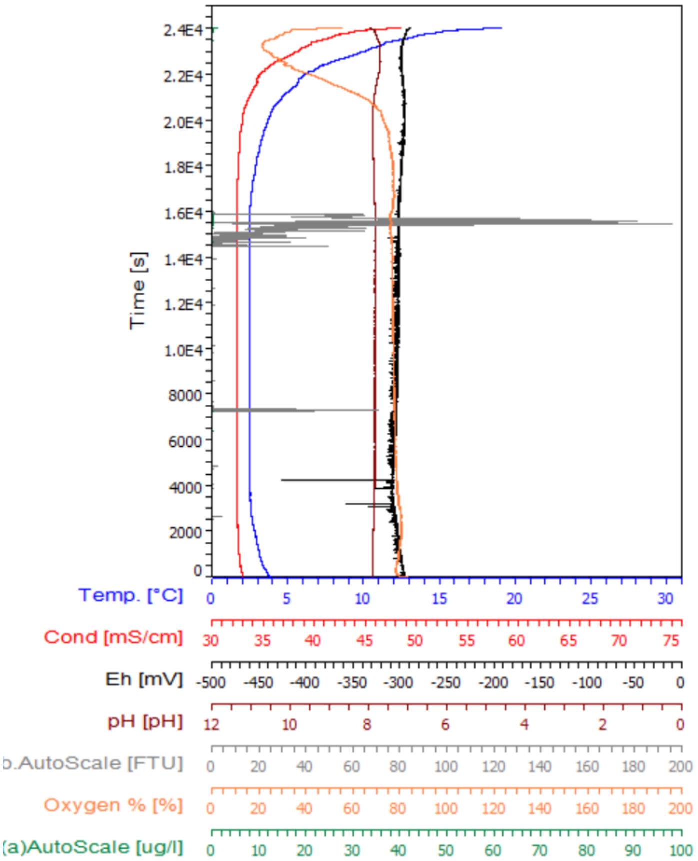
Help Files

FILE	OBSERVATIONS
CONTROS HydroC® CH4 data format.jpg	Imirabilis2_DXX_SXX_Contros.txt data format (CH_4 columns)
CONTROS HydroC® CO2 data format.jpg	Imirabilis2_DXX_SXX_Contros.txt data format (CO_2 columns)
ABY telemetry data format.pdf	Imirabilis2_DXX_SXX_ABY_telemetry.txt data format
Idronaut data format.txt	Imirabilis2_DXX_SXX_Idronaut.txt data format
HIPAP data format.pdf	Imirabilis2_DXX_SXX_HIPAP.txt data format
SAIV data format.txt	imirabilis2_DXX_SXX_SAIV.txt data format
INS_telemetry data format.pdf	Imirabilis2_DXX_SXX_INS_telemetry.txt data format

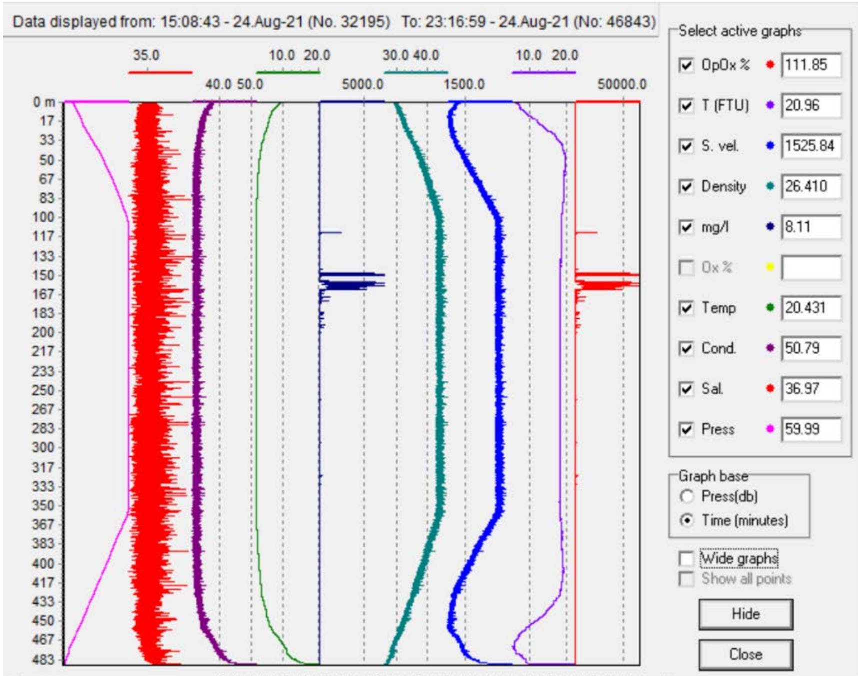
Data Graphs



DETECT Data Archive: datafile_20210825_102423.txt
CH4-0412-009 - Conc_estimate / digits
CO2-0716-001 - pCO2_corr / µatm
CO2-0716-001 - pCO2_corr / µatm
CH4-0412-009 - Conc_estimate / digits (10^3)
CH4-0412-009 - Date



Time [s]
Temp. [°C]
Cond [mS/cm]
Eh [mV]
pH [pH]
Oxygen % [%]

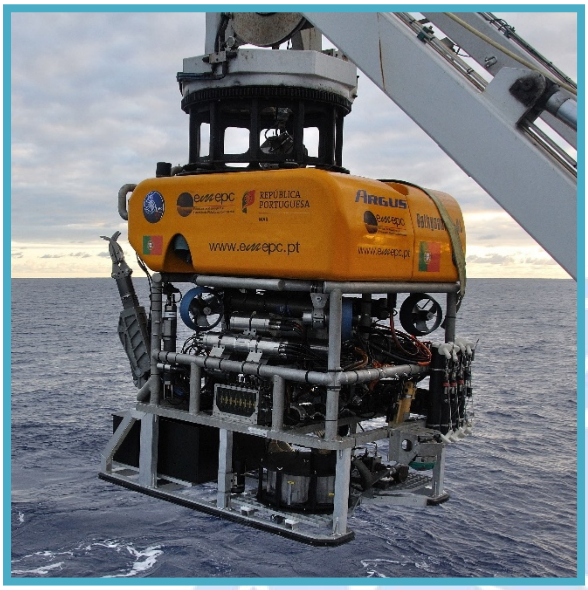


Technical Dive Log

Time	DESCRIPTION – AUG 26, 2021	TAGS
9:37:55	All Ok. put the suction camera pointing to ROCSI to see if works. Plug the cable made for ROCSI with traco 24v to 12v, in transponder bulkhead.	Pre-dive checks
17:00:07		Off deck
17:05:58	INS not working well with the HIPAP data. Restarted.	Sensors
17:07:21	EIVA not working well. Restarted.	Sensors
17:14:01	MS (Pilot), RB (Co-Pilot), AA(Winch)	Pilot exchange
17:57:50	ctd idronaut not working well. restarted.	Sensors
18:05:46	RB (Pilot), BR (Co-Pilot), MS (Winch)	Pilot exchange
18:53:45	UHD not working. Changed to HD. Lost some minutes of video. Is not possible to receive video from the camera and is not possible to communicate with the camera also.	
19:00:04		At bottom
19:12:16	INS not working well with the HIPAP data. Restarted.	Sensors
19:12:46	EIVA not working well. Restarted.	Sensors
19:18:52	StillCam not working. turned off.	Image
19:22:41	Niskin camera has some faults.	Image
20:16:33	BR (Pilot), AC (Co-pilot), MS (Winch)	Pilot exchange
21:47:44	Positioning System with some missing points	Sensors
22:21:25		Off bottom
22:22:04	AC (pilot); AA (co-pilot); BR (winch)	Pilot exchange
	AUG 26, 2021	
0:12:58	AC (pilot); MS (co-pilot); AA (winch)	Pilot exchange
0:34:44	Contros pumps turned off	Sensors
0:38:23	SAIV and Idronaut turned off	Sensors
0:44:40		On deck
1:11:45	Ok	Post-dive checks

10.10 ROV Luso. List of equipments and characteristics

ROV Luso



General

Dimensions	Length 2.0m
	Width 1.6m
	Height 2.2m
	Weight 2400kg
Payload	100kg
Frame	Aluminum tube T6062
Pods	Titanium Grade 5
Connectors	Titanium Grade 5
Buoyancy	Syntactic foam
Umbilical	6000m Kevlar Armored Umbilical
Deployment method	Free Flying Latch
Launch method	LARS (Launch And Recovery System)
Total Deck weight	35 Tons (ROV, LARS, Workshop, Control room, Generator)

Standard Equipment Fit

Manipulators	1 x 5 function Schilling Rigmaster 1 x 7 function Schilling T4
Cameras	1 x Sony FCBH10 Argus RS Focus Zoom HDTV camera 1 x Sony FCBER8530 Argus RS Focus Zoom 4K camera 1x Kongsberg Still camera 10Mpx+ flashgun 1 x DSPL lowlight B&W camera 5 x DSPL other cameras
Sonar	Mesotech MS1000
Altimeter	Mesotech 1007
Lights	4 x 250W DSPL Halogen 4 x 150W Argus RS HID I
Pan&Tilt and Tilt	2 x SubAtlantic 24VDC
Depth Sensor	SAIV TD 303
Compass and Gyro	KVH C-100 Fluxgate KVH DSP 3000 FOG Gyro
Samplers	Up to 9 Push Corers Suction sampler with 5 chambers Biologic and geologic sample boxes 4 x 2,5l niskin bottles
Sensors	Teledyne DVL Contros CH_4 Sensor and CO_2 Sensor SAIV CTD SD204 with additional sensors: Dissolved Oxygen, Fluorescence, Turbidity Idronaut CTD with additional sensors: Dissolved Oxygen, Turbidity, pH, Redox Potential
Lasers	2 x Imenco green scaling lasers
Auto Functions	Auto Head Auto Depth Auto Altitude
Hydraulic Compensators	2 x SubAtlantic 2700cc 4 x SubAtlantic 860cc

Performance

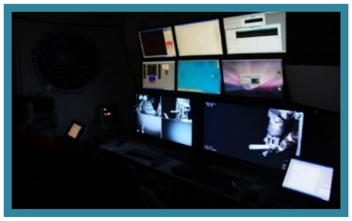
Bollard Pull	Fwd 370kg Lat 250kg Vert 300kg
Speed	Fwd 3kn Vert 1.6knt
Potency	75HP
Thrusters	7 x 5.5kW, 20A, 4 Horizontal, 3 Vertical

Surface Controls

Control Container	1 x 20" feet Control container (5 Tons)
Transformers	1x 440VAC, 60kVA, 400Hz system (needs to be stable) 1x 60kVA 3300VAC UPS 30kVA
Power panel Inputs	440V (3-phases) 400V (3-phases) 230V (single phase)
Outputs	230V (single phase) 400V (3-phases)

Interface panel

Available connectors	4 serial 6 fiber optics 5 LAN
Control console	Integrated joysticks and touch screen in pilot chair 6 x 32'' 4K HDR10 monitors + 2 x 50'' 4K TV's 19" inch rack Options Video Overlay Apple Computer Recording System (HD or 4K) Manipulator Control Console
Power generator	4 x 2.435 x 2.571 m (L x W xH) (5 Tons) 150kVA, 120kW, 400V+N (3-phases), 50 Hz Fire detection system Remote control CCTV system
Workshop container	1 x 10" feet Workshop container (4 Tons)

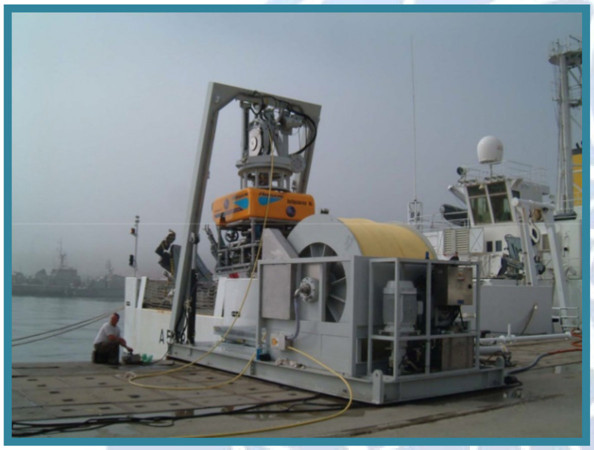


Positioning system

Type	LinkQuest USBL
Transceiver Model	TrackLink 10000HA, accuracy of 0.25degrees
Transponder Model	TN10010C and TN10015C
Input from the Ship	VRU, GPS and Compass

INS system

Type and model	iXblue ROVINS Nano resolution of 0.01degrees
Input from the ROV	USBL, DVL



Multibeam system

Type and model	Norbit WBMS
Swath coverage	5-210 degrees flexible sector
Operating Frequency	nominal frequency 400kHz Frequency agility 200kHz-700KHz
Range Resolution	<10mm (Acoustic w. 80kHz bandwidth)
Resolution (Across x Along)	Standard: 0.9° x 1.9° @400kHz and 0.5° X 1.0° @700kHz Narrow option: 0.9° X 0.9° @400kHz and 0.5° X 0.5° @700kHz

Launch And Recovery System

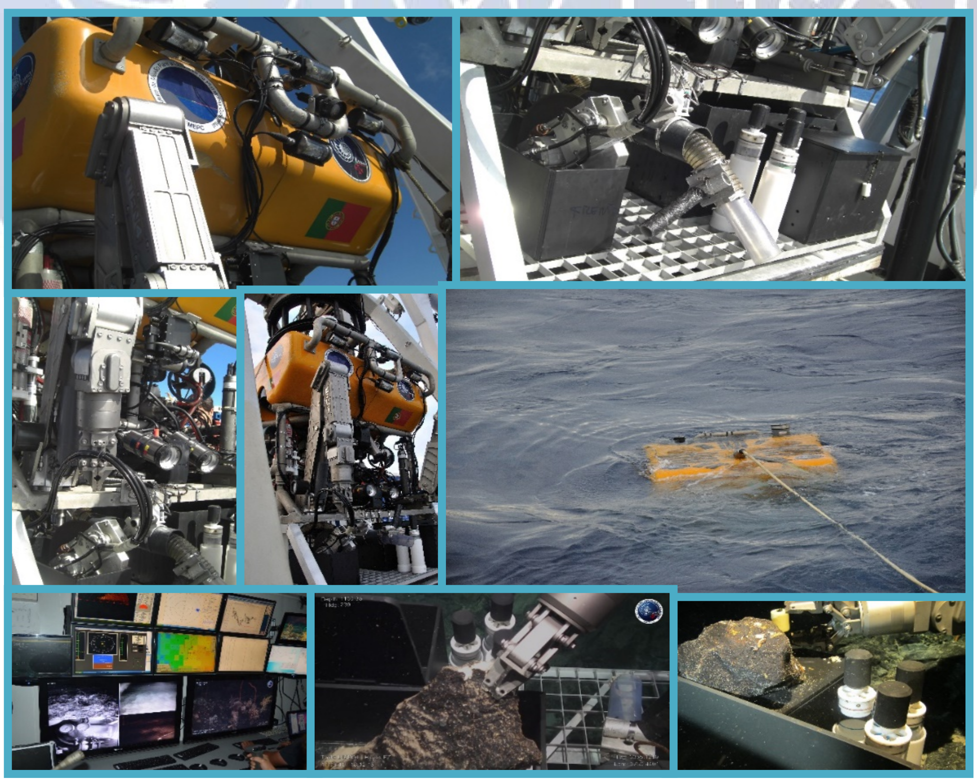
Winch power input	440 VAC / 45 kVA - 3 phases
Dimensions	7.00 x 2.90 x 5.53 m (L x W x H)
Weight	21 ton (umbilical included)
Capacity	6100 of 25.7mm umbilical
Winch velocity	75 m/min mid drum 11rpm
Water input to cool hydraulic system units	

Power Requirements

ROV power unit	440 VAC, 3-phase, 60kVA, 80A (needs to be stable)
Hydraulic Power Unit	2 x 5.5kW, 15lpm, 180bar

Umbilical

Type	Nexans Kevlar Armored
Length & Diameter	6 100m x 25.7mm
Breaking strain	125kN
SWL	23kN
Cores	3 x power 8mm^2 12 x SM 9/125µm



iMirabilis2