FKt230918 Cruise Report
September 18th to October 19th, 2023
Puerto Ayora, Santa Cruz Island, Galápagos, Ecuador to Golfito, Costa Rica

Vertical Reefs of the Galápagos

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1. Personnel Onboard

FKt230918 Science and Observer Team

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4. Claudio Lo Iacono, Spanish National Research Council
5. Robert Alan Hall, University of East Anglia
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9. Catherine Ann Wardell, National Oceanography Centre
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15. Andrea Giulia Varzi, University of Milano-Bicocca
16. Salome Buglass, University of British Columbia
17. Odalisca Breedy, University of Costa Rica
18. Nathalia Tirado, Charles Darwin Foundation
19. Paulina Sepa, Charles Darwin Foundation
20. Esther Markayata, Charles Darwin Foundation
21. Stuart Banks, Charles Darwin Foundation (Observer)
22. Estefania Altamirano, Galápagos National Park (Observer)
23. Jennifer Suarez, Galápagos National Park (Observer)
24. Elsa Salazar, INOCAR (Observer)
25. Misha Vallejo Prut, Multimedia correspondent
26. Ollie Putnam, BBC assistant technical producer

Shore-Based Participants

1. Laura Robinson, University of Bristol
2. Salem Morsy, Memorial University

***SuBastian* Team**

1. Zach Bright, ROV supervisor
2. Carl Hill, ROV Technician
3. Adam Wetmore, ROV Technician
4. Doug Mania, ROV Technician
5. Kris Ingram, ROV Technician
6. Benhur Chiong, ROV Technician
7. Tyler Smith, ROV Technician
8. Russ Coffield, ROV Technician

Falkor (too) Ship's Crew

1. Pete Reynolds, Captain
2. Jason Garwood, Chief Officer
3. Oliver Hurdwell, Second Officer
4. Tony McCann, Second Officer
5. Robert, Keino, Bosun
6. Archel Benitez, Assistant Bosun
7. Lewis Evans, AB
8. Keith Damaolao, AB
9. June de Arce, AB
10. Miro Mirchev, Chief Engineer
11. Ewan Flatman, 2nd Engineer
12. Roxana Gonzalez Contreras, 3rd Engineer
13. Matthew Newell, 3rd Engineer
14. Albert Barcelo, Fitter
15. Edwin Pabustan, Fitter
16. Vasil Borisov
17. Electro-Technical Officer
18. Tim Quan, AV/IT Engineer
19. Leena Inkinen, Purser
20. Joaneen Botha, Chief Stewardess
21. Mildred Dadis, Stewardess
22. Januarie Jangcan, Stewardess
23. Greg Kuberski, Head Chef
24. Peter Goeppel, Chef
25. Alexander Macamos, Galley Steward
26. Paul Duncan, Lead Technician
27. Josh O'Brian, Marine Technician
28. Julianna Diehl, , Marine Technician
29. Richard Jeong, , Marine Technician
30. Alexander Havens, , Marine Technician

2. Scientific Rationale and objectives

Galápagos (September 18th – October 13th 2023)

Shipboard multibeam echosounders provide a smoothed (at ~50-100 m spatial resolution) representation of rough topography, particularly in deeper waters, and as such cannot adequately characterize the vertical dimension of complex 3D seafloor structures. Trawls or towed-camera systems are similarly ineffective in very rugged environments. Consequently, it was not until the 1990's that vertical deep-sea habitats started being discovered using human-occupied submersibles (*1*). Only recently were methods developed to map the heterogeneity of these cliffs at high resolutions, exploiting the extra maneuverability provided by ROVs (*2*). However, for the most part, these striking deep-sea landscapes have remained unexplored, even though cliffs provide environmental conditions different from the surrounding terrain, and often host rich communities of fragile suspension feeders (*3*). In particular, cliff environments represent an unaccounted cold-water coral (CWC) habitat of global importance. Although difficult to quantify owing to lack of systematic data, we estimate that, globally, over 6,000 distinct geomorphological features with rocky walls likely harbor CWCs, representing an estimated global surface area equivalent to ~10% of shallow coral reefs (*4*).

In addition to providing suitable habitat for a range of species, cliff environments are of further interest as, owing to their complex topography, they provide a natural protection for vulnerable coral species against trawling activities, potentially allowing larvae to help recolonize surrounding damaged habitats (*2*). However, environmental conditions likely affect the life cycle of these habitats distinctly from other CWC environments. For example, large coral colonies may only grow on rock faces with particular strength properties, currents interact with the steep topography to create complex flow patterns that affect suitability of feeding conditions (*5*, *6*), and naturally broken pieces of coral accumulate at the base of cliffs rather than contribute to reef development. As such, our proposed scientific voyage ***aimed to apply new technologies to unveil, for the first time, the environmental drivers of vertical CWC cliff ecosystems***. The data we collected will help quantify the contribution of these understudied environments to regional biodiversity before environmental change alters further ecosystem function.

Our project has four primary objectives:

(1) Establish the geological characteristics and formation of cliff environments: The Galápagos are volcanic islands with peaks reaching 2,000-3,000 m above the surrounding seafloor (*7*) and, as a result, are characterized by very steep topography and large quantities of exposed hard substrate resulting from lava flows that have built the submarine pedestals of the islands. Many of the submarine cliff faces are formed by the fronts of stacked lava flows forming terraces at various depths, ranging from ~600 m down to 3,000 m (*8*, *9*). With the escarpments being largely constructional in nature, as opposed to being fault controlled, the stability of these terraces has enabled long-term coral growth. However, across depth and position around the Galápagos platform, the age of these flows remains poorly constrained. Along the western margin of the platform, the deep submarine portions of the volcanic pedestal are exposed and the stratigraphic sequence over the past ~2 million years appears to be undisrupted by structural complexities or large-scale slumping processes. This provides us with a rare opportunity to address key research objectives such as: (1) reconstructing geological history(ies) of the formation of individual terraces and terrace complexes at various locations along the margins of the Galápagos platform, (2) determining the geochemical evolution of the magmas that constructed these terraces, and (3) establishing the petrologic relationships between the terrace-forming lavas, adjacent subaerial volcanoes, and large deep-water lavas. This geological, geochemical, and petrologic evidence will help reconstruct the evolution of the submarine foundation of the Galápagos Archipelago, help better constrain subsidence rates for various portions of the platform, and provide valuable insights into the evolution of a CWC-rich ocean-island environment.

***(2) Model the hydrodynamic environment and interactions with complex topographies*:** Around the Galápagos Archipelago, the cold South Equatorial Current runs northward along South America, veering westward along the equator, while the warmer Panama Current flows southward. The westward flowing Pacific Equatorial Undercurrent interacts with the Galápagos Islands, which leads to upwelling, vertical mixing of nutrients as well as high surface chlorophyll and biological productivity (*10*, *11*). Although there has been much interest in the broader-scale oceanographic patterns of the Galápagos (*12*, *13*), local flow-topographic interactions (*14*), such as wake vortices, lee waves, internal waves and tides, and the turbulent mixing resulting from these processes, are still poorly understood. Being both a geologically and oceanographically complex area, at a transition zone between tropical and subtropical waters, the Galápagos Islands are a perfect location to examine the interactions between the larger-scale (e.g., regional) oceanographic settings and finer-scale hydrodynamic processes controlled by local-scale bathymetric features. For example, in the case of vertical to near-vertical submarine escarpments, we can expect the currents to be focused and steered by the steep and complex topography, possibly generating internal waves and hydraulic jumps, and leading to increases in near-bottom current velocities that may cause particle resuspension, horizontal fluxes of organic matter *(6)*, and the formation of nepheloid layers rich in nutrients (*15*). After collecting remote sensing satellite data on large-scale oceanographic processes (e.g., surface currents, temperature, salinity and chlorophyll), our aim will be to: (1) capture the vertical dynamics of the water column across different seafloor walls, and (2) quantify the interactions between hydrodynamics and reef complexity (fine-scale). This will produce a holistic and integrated view of oceanographic and hydrodynamic regimes interacting at different spatial scales. With changes in upwelling patterns being an expected consequence of climate change (*10*, *16*), a better understanding of local and regional oceanographic settings surrounding the Galápagos Islands will provide insights regarding likely responses in community structure (*14*, *17*) resulting from changes in environmental conditions and productivity.

***(3) Establish prior coral history and past oceanic conditions*:** The eastern tropical Pacific is a region that drives climate change and variability (*12*), but reconstructing past oceanographic conditions at decadal to centennial time scales requires the use of reliable proxies (*18*). Because corals are long-lived organisms (e.g., individuals over 4,000 years old have been reported (*19*)), and many species produce calcium carbonate secretions resulting in a continuously growing skeleton (*20*), CWCs are a powerful and relatively new archive of past oceanic and climatic change. Recent proxy development work has yielded new and promising methods for reconstructing past ocean history (*18*), and precise U-Th dating of sub-fossil specimens can further extend the paleo-environmental archive (*21*, *22*). The Galápagos Islands, through their interaction with the Pacific Equatorial Undercurrent, have been suggested as having a significant impact on the circulation pattern of the region, and as a result, global climatic changes are predicted to have particularly pronounced impacts locally (*12*). Geochemical analyses on precisely located and dated CWC samples will allow us to: (1) reconstruct the history of the Galápagos' subsurface water masses during the last millennia and potentially back through the last glacial maximum, (2) estimate CWC growth rates in relation to environmental conditions, and (3) obtain an estimate of the minimum time since colonization of specific cliff environments. This multi-proxy approach will help decipher decadal and millennial scale climate signals as well as improve our understanding of potential local changes.

(4) Understand the links between environmental settings, CWC habitat complexity and biodiversity of associated communities**:** Over 100 records of reef-building corals are available for the area surrounding the Galápagos Archipelago in the Ocean Biogeographic Information System (OBIS) (170-1400 m in depth, mean depth 535 m). With cliffs and escarpments providing hard substrate for attachment, and currents affecting local hydrodynamics and likely creating complex (mix of suitable/unsuitable) conditions influencing individuals' ability to capture food particles (*23–25*), these steep environments harbor rich and diverse filter-feeding communities (*26*). However, prior technological limitations have resulted in the complexity and possible ecological importance of vertical submarine structures to remain largely unexplored. The complex environment of the Galápagos Islands will allow us to quantify both local (along individual escarpments) as well as broader-scale (across the archipelago) spatial patterns. Data acquired during this expedition will allow us to: (1) reconstruct vertical coral cliffs in high resolution, (2) examine how environmental conditions (e.g., geological and terrain characteristics, hydrodynamic patterns and variability, past and present climatic conditions) influence the habitat complexity created by coral skeletons, (3) quantify how different species exploit this complexity; and (4) determine whether there is a link between increased habitat complexity and increased biodiversity. To do so, we will test the combined use of an underwater laser system with 3D point cloud segmentation to robustly estimate live coral surface cover.

The Galápagos Islands are the ideal location for this expedition as cosmopolitan CWC species are known to be present (*20*) in an active and complex geological and oceanographic environment (*8*, *9*), and the oceanographic complexity of the region is important for understanding past and future climatic conditions (*22*, *27*). Moreover, these ecosystems have been highly protected and as such remain near pristine, allowing for the observation of natural patterns of biogeography and diversity, and the establishment of ecological baselines that are often missing from better studied, but more impacted, systems (e.g., North Atlantic).

Isla del Coco (October 13th – October 19th 2023)

Cold-water corals (CWC) form oases of life in the deep sea, providing habitat, food, and shelter to marine animals, including commercial species, but are sensitive to increased temperature and low oxygen. The Eastern Tropical Pacific (ETP) is one of the areas of the planet where oxygen minimum zones (OMZ) are naturally large and expected to expand due to ocean warming (*28*, *29*). However, how oxygen concentrations affect different species of CWC and how these ecosystems may respond to future changes constitute a knowledge gap for this region.

Through this research, we will study CWC across the OMZ in two areas located in the ETP: Isla del Coco and The Galápagos. The Galápagos and Isla del Coco are connected through a coalesced chain of seamounts known as the Cocos Ridge (*30*), which is characterized by complex topographic settings and the convergence of different currents (*31*), promoting the occurrence of diverse sessile species. Owing to a high degree of endemism, these islands have been declared marine protected areas in Ecuador and Costa Rica, respectively, and World Heritage Sites by UNESCO.

Our aim is to identify CWC species biodiversity and composition across depth gradients (200 to 2000 m) and traversing OMZ boundaries to determine whether there is a difference in coral communities and populations between islands (the Galápagos and Isla del Coco) and how the environmental variables relate to these differences.

3. Operational overview and objectives

Galápagos (September 18th – October 13th 2023)

During this scientific voyage, our main operational objectives were as follows:

1. Map the geological context of volcanic cliffs and flow fronts in high resolution
2. Collect co-registered lava and coral samples at various depths and across the submarine slopes of the islands
3. Acquire near-cliff water column profiles of physical and biogeochemical properties over multiple tidal cycles (medium scale) and measure flow characteristics (fine scale)
4. Collect live and fossil coral samples to establish the colonization history of the cliff environments, and study the past environmental conditions that led to this development
5. Estimate the habitat complexity created by CWC colonies
6. Characterize associated megafaunal communities and georeference all individual organisms in 3D space

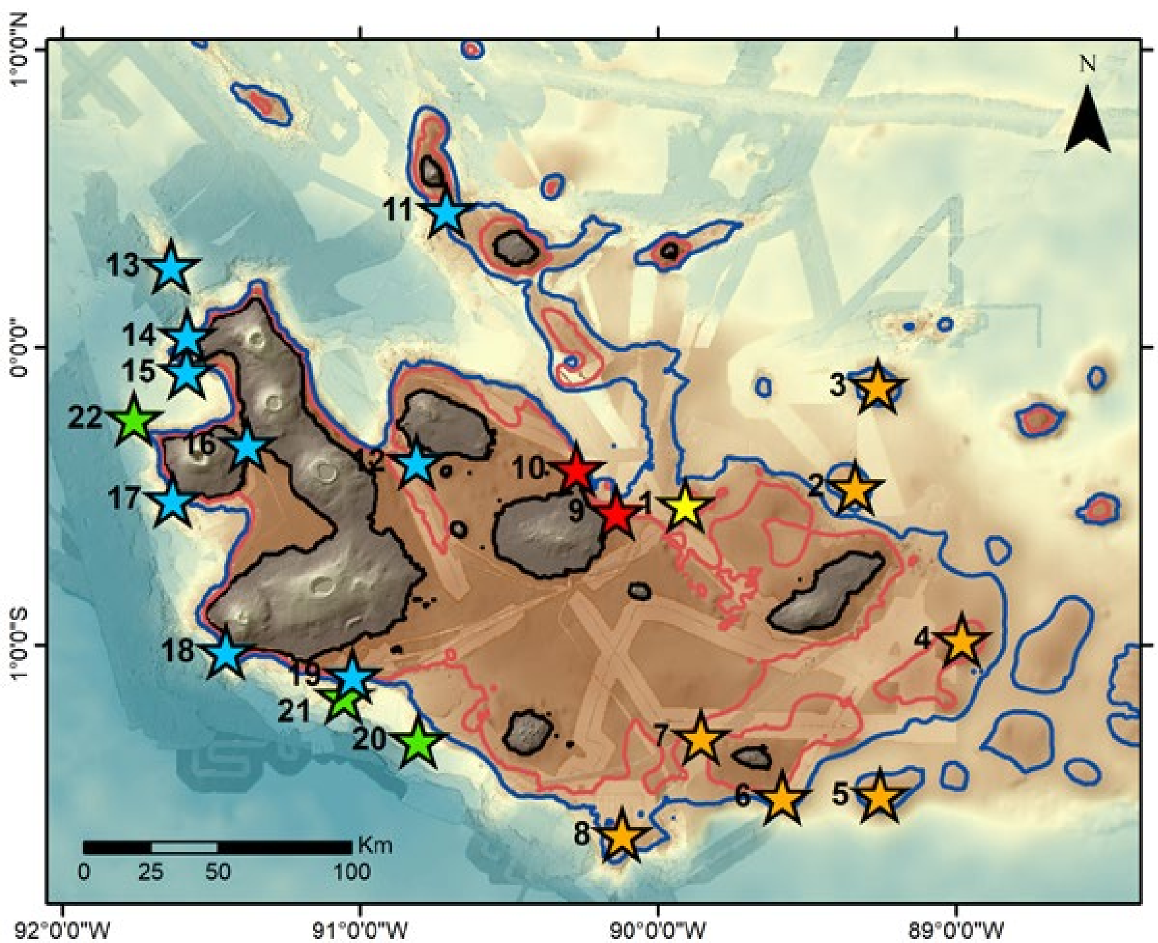


Figure 1: Operational area overview and approved dive location prior to departure for the Galápagos Islands.

At sites where previous ship-borne multibeam data is not available, shipboard multibeam acquisition will first take place to find target cliffs in areas of known coral presence (800-500 m in depth for primary objectives, possible dives to 3,000 m for secondary objectives). At each chosen site, on the first dive, the ROV will carry out reconnaissance for CWCs and, once a suitable site is selected, carry out an initial video survey of species assemblages and collect biological and geological samples. On the following dive, we will map the cliff face using the ROV's multibeam sonar and the DVL in ADCP configuration. The third dive will be dedicated to ultra-high resolution mapping using the laser system. Time permitting, one final dive will be carried out in the deeper region to collect additional fossil coral specimens and lava flow samples to help reconstruct past events and conditions. CTD casts to 2,000 m (or near the seabed) will be carried out in the vicinity of the mapped sites to measure the background hydrography.

Isla del Coco (October 13th – October 19th 2023)

During our dives at Isla de Coco, the main operational objectives are as follows:

1. Collect ROV video footage of seamounts (~2,000 m max depth).
2. Collect *in situ* environmental data (temperature, oxygen concentration, pH, conductivity, depth) during ROV dives (using CTD, Oxygen sensor, pH sensor, mounted on the ROV). Collect ROV navigation data using the ultra-short baseline acoustic system (USBL).
3. Collect corals samples and associated organisms for genetic analysis.
4. If time allows, collect shipboard multibeam data for the seamounts.

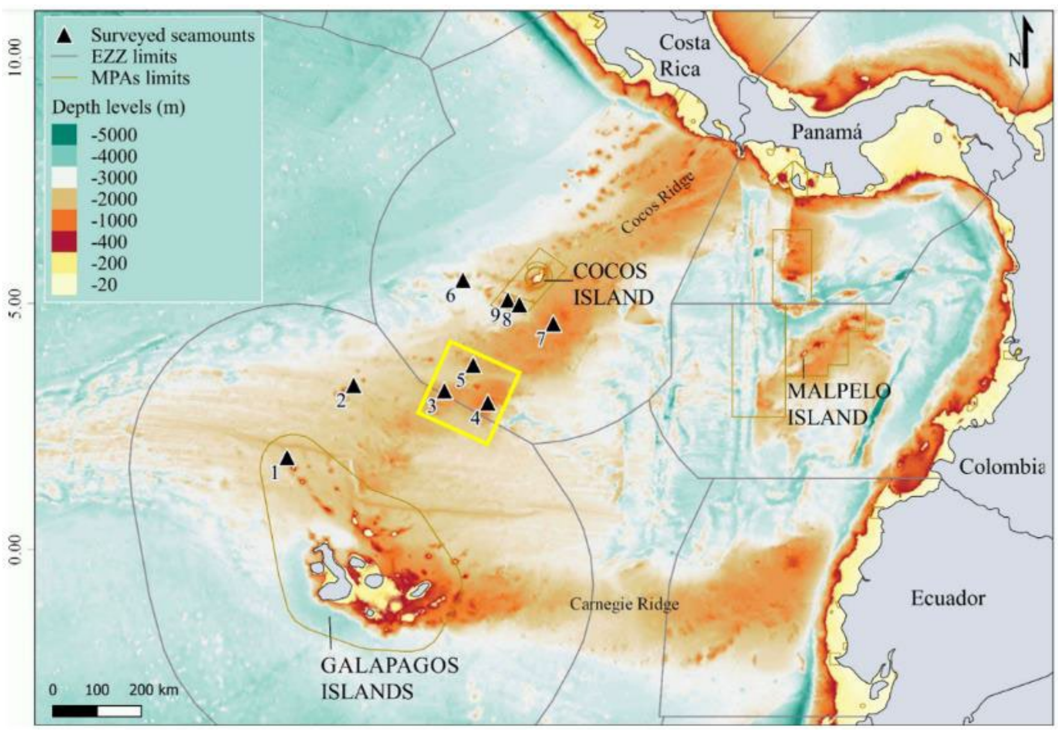


Figure 2: Operational area overview and potential dive locations prior to departure for Costa Rica. 1 NW Darwin, 2. Paramount, 3. Medina 1, 4. Medina 2, 5. Medina 3, 6. West Cocos, 7. East Cocos, 8. Las Gemelas 1, 9. Las Gemelas 2.

4. Expedition Narrative

FKt20230918 took place over 32 days and visited the Galápagos Islands, Ecuador, as well as Isla del Coco, Costa Rica (Figure 3). 126 scientific stations were conducted (Appendix 1) and 46Tb of data collected. There was no weather down time and no ROV down time.

16 September
We mobilized personnel and gear, leaving Puerto Ayora from the dock and boarding the vessel at 0900L. The lab spaces were designated, we followed the induction tour, and the laser system was bench tested.

17 September
We completed setting up of labs and followed the Sealog (real-time data logging/observation system) introduction. Buttons for annotation were developed and we decided on a standard ROV porch/basket configuration. We completed the ship's safety drill which included getting into the lifeboat. Departure from Puerto Ayora was brought forward to 19h55L (GALT, UTC-6) (2023-09-18 01:55:14 UTC), and we started the expedition by carrying out a short EM712 survey over the Cacho de Coral seamount.

18 September
First ROV dive (S0577) occurred at 02:58L (08:58:58 UTC), targeting the ridge feature of the plug of the caldera of the Cacho de Coral. Geological samples were taken and corals were observed along the top of the ridge. There was significant dead coral framework and fossil coral samples were taken. Two of the most-wanted coral specimens were encountered and sampled in addition to associates. The steep slope was mainly sediment dominated with exposed rock on the steep portion near the summit. Rodolith deposits were sampled at 120 m depth near the summit. The hand-held pH sensor failed, and we could not process the water samples in the Niskin bottles. The oxygen meter meant to go on the ROV will be unavailable for this expedition as it is not back from calibration. One case of flu-like symptoms detected onboard.

19 September
We left the Cacho de Coral area as we needed to empty the grey water tanks outside of the boundaries of the marine protected area (MPA). On the transit, we added a few lines of EM712 to the Cacho de Coral dataset as well as three lines to an unmapped seamount to the northeast. For the ~16 hrs needed to empty the grey water tanks, we mapped a second seamount along the northeast limit of the MPA. Once done, we carried out a shakedown CTD cast to 2000 m (20/09/2023 2:29:38 UTC).

20 September
We transited back to the Cacho de Coral while acquiring multibeam data to do our first mapping dive (S0578, 14:19:21 UTC). We had some small initial issues with the DVL and noticed that the multibeam is mounted back to front. We carried out a patch test, a multibeam survey over the small mount feature using the 700 kHz and followed on with the laser scanner survey and ADCP survey. All this occurred while a yoyo CTD was carried out concurrently, collecting 29 profiles. A second Covid case was detected.

21 September
After recovering from the mapping dive, the ship carried out a few lines of EM710 over the Cacho de Coral while the ROV changed the porch layout for a sampling dive (S0579). We then dove (14:22:18 UTC) along the back edge of the northern flank towards the newly discovered reef from the RV*Atlantis/Alvin* cruise (AT50-09). We found coral framework from the beginning and started seeing live coral framework as we moved up the feature. A few additional mounds visible in the multibeam were also observed as we transited along the steep rocky terrain.

22 September
The ROV was recovered before breakfast (11:50:20 UTC) with most bioboxes and coral quivers filled. The biology team worked through all samples to process associated fauna. Ship-based multibeam "edge mapping" was carried out on the way to the next dive site, on the southern rim of the caldera. The ROV dove (S0580) around 21h05L (03:05:12 UTC) for a 20hrs dive. It started deeper than previous dives, in sedimented areas dominated by echinoderms and moved upslope to areas with boulders and gorgonians. Abundant deposits of coral fossils were observed, but no significant amounts of live hard corals were observed. Our first ship-to-shore broadcast took place at 15h00L.

23 September
The ROV was back on deck at 4:06L (10:16:02 UTC), we added one line of shipboard multibeam to the lower portion of the caldera map during transit to the CTD location near the start of the previous ROV dive. We transited 8hrs to a new location, an unmapped seamount on the eastern edge of the platform offshore San Cristobal Island. We arrived around ~17h00L to carry out a 24hrs multibeam survey.

24 September
We continued with the multibeam survey until 18:48L (25/09/2023 00:48:59 UTC). Carried out CTD cast (25/09/2023 01:24:31 UTC) in vicinity of the start of the ROV dive (S0581) on the southern side of the seamount. The dive examined deeper lava flows as well as benthic communities. Stronger currents were observed and sediments dominated the seafloor along the dive track. There were a few *Madrepora* patches, but a lot more Stylasterids, fly-trap anemones and sea pen fields. A small imagery survey using structure-from-motion technique was attempted on a prominent dyke outcrop.

25 September
The dive (S0581) continued until 11:07L (17:07:13 UTC), no large aggregations of *Madrepora* were observed. We carried out a CTD near the start of the following dive and sent the ROV down (S0582) along a fault at 14h54L (S0582, 20:54:39 UTC). Massive walls with significant coral coverage were observed. Vertical mapping with the multibeam system was accomplished as well as perpendicular ADCP surveys.

26 September
We continued the previous dive from ~500 m, encountering multiple walls. At shallower depths, increasing coverage of *Madrepora* was observed. A coral rubble mound was investigated, but only small colonies remained alive. Additional vertical mapping surveys were conducted and a site for laser mapping was selected. The ROV was recovered at 01:42:09 UTC. Issues with the procedure for processing the laser data were fixed (navigation files should only be loaded one at a time).

Multibeam mapping with the EM712 was carried over the ROV transect, and EM124 surveys were carried out through the night as the biological team handled the samples.

27 September
A new dive site, a large wall at a fault in the north of the mapped area, was selected based on the new EM124 multibeam data. We carried out a CTD (14:33:08 UTC) near the wall before the start of the dive (S0583). We observed very interesting geology as well as a discovered of a very large *Leiopathes* that may well have been over 1,000 years old. The large wall was however only sparsely inhabited. We had to cut the dive short prior to reaching the shallower depth. After, the ROV was back on deck (28/09/2023 04:16:57 UTC), we leave the reserve to empty the grey water tank.

28 September
A mapping dive (S0584) at the wall previously mapped with sideways multibeam during dive S0582 started at 14:00:23 UTC while we also did 12hrs of yoyo CTD resulting in 30 casts. Sealog had some issues starting due to lack of data space, but the issue was fixed within 2hrs. We carried out 79 lines of laser mapping and continued with the ADCP survey. The 200kHz setting of the multibeam was tested and we recovered the ROV after the CTD was finished (29/09/2023 4:19:00 UTC). We completed EM712 mapping over the previous dive tracks. Dan gave a presentation to the ship on the geology of the Galápagos.

29 September
We transited to Cacho de Coral and carried out 8hrs of ship-mounted ADCP surveys over the seamount. We had our second ship-to-shore outreach broadcast at 10:00L. We observed a soliton wave over the seamount. We then transited to Santa Cruz / Baltra Islands and mapped overnight on the eastern side to identify a dive location for tomorrow.

30 September
The dive was delayed by ~3hrs as a result of a medical emergency which required offloading a member of the ship's crew. We continued mapping and completed a CTD near the start of the dive location. We ended up diving at 14:24L (20:24:14 UTC, S0585) on two lava flows at ~1,000 m depth. We also visited a small scarp at ~450m.

1 October
We finished the dive and had the ROV back on deck 05:14L (11:14:02 UTC) and left to steam around Baltra Island to change out some personnel. Aaron, Paulina and Jennifer joined while Estefania and Nathalia departed. The rest of the afternoon was spent on a BBC filming dive (S0586) which involved deploying the lander for the first time. We transited overnight to the northern cape of Isabela Island and crossed the Equator.

2 October
We started mapping at 04:00L (09:42:20 UTC) near Roca Redonda, north of Isabela. Very steep walls came up very fast, the terrain looks like it plateaus around the emerging portion. The charts were very different from what was mapped. Since the surface currents were very strong, we carried out an ADCP survey around the four sides of the rock before deploying a CTD near the starting location of the ROV dive. Stuart gave a presentation to the ship on the Galápagos Islands and history of conservation efforts. The ROV dive (S0587) started at 16:38L (22:38:56 UTC). When

we arrived on the seafloor, we were on a talus slope covered with shrimp. The shrimp occurence continued until a wall was encountered at ~860 m. BBC carried out an hour of filming at the wall.

3 October
The ROV dive went longer than originally planned as a very interesting wall around 500 m was found and strong currents were encountered. The upper portion of the dive, within the oxygen minimum zone, had a good cover of *Madrepora*. The ROV was back on deck at 7h02L (13:02:33 UTC), after which we transited to El Muneco, north of Isabela Island for EM712 mapping to determine the location of the next dive. A CTD to 1100 m was carried out near the start location of the dive. The dive (S0588) visited a small ridge feature at 700 m and moved toward 360 m over several smaller walls. Strong currents were again encountered during this dive.

4 October
After recovery at 05:00L (11:00:03 UTC), we transited to the northwest corner of Fernandina Island to carry out our deepest dive yet (1,600 m), but first, we did a CTD. The dive (S0589) had geological objectives, 11 *in situ* rock samples were collected between depths of ~1620-720 m along north flank of the NW submarine rift of Fernandina.

5 October
The end portion of the dive discovered a large *Madrepora* reef which seemed to have been visible on the ship-board bathymetry collected from the AT5009. The ROV was back on deck at 04:17L (10:17:43 UTC), at which point, the ship sailed toward to Canal Simón Bolívar (shallow channel between Isabela and Fernandina Islands). The ROV went back down at 09:13L (S0590, 15:13:44 UTC), to carry out a short shallow transect to see whether the fished sea cucumber (*Isostichopus fuscus*) was present at depths >40 m. We then transited toward the southwest corner of Isabela Island to carry out a CTD and a ROV dive on similar cone features as those observed to be reefs in yesterday's dive. The deep-water portion of the dive S0591 was characterized by large coral fans. BBC filmed for a few hours.

6 October
No large coral framework was encountered during dive (S0591), but different species of soft corals were encountered during the shallower portion of the dive. As a result, we decided to go back to the location of dive S0589 to sample live and fossil more extensively. We first mapped the features with the EM712 and carried out a CTD closer to the reef. The ROV dove at 12:36L (S0592, 18:36:23 UTC) and found extensive reef on a nearby mound. Fossil coral samples were taken. We were able to establish the area most densely covered with corals on the second mound. BBC shot images of the ROV using the MISO camera.

7 October
We transited south of Isabela, transit took a little longer than planned as stronger currents were encountered. We carried out a CTD near the start of the ROV dive at 800 m. The ROV (S0593) went down at 10:42L (16:42:32 UTC) to explore a small steep feature between 740-460 m to look for potential vertical mapping targets. Many *Bathypathes* were observed with some patches of hard corals, and a lot of dead *Dendrophylia* framework. The shallower portion of the dive was mainly a sedimented area so we recovered early to have a quick dive at 650 m on a wall on the terraces of Isabela.

8 October
The ROV was back in the water at 02:34L (8:34:07 UTC) for dive S0594. The edge of this terrace was, in reality, a steep slope with pillow lava as opposed to a vertical wall, but a variety of corals were still observed. Vertical mapping was attempted on a section of the wall and the ROV recovered at 06:54L (12:54:00 UTC) to pick up personnel near Tortuga Island. A CTD was carried out near the start location of the next dive. The transmissometer and turbidity data from the CTD showed much higher values than previously encountered. Dive S0595 (19:03:38 UTC) visited two steeper sections on shallower terraces south of Isabela. Neither of which were truly vertical and sediment cover was extensive. Some *Dendrophylia* colonies were observed near 410 m as well as dead framework, but no significant live coverage was encountered. One section of the deeper wall was mapped.

9 October
Once the ROV completed dive S0595 at 07:58:31 UTC, we transited while edge mapping on our previous data to the site of dive S0596. This dive had the objective of collecting deeper lava on the terraces south of Isabela. As elsewhere south of Isabela, more sediment was observed, even covering some of the flows visible in the sidescan imagery. As time is starting to run short, a CTD cast was carried out concurrently to the dive while the ROV was at ~850 m. Numerous geological samples were collected along the dive and BBC took some time to collect footage. A steep section of wall was encountered at ~250 m depth, it was mainly colonized by large colonies of yellow coral fans (possibly Acanthogorgia). The dive ended at 20h:51L (10/10/2023 02:51:01 UTC), and we started the transit to Cacho de Coral (~10hrs).

10 October
Stronger currents were encountered during the transit and a third engine had to be powered. The ROV dove (S0597) at 14:45:36 UTC on the Cacho de Coral reef for multibeam, laser and ADCP mapping. Seven lines of multibeam data were collected and four 10x10m laser sections were collected in addition to 13 lines of ADCP. The ROV recovered at 4:11:15 UTC (11/10/2023), and we collected additional EM712 data of the reef, as noise was present in the previously collected multibeam data. The ROV went back down at 06:14:24 UTC (11/10/2023) for more BBC filming.

11 October
The BBC dive (ROVS0598) was completed at 10:28:15 UTC. A small section of multibeam EM712 was acquired and the ROV (ROVS0599) went down again at 12:10:51 UTC on the northern section of the Cacho de Coral seamount. A very different fauna was observed and multibeam mapping of a small wall near the top of the seamount was carried out. A CDT was carried out near the starting location of the dive and after the BBQ, we repeated the ADCP survey.

12 October
The second ADCP survey over the Cacho de Coral was completed at 07:24:00 UTC, at which point the scientific work in Galápagos was completed. We arrived back in Pt. Ayora in the morning to conduct inspection of samples, primarily the rock samples as other samples will remain with the CDF research station and be exported at a later date. Samples were offloaded at ~14:00L, and the scientific party presented the results of the expedition at the CDF research station.

13 October
The members of the scientific party who did not continue on to Costa Rica disembarked at ~10:00L. The transit started shortly thereafter toward the seamount Las Gemelas 1, southwest of

Isla del Coco, Costa Rica. During the transit M712 mapping was executed. We reorganized the labs and planned for dives at Las Gemelas 1.

14 October
Continued transit in the direction of the seamount Las Gemelas 1, southwest of Isla del Coco, Costa Rica. During the transit M712 mapping was executed. The ROV basket was modified to have more space for biological samples. An oxygen sensor was mounted on the ROV. We conclude planning for the dive in Las Gemelas 1. Jorge did a presentation about Isla del Coco for crew and scientists.

15 October
The *Falkor (too)* arrived at Las Gemelas 1. We deployed the CTD near the ROV starting point. Then, we deployed the ROV at 16:40:00 UTC. This dive was focused on identifying the cold-water coral distribution across oxygen minimum zones. The ROV touched bottom at 682 m and had our first coral collection, which was a fiddlehead sea pen. The substrate on this dive was mostly sand. Several corals were sampled, and within the OMZ, we observed a high abundance of ophiuroids. We started transiting to an unmapped seamount west of Las Gemelas 1 called Las Gemelas 2.

16 October
The initial plan was to only map around the seamount. However, it was decided to map the entire seamount Las Gemelas 2 based on the initial multibeam survey which showed several small satellite peaks around the main edifice. Diving waypoints were set so that the ROV dove across the edifices towards the larger seamount - from the southwest to the northeast. We deployed the CTD near the ROV starting point. The ROV was down at 12:55 UTC. The ROV touched the bottom at 612 m, rocky outcrops were encountered, and the predominant sediment was volcanic rubble. We encountered several corals right from the beginning and collected multiple coral species. We also collected nudibranchs and a large glass sponge. We observed several species of corals with gametes inside potentially ready to spawn where observed and collected. The break off time from Las Gemelas 2 to transit back to Golfito was at ~22h30L. The team continued to work in the cold and wet labs processing samples.

17 October
Transiting to Golfito, we used EM712 to map the area. The scientific team spent the day copying files to NAS and hard drives, cleaning the laboratories, organizing and preserving materials.

18 October
Ana Belen did a presentation about the observations and highlights during the dives in Las Gemelas, Isla del Coco National Park. The Falkor (too) arrived in Golfito at 16:00L. Materials meant to be used for the next cruise were organized and secured in the lab.

19 October
The scientific team prepared to leave. Transport from the University of Costa Rica arrived to pick up samples and leave materials for Dr. Cortés' upcoming expedition in December. The science party left the ship before 12:00L.

A)

B)

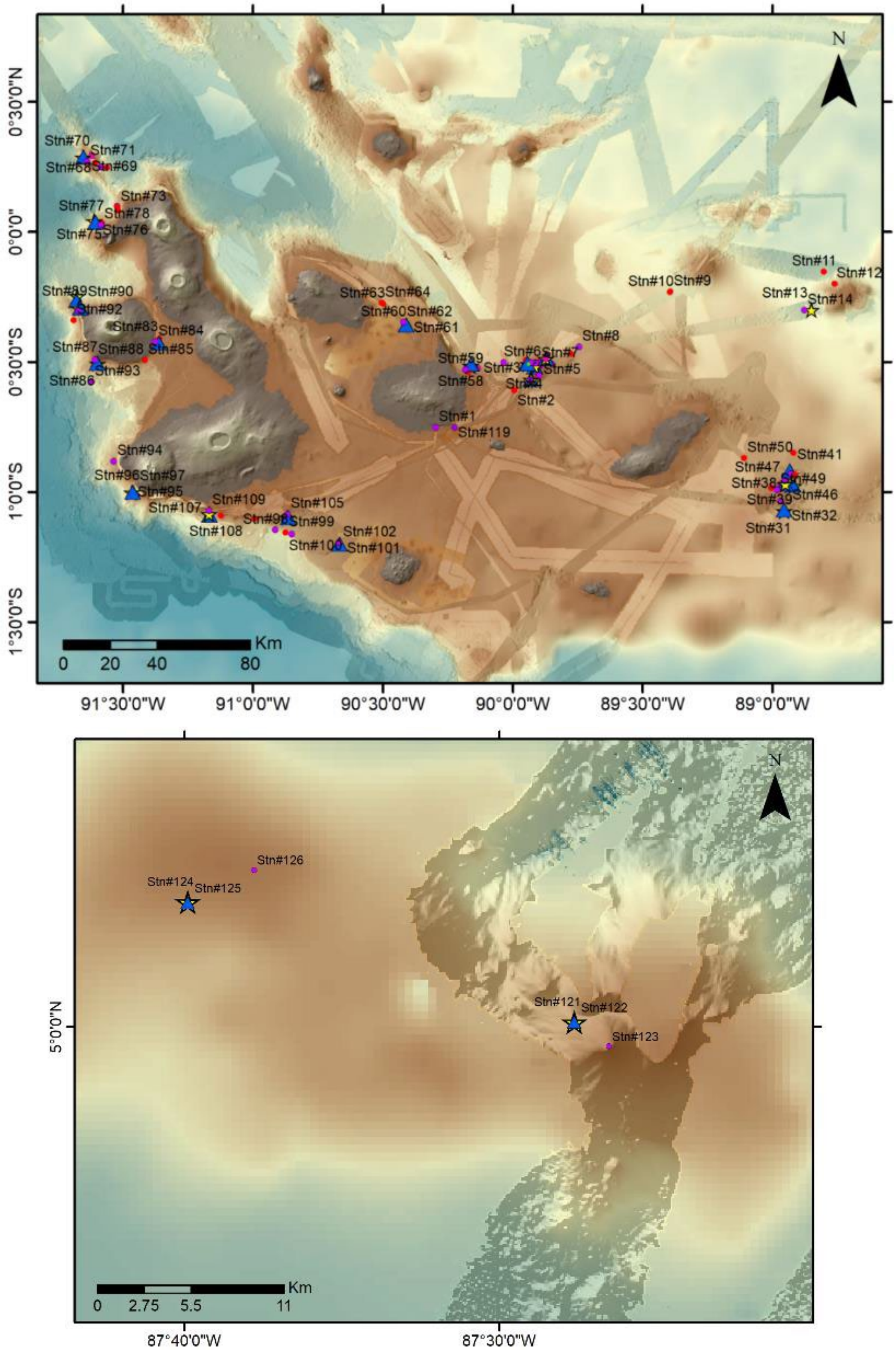


Figure 3: FKT20230918 Stations for A) Galápagos and B) Isla del Coco, Costa Rica. Bathymetry is a compilation of data acquired during multiple expeditions (including NEMO02MV DRFT04RR, AL150801, AT5009, FK190106 and FKt20230918) overlaid on GEBCO layer. Red circle – XBT, Purple circle – MBES, Pink circle – ADCP, Yellow star CTD, Blue triangle – ROV dive.

Equipment and sampling reports

5.1. *SuBastian* ROV Dive summaries

The remotely Operated Vehicle (ROV) *SuBastian* is depth rated to 4,500 meters and was equipped with:

- Situational Video – Insite Pacific Mini Zeus, HD
- Science Camera – SULIS Subsea Z70, 4K (12X zoom)
- Multi-Chamber Suction Sampler – SOI Custom Build
- Multichamber Insulated Bioboxes (for fragile animals)
- CTD Sensor – Seabird FastCAT SBE49
- Inertial Measurement Unit (IMU) – Sonardyne Lodestar
- Inertial Navigation System (INS) – Sonardyne SPRINT
- Ultra-Short Baseline (USBL) Transponder – Sonardyne WMT
- Doppler Velocity Log (DVL) – Sonardyne Syrinx (only operational on the first few dives, and turned on occasionally for the mapping dives)
- Aandera O2 optode 483 (only in Costa Rica)
- Norbit WMBS (400-700 kHz) multibeam system
- Voyis Micro Insight laser scanning system
- Science supplied WHOI-MISO GoPro 23MP still camera mounted on the front starboard side of the ROV collecting fixed focus images of the work area in front of the basket every 5 seconds
- Science supplied WHOI-MISO GoPro 5.3k video camera mounted on the front middle the ROV basket acquiring fixed focus video at 30fps of the seafloor area in front of the basket for the duration of each dive.

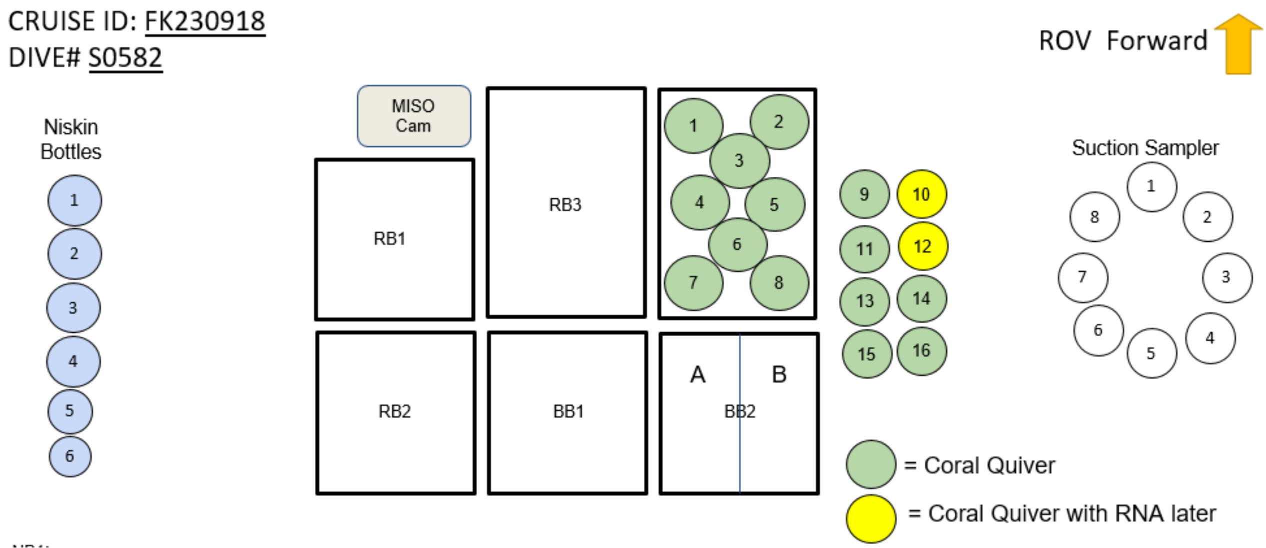
A total of 25 ROV dives were conducted providing a total of 322hours 56min 35ec of ROV dive time, with two basic operational configurations (Table 1), sampling or mapping. During sampling dives, the ROV was equipped with bioboxes, rock boxes and coral quivers (see example porch map, Figure 4), and organisms (coral and associated fauna), rocks and fossil corals were sampled using the vehicle's arm. During dedicated mapping dives, a laser scanner and a multibeam echosounder (MBES) were mounted on the porch directly in front of the camera. The DVL had a ground fault and was often kept turned off except during mapping. It became fully non-functional during dives S0600 and S0601. Dive descriptions are provided in Appendix 2.

The ROV was operated from a dedicated mission control room where scientists led the dive and annotated the real-time video making observations using the Sealog software (Figure 5). For each dive, a dive plan and porch/basket map were created (example shown in Figure 4). For each collection an event number was assigned (starting at 1 for each dive) on the event logsheet complemented with a small description, and the location of the sample was identified on the porch/basket map. Before each dive, the ROV basket and all containers were cleaned and visually inspected. Two coral quivers filled with homemade RNA later were used to place different corals (yellow octocorals, primnoids, black corals, and hard corals) found within and outside oxygen minimum zones as identified using CTD readings obtained before each dive.

Table 1: Overview of SuBastian Dives

Dive #	Start Date/ Time	Start Latitude	Start Longitude	End Date/ Time	End Latitude	End Longitude	Config.
S0577	18/09/2023 8:58:58	-0.52013	-89.91433	18/09/2023 19:25:08	-0.5182	-89.8934	Sampling
S0578	20/09/2023 14:19:21	-0.51919	-89.91562	21/09/2023 14:22:18	-0.5080	-89.9466	Mapping
S0579	21/09/2023 14:22:18	-0.50802	-89.94664	22/09/2023 11:50:20	-0.5062	-89.9093	Sampling
S0580	22/09/2023 15:05:12	-0.56915	-89.92950	22/09/2023 10:16:02	-0.5631	-89.9036	Sampling
S0581	25/09/2023 2:49:53	-1.06961	-88.95591	25/09/2023 17:07:13	-1.0401	-88.9648	Sampling
S0582	25/09/2023 20:54:39	-0.97456	-88.92205	27/09/2023 1:42:09	-0.9704	-88.9564	Sampling
S0583	27/09/2023 16:20:38	-0.92052	-88.93420	28/09/2023 04:16:57	-0.9329	-88.9249	Sampling
S0584	28/09/2023 14:00:23	-0.97013	-88.95152	29/09/2023 04:19:00	-0.9705	-88.9520	Mapping
S0585	30/09/2023 20:24:14	-0.50977	-90.15925	01/10/2023 11:14:02	-0.5306	-90.1817	Sampling
S0586	01/10/2023 18:42:16	-0.35837	-90.40999	01/10/2023 23:29:27	-0.3591	-90.4070	BBC Filming
S0587	02/10/2023 22:38:56	0.28688	-91.65114	03/10/2023 13:02:33	0.2884	-91.6391	Sampling
S0588	03/10/2023 22:21:07	0.03686	-91.60434	04/10/2023 11:00:03	0.0263	-91.5827	Sampling
S0589	04/10/2023 16:32:15	-0.26502	-91.67812	05/10/2023 10:17:43	-0.3013	-91.6668	Sampling
S0590	05/10/2023 15:13:44	-0.42826	-91.36114	05/10/2023 20:18:02	-0.4225	-91.3753	Sampling
S0591	06/10/2023 02:52:38	-0.50618	-91.59774	06/10/2023 13:53:12	-0.4939	-91.6068	Sampling
S0592	06/10/2023 18:36:23	-0.29363	-91.66359	07/10/2023 4:10:08	-0.3023	-91.6667	Sampling
S0593	07/10/2023 16:42:32	-1.00100	-91.46220	8/10/2023 00:39:22	-1.0058	-91.4505	Sampling
S0594	08/10/2023 8:34:07	-1.20146	-90.66691	08/10/2023 12:54:00	-1.1970	-90.6656	Sampling
S0595	08/10/2023 19:03:38	-1.10039	-90.86259	09/10/2023 07:58:31	-1.0833	-90.8556	Sampling
S0596	09/10/2023 12:29:01	-1.09035	-91.16687	10/10/2023 2:51:01	-1.0729	-91.1687	Sampling
S0597	10/10/2023 14:45:36	-0.50811	-89.94117	11/10/2023 4:11:15	-0.5078	-89.9408	Mapping
S0598	11/10/2023 06:14:24	-0.50688	-89.94286	11/10/2023 10:28:15	-0.5065	-89.9390	BBC Filming
S0599	11/10/2023 12:10:51	-0.48713	-89.87175	11/10/2023 20:22:19	-0.4994	-89.8942	Sampling
S0600	15/10/2023 16:35:30	5.00254	-87.46020	16/10/2023 1:53:49	5.0025	-87.5602	Sampling
S0601	15/10/2023 12:17:51	5.06576	-87.66493	17/10/2023 3:04:30	5.0813	-87.6432	Sampling

A)



B)

FKt230918
ROV SAMPLE LOGSHEET

Station No:		**Dive number :**		**Please note:** See sheet for guidance on event numbering			**Sheet No:**	
Event	**Event Type**	**UTC**	**Latitude**	**Longitude**	**Depth (m)**	**Sample description**	**Location on ROV**	**Logger Initials**

Event type: **BB** (Biobox), **CQ** (Quiver), **NB** (niskin bottle), **SS** (suction sampler), **NET** (net with ROV [add colour in description]), **RB** (Rock box), **MBS** (start multibeam survey), **LSR** (start Laser survey), **DVL** (start DVL-ADCP survey), **PGR** (Start Photogrammetry Survey), **CRM** (Current Meter Deployed)

Figure 4. A) Example SuBastian porch/basket map. B) Event log sheet used on FKt230918.

Figure 5: Mission control room. Photo: Misha Vallejo Prut.

Real-time dive observations were made in Sealog after designing a series of shortcut buttons, representing characteristic dive activities, biological and geological observations (Figure 6). The SOI Marine Technicians took care of all ship/vehicle related observations and operational data. Sealog appended all metadata (timestamp, vehicle position, CTD information, etc) to each observation, took frame grabs every 10sec, and provided dive summaries at the end of each dive. Video from all dives was streamed live to the Schmidt Ocean Institute YouTube page (https://www.youtube.com/@SchmidtOcean/streams), and interaction with the viewers was encouraged.

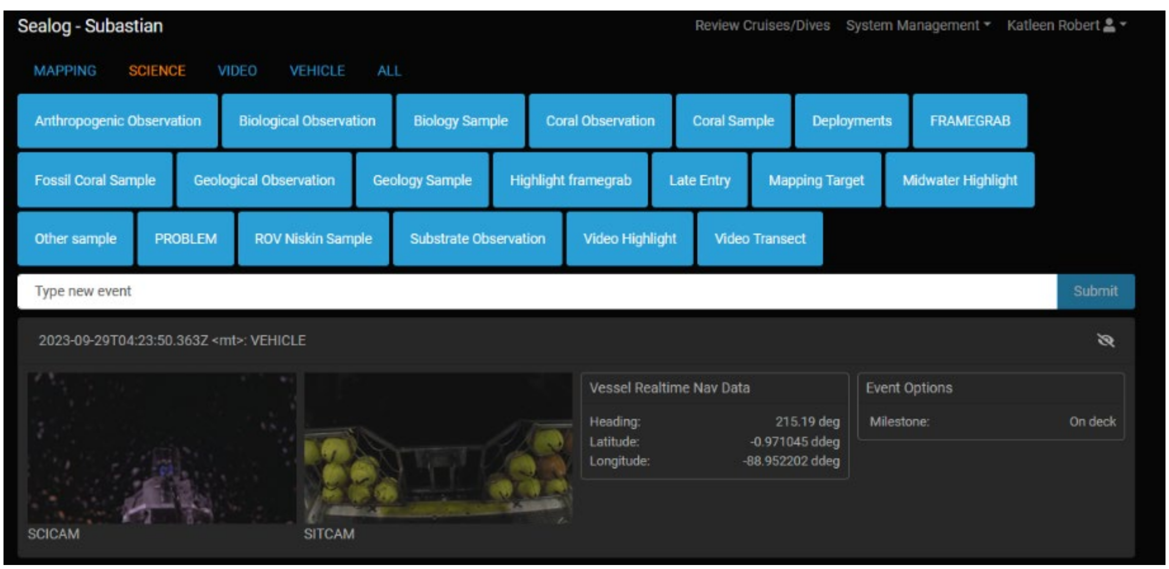


Figure 6: SeaLog interface

5.2 Fossil coral sampling

One aim of this cruise is to investigate variations in oceanic conditions around the Galápagos Platform through time. To achieve this, both fossil and live coral samples were collected. Fossil coral samples are defined here as the skeletons of corals which died at some point in the past, and will be used to provide palaeoceanographic constraints on centennial to millennial timescales. Although modern specimens will be mainly used to calibrate palaeoceanographic proxies, large and live-collected specimens will also be used to provide higher resolution records of oceanographic change on decadal to centennial timescales. Collections of fossil and live coral samples made during this cruise include solitary and colonial scleractinian corals, as well as stylasterid and bamboo corals. Sample acquisition and handling are outlined in the following sections.

5.2.1 Fossil coral skeletons

149 fossil coral samples were collected at multiple locations across the Galápagos Platform, during 14 of the ROV dives carried out during FKt230918. Of these, 102 scleractinian and stylasterid samples will be transferred to the University of Bristol for geochemical analysis. The location and depth of all samples collected are summarized in Table 2-5 and Figures 7-Figure 8. All samples were collected from <800 m water depth, and substantial aggregations of fossil corals were not observed at deeper sites.

These samples will be dated using U-series (laser ablation and, for selected samples of interest, isotope dilution) techniques to provide constraint on the age of fossil coral. Additional geochemical measurements will then be made to investigate changes in ocean conditions around the Galápagos Platform. The aim of this multi-proxy approach is to provide information on past variations in climatically-relevant parameters including temperature, ocean ventilation, circulation patterns and primary production.

The remaining 47 samples will be housed at the Charles Darwin Foundation. These samples dominantly consist of non-coral samples such as rocks or hard/skeletal elements of other organisms (e.g., sea urchin spines and bivalve, gastropod and brachiopod shells), which were incidentally collected along with fossil corals. Samples also include pieces of fossil coral which came up on the ROV porch but were not clearly associated with a single sampling event (e.g., they may have fallen from nets and/or the manipulator claw during other sampling events, or fallen out of collected nets during ROV transit). All these samples were processed in the same manner as fossil corals, and will be used to provide information on substrate type and how this varies around the Platform. Sample metadata for these samples is summarized in Table 3.

All fossil coral samples taken during this cruise were collected by means of the ROV *SuBastian*. Most samples were acquired using nets, which the ROV pilots handled via the manipulator arms to scoop through dense aggregations of fossil corals. On occasion, individual specimens were grabbed directly using the manipulator claw, which was most effective when sampling large pieces of fossil coral framework. On a few occasions, the suction hose was placed over samples and used to transfer the specimens to coral quivers.

Once on deck, samples were examined to extract any associated living organisms, which were then processed through the biology team's protocols inside the cold laboratory on board. The fossil coral specimens were subsequently rinsed with freshwater to remove any remains of encrusting organisms and sediments, before being air dried using fans, trays and egg boxes (Figure 7). Once dried, samples were photographed, catalogued and packed in labelled sample bags.


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Figure 7: Fossil corals being dried in the main lab onboard R/V Falkor (too). Photo: Misha Vallejo Prut.

Table 2: Metadata for fossil coral samples collected during cruise FKt230918. These samples will be transferred to the University of Bristol for geochemical analysis. The sample ID column indicates the ROV dive (e.g. S0577) and sampling event (e.g. Ev02) numbers. Events were further split into separate samples representing different taxonomic groups as best as possible.

Sample number	Sample ID	Latitude	Longitude	Depth (m)	Order
1	FKt230918_S0577_Ev02_01	-0.51845	-89.91446	502	Scleractinia
2	FKt230918_S0577_Ev02_02	-0.51845	-89.91446	502	Scleractinia
3	FKt230918_S0577_Ev02_03	-0.51845	-89.91446	502	Scleractinia
4	FKt230918_S0577_Ev02_04	-0.51845	-89.91446	502	Scleractinia
5	FKt230918_S0577_Ev02_06	-0.51845	-89.91446	502	Scleractinia
6	FKt230918_S0577_Ev02_07	-0.51845	-89.91446	502	Scleractinia
7	FKt230918_S0577_Ev02_08	-0.51845	-89.91446	502	Scleractinia
8	Fkt230918_S0577_Ev09_01	-0.524745	-89.908263	370	Scleractinia
9	FKt230918_S0579_Ev02_F03	-0.508077	-89.946384	560	Scleractinia
10	FKt230918_S0579_Ev02_F04	-0.508077	-89.946384	560	Scleractinia
11	FKt230918_S0579_Ev02_F05	-0.508077	-89.946384	560	Scleractinia
12	FKt230918_S0579_Ev06_F02	-0.507339	-89.942699	484	Scleractinia

13	FKt230918_S0579_Ev06_F03	-0.507339	-89.942699	484	Scleractinia
14	FKt230918_S0579_Ev21_F01	-0.505374	-89.928655	334	Scleractinia
15	FKt230918_S0579_Ev21_F03	-0.505374	-89.928655	334	Scleractinia
16	FKt230918_S0579_Ev21_F04	-0.505374	-89.928655	334	Scleractinia
17	FKt230918_S0579_Ev03_F01	-0.508044	-89.946152	553	Scleractinia
18	FKt230918_S0579_Ev04_F01	-0.507797	-89.944679	511	Scleractinia
19	FKt230918_S0579_Ev08_F03	-0.507533	-89.940078	424	Scleractinia
20	FKt230918_S0579_Ev12_F01	-0.507772	-89.937917	453	Scleractinia
21	FKt230918_S0579_Ev16_F01	-0.505825	-89.935327	391	Scleractinia
22	FKt230918_S0579_Ev22_F01	-0.506163	-89.926735	347	Scleractinia
23	FKt230918_S0580_Ev09_F01	-0.569722	-89.916943	477	Scleractinia
24	FKt230918_S0580_Ev09_F02	-0.569722	-89.916943	477	Scleractinia
25	FKt230918_S0580_Ev09_F03	-0.569722	-89.916943	477	Scleractinia
26	FKt230918_S0580_Ev09_F04	-0.569722	-89.916943	477	Scleractinia
27	FKt230918_S0580_Ev14_F01	-0.568146	-89.914276	472	Scleractinia
28	FKt230918_S0580_Ev14_F02	-0.568146	-89.914276	472	Scleractinia
29	FKt230918_S0580_Ev14_F03	-0.568146	-89.914276	472	Scleractinia
30	FKt230918_S0580_Ev14_F04	-0.568146	-89.914276	472	Scleractinia
31	FKt230918_S0580_Ev14_F05	-0.568146	-89.914276	472	Scleractinia
32	FKt230918_S0580_Ev16_F01	-0.566886	-89.909598	373	Scleractinia
33	FKt230918_S0580_Ev16_F02	-0.566886	-89.909598	373	Scleractinia
34	FKt230918_S0580_Ev16_F03	-0.566886	-89.909598	373	Scleractinia
35	FKt230918_S0580_Ev16_F04	-0.566886	-89.909598	373	Scleractinia
36	FKt230918_S0580_Ev17_F01	-0.564887	-89.907719	380	Scleractinia
37	FKt230918_S0579_Ev02_F01	-0.508077	-89.946384	560	Scleractinia
38	FKt230918_S0579_Ev06_F01	-0.507339	-89.942699	484	Scleractinia
39	FKt230918_S0579_Ev02_F02	-0.508077	-89.946384	560	Scleractinia
40	FKt230918_S0581_Ev08_F01	-1.049929	-88.9593	409	Scleractinia
41	FKt230918_S0581_Ev08_F02	-1.049929	-88.9593	409	Scleractinia
42	FKt230918_S0581_Ev08_F03	-1.049929	-88.9593	409	Scleractinia
43	FKt230918_S0581_Ev08_F05	-1.049929	-88.9593	409	Scleractinia
44	FKt230918_S0581_Ev09_F01	-1.049719	-88.959754	390	Scleractinia
45	FKt230918_S0581_Ev14_F02	-1.04911	-88.961299	363	Scleractinia
46	FKt230918_S0581_Ev14_F03	-1.04911	-88.961299	363	Scleractinia
47	FKt230918_S0581_Ev14_F04	-1.04911	-88.961299	363	Scleractinia
48	FKt230918_S0581_Ev17_F01	-1.043867	-88.963244	338	Scleractinia
49	FKt230918_S0581_Ev17_F02	-1.043867	-88.963244	338	Scleractinia
50	FKt230918_S0581_Ev17_F03	-1.043867	-88.963244	338	Scleractinia
51	FKt230918_S0582_Ev04_F01	-0.974909	-88.924091	664	Scleractinia
52	FKt230918_S0582_Ev05_F01	-0.974953	-88.924735	662	Scleractinia
53	FKt230918_S0582_Ev05_F02	-0.974953	-88.924735	662	Scleractinia
54	FKt230918_S0582_Ev05_F03	-0.974953	-88.924735	662	Scleractinia

55	FKt230918_S0582_Ev09_F01	-0.975311	-88.929311	541	Scleractinia
56	FKt230918_S0582_Ev09_F02	-0.975311	-88.929311	541	Scleractinia
57	FKt230918_S0582_Ev26_F01	-0.971476	-88.95033	418	Scleractinia
58	FKt230918_S0582_Ev28_F01	-0.971628	-88.953016	391	Scleractinia
59	FKt230918_S0583_Ev07_F01	-0.924372	-88.934174	607	Scleractinia
60	FKt230918_S0583_Ev07_F02	-0.924372	-88.934174	607	Scleractinia
61	FKt230918_S0583_Ev07_F03	-0.924372	-88.934174	607	Scleractinia
62	FKt230918_S0585_Ev13_F01	-0.530242	-90.179722	390	Scleractinia
63	FKt230918_S0585_Ev13_F02	-0.530242	-90.179722	390	Scleractinia
64	FKt230918_S0587_Ev17_F01	0.287899	-91.639227	650	Scleractinia
65	FKt230918_S0587_Ev18_F01	0.287916	-91.639221	650	Scleractinia
66	FKt230918_S0587_Ev18_F02	0.287916	-91.639221	650	Scleractinia
67	FKt230918_S0587_Ev18_F03	0.287916	-91.639221	650	Scleractinia
68	FKt230918_S0588_Ev09_F01	0.033219	-91.588043	535	Scleractinia
69	FKt230918_S0588_Ev09_F02	0.033219	-91.588043	535	Scleractinia
70	FKt230918_S0588_Ev09_F03	0.033219	-91.588043	535	Scleractinia
71	FKt230918_S0581_Ev14_F01	-1.04911	-88.961299	363	Scleractinia
72	FKt230918_S0591_Ev07_F01	-0.503766	-91.597519	431	Scleractinia
73	FKt230918_S0591_Ev11_F01	-0.502359	-91.597185	363	Scleractinia
74	FKt230918_S0591_Ev12_F01	-0.498606	-91.595871	195	Scleractinia
75	FKt230918_S0592_Ev07_F01	-0.296153	-91.664476	452	Scleractinia
76	FKt230918_S0592_Ev07_F02	-0.296153	-91.664476	452	Scleractinia
77	FKt230918_S0592_Ev07_F03	-0.296153	-91.664476	452	Scleractinia
78	FKt230918_S0592_Ev07_F04	-0.296153	-91.664476	452	Scleractinia
79	FKt230918_S0592_Ev13_F01	-0.300364	-91.669983	368	Scleractinia
80	FKt230918_S0592_Ev14_F01	-0.300364	-91.669988	368	Scleractinia
81	FKt230918_S0592_Ev12_F01	-0.299766	-91.669324	368	Scleractinia
82	FKt230918_S0592_Ev12_F03	-0.299766	-91.669324	368	Scleractinia
83	FKt230918_S0592_Ev08_F01	-0.296828	-91.664765	389	Scleractinia
84	FKt230918_S0593_Ev08_F01	-1.000791	-91.456155	501	Scleractinia
85	FKt230918_S0593_Ev08_F02	-1.000791	-91.456155	501	Scleractinia
86	FKt230918_S0593_Ev08_F03	-1.000791	-91.456155	501	Scleractinia
87	FKt230918_S0595_Ev06_F01	-1.082206	-90.854986	361	Scleractinia
88	FKt230918_S0596_Ev19_F01	-1.074321	-91.167196	379	Scleractinia
89	FKt230918_S0577_Ev02_09	-0.51845	-89.91446	502	Stylasteridae
90	FKt230918_S0579_Ev02_F06	-0.508077	-89.946384	560	Stylasteridae
91	FKt230918_S0579_Ev06_F05	-0.507339	-89.942699	484	Stylasteridae
92	FKt230918_S0579_Ev21_F05	-0.505374	-89.928655	334	Stylasteridae
93	FKt230918_S0580_Ev09_F05	-0.569722	-89.916943	477	Stylasteridae
94	FKt230918_S0580_Ev14_F06	-0.568146	-89.914276	472	Stylasteridae
95	FKt230918_S0580_Ev16_F05	-0.566886	-89.909598	373	Stylasteridae
96	FKt230918_S0581_Ev08_F04	-1.049929	-88.9593	409	Stylasteridae

97	FKt230918_S0581_Ev14_F05	-1.04911	-88.961299	363	Stylasteridae
98	FKt230918_S0581_Ev17_F04	-1.043867	-88.963244	338	Stylasteridae
99	FKt230918_S0582_Ev05_F04	-0.974953	-88.924735	662	Stylasteridae
100	FKt230918_S0583_Ev07_F04	-0.924372	-88.934174	607	Stylasteridae
101	FKt230918_S0591_Ev12_F02	-0.498606	-91.595871	195	Stylasteridae
102	FKt230918_S0592_Ev12_F02	-0.299766	-91.669324	368	Stylasteridae

Table 3: Metadata of fossil samples (generally rock, shelly debris or coral rubble) which will be housed and analyzed at the Charles Darwin Foundation. The sample ID column indicates the ROV dive (e.g. S0577) and sampling event (e.g. Ev02) numbers. Events were further split into separate samples representing different taxonomic groups as best as possible.

Sample number	Sample ID	Latitude	Longitude	Depth (m)
1	FKt230918_S0577_Ev02_05	-0.51845	-89.91446	502.23
2	FKt230918_S0577_Ev02_10	-0.51845	-89.91446	502.23
3	FKt230918_S0579_Ev02_F07	-0.508077	-89.946384	560.3
4	FKt230918_S0579_Ev02_F08	-0.508077	-89.946384	560.3
5	FKt230918_S0579_Ev06_F04	-0.507339	-89.942699	483.58
6	FKt230918_S0579_Ev06_F06	-0.507339	-89.942699	483.58
7	FKt230918_S0579_Ev21_F02	-0.505374	-89.928655	333.89
8	FKt230918_S0579_Ev21_F06	-0.505374	-89.928655	333.89
9	FKt230918_S0579_unknown_event	NA	NA	NA
10	FKt230918_S0580_Ev09_F06	-0.569722	-89.916943	476.62
11	FKt230918_S0580_Ev09_F07	-0.569722	-89.916943	476.62
12	FKt230918_S0580_Ev14_F07	-0.568146	-89.914276	471.9
13	FKt230918_S0580_Ev14_F08	-0.568146	-89.914276	471.9
14	FKt230918_S0580_Ev16_F06	-0.566886	-89.909598	373.38
15	FKt230918_S0580_Ev16_F07	-0.566886	-89.909598	373.38
16	FKt230918_S0580_unknown_event	NA	NA	NA
17	FKt230918_S0581_Ev08_F06	-1.049929	-88.9593	408.81
18	FKt230918_S0581_Ev08_F07	-1.049929	-88.9593	408.81
19	FKt230918_S0581_Ev14_F06	-1.04911	-88.961299	362.57
20	FKt230918_S0581_Ev14_F07	-1.04911	-88.961299	362.57
21	FKt230918_S0581_Ev17_F05	-1.043867	-88.963244	338.29
22	FKt230918_S0582_Ev05_F05	-0.974953	-88.924735	661.59
23	FKt230918_S0582_Ev05_F06	-0.974953	-88.924735	661.59
24	FKt230918_S0582_Ev05_F07	-0.974953	-88.924735	661.59
25	FKt230918_S0582_Ev09_F03	-0.975311	-88.929311	540.72
26	FKt230918_S0582_Evunknown	NA	NA	NA
27	FKt230918_S0583_Ev07_F06	-0.924372	-88.934174	606.67
28	FKt230918_S0583_Ev07_F05	-0.924372	-88.934174	606.67
29	FKt230918_S0580_Ev16_F08	-0.566886	-89.909598	373.38
30	FKt230918_S0587_Ev18_F04	0.287916	-91.639221	650.25

31	FKt230918_S0587_Ev18_F05	0.287916	-91.639221	650.25
32	FKt230918_S0588_Ev09_F04	0.033219	-91.588043	535.28
33	FKt230918_S0588_Ev09_F05	0.033219	-91.588043	535.28
34	FKt230918_S0591_Ev12_F03	-0.498606	-91.595871	194.81
35	FKt230918_S0592_Ev07_F05	-0.296153	-91.664476	451.66
36	FKt230918_S0592_Ev07_F06	-0.296153	-91.664476	451.66
37	FKt230918_S0592_Ev07_F07	-0.296153	-91.664476	451.66
38	FKt230918_S0592_Ev12_F04	-0.299766	-91.669324	368.42
39	FKt230918_S0592_Ev12_F05	-0.299766	-91.669324	368.42
40	FKt230918_S0592_Ev12_F06	-0.299766	-91.669324	368.42
41	FKt230918_S0592_Ev12_F07	-0.299766	-91.669324	368.42
42	FKt230918_S0592_Ev12_F08	-0.299766	-91.669324	368.42
43	FKt230918_S0593_Ev08_F04	-1.000791	-91.456155	501.17
44	FKt230918_S0593_Ev08_F05	-1.000791	-91.456155	501.17
45	FKt230918_S0593_Ev08_F06	-1.000791	-91.456155	501.17
46	FKt230918_Unknown_01	NA	NA	NA
47	FKt230918_Unknown_02	NA	NA	NA

5.2.2 Live coral skeletons

The carbonate skeletons of live corals collected for taxonomic and genetic purposes were retained and will contribute to two additional research themes. First, these skeletons can be used to calibrate coral geochemistry to modern seawater conditions, allowing testing and refinement of the palaeoceanographic proxies we plan to apply to fossil and large, live-collected coral samples (see below). These measurements will be made at the University of Bristol, with corresponding seawater conditions taken from the CTD onboard ROV *SuBastian* or from proximal measurements made by other cruises. Secondly, large, live-collected corals will be used to generate higher resolution records of decadal-centennial changes in oceanographic conditions around the Galápagos Platform.

Live-collected corals were sampled on this cruise for genetic/taxonomic analysis. The carbonate skeletons of 37 of these samples were retained and processed ready for geochemical analysis. For the first half of the expedition, samples were bleached in NaClO to help remove organic matter, which was then fully removed by physical scraping and repeated freshwater rinses. Owing to shortages of equipment and storage space, specimens from the second half of the cruise were not bleached, and organic matter was removed only by rinsing with a powerful freshwater hose.

After removal of organic matter, samples were air dried, photographed, packaged and databased following the same protocol as outlined for fossil corals. The samples collected and their depth distribution are summarized in Table 4 and Figure 8. Again, most specimens were collected from depths < 800 m, although one bamboo coral was collected from a much deeper site (> 1500 m depth).

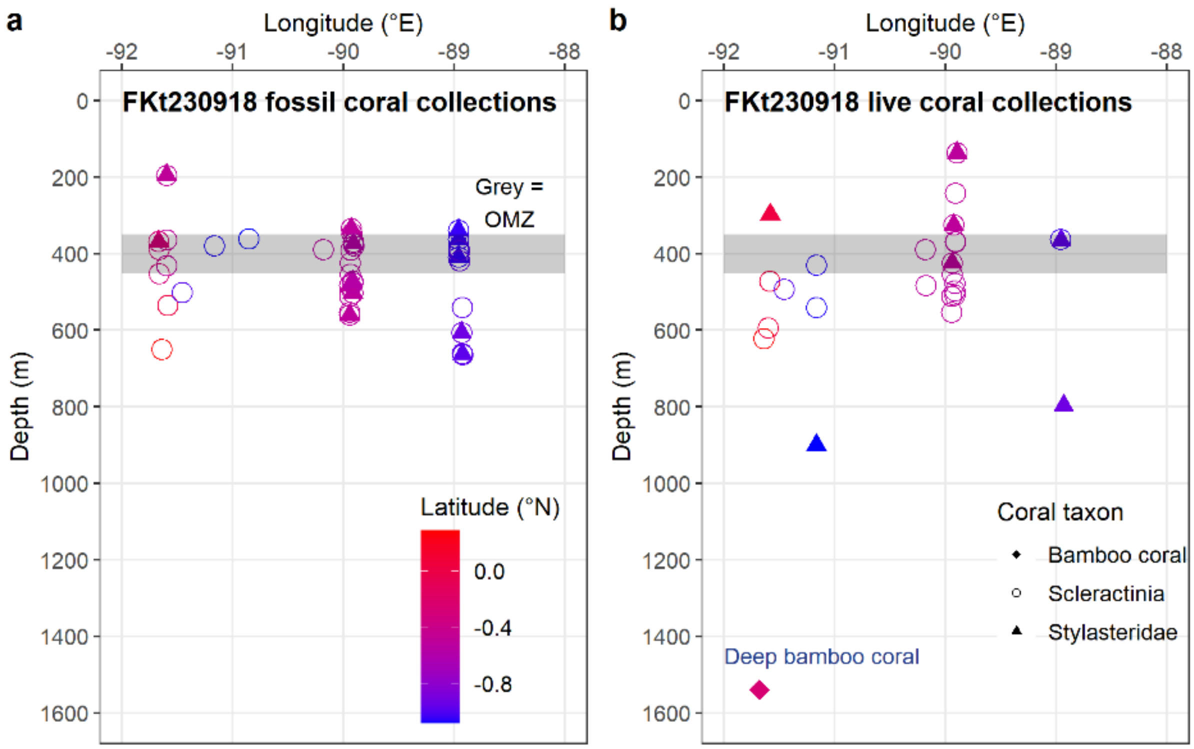

Figure 8: Fossil (a) and live (b) coral skeleton collection locations during cruise FKt230918. Point colours show latitude. Grey bands in each panel show the approximate depth of the oxygen minimum zone (OMZ) assessed by CTD casts during the cruise. Note that live coral collections shown here are only those in which pieces of carbonate skeleton will be analyzed for inorganic geochemistry.

Table 4: Details of live coral skeleton samples which will be analyzed for their geochemical composition at the University of Bristol. The sample ID column indicates the ROV dive (e.g. S0577) and sampling event (e.g. Ev02) numbers. Events were further split into separate samples representing different taxonomic groups as best as possible.

Sample number	Sample ID	Latitude	Longitude	Depth (m)	Taxon
1	Fkt230918_S0577_Ev09_02	-0.524745	-89.908263	370	Scleractinia
2	Fkt230918_S0577_Ev10_01	-0.524755	-89.908238	368	Scleractinia
3	FKt230918_S0577_Ev04_01	-0.518516	-89.914601	508	Scleractinia
4	FKt230918_S0577_Ev04_02	-0.518516	-89.914601	508	Scleractinia
5	Fkt230918_S0577_Ev10_02	-0.524755	-89.908238	368	Scleractinia
6	Fkt230918_S0577_Ev16_01	-0.519261	-89.893704	137	Scleractinia
7	Fkt230918_S0577_Ev16_02	-0.519261	-89.893704	137	Stylasteridae
8	Fkt230918_S0577_Ev16_03	-0.519261	-89.893704	137	Stylasteridae
9	Fkt230918_S0577_Ev15_01	-0.519256	-89.893627	136	Stylasteridae
10	FKt230918_S0579_Ev08_03	-0.507533	-89.940078	424	Scleractinia
11	FKt230918_S0579_Ev03_01	-0.508044	-89.946152	553	Scleractinia
12	FKt230918_S0579_Ev12_01	-0.507772	-89.937917	453	Scleractinia
13	FKt230918_S0579_Ev05_01	-0.507786	-89.944680	511	Scleractinia
14	FKt230918_S0579_Ev28_01	-0.505075	-89.909426	242	Scleractinia

15	FKt230918_S0579_Ev23_01	-0.505744	-89.924811	325	Scleractinia
16	FKt230918_S0579_Ev08_01	-0.507533	-89.940078	424	Scleractinia
17	FKt230918_S0579_Ev08_02	-0.507533	-89.940078	424	Stylasteridae
18	FKt230918_S0579_Ev07_01	-0.507537	-89.940075	424	Scleractinia
19	FKt230918_S0579_Ev03_02	-0.508044	-89.946152	553	Scleractinia
20	FKt230918_S0581_Ev14_01	-1.049110	-88.961299	363	Scleractinia
21	FKt230918_S0583_Ev12_01	-0.930005	-88.932630	797	Stylasteridae
22	FKt230918_S0582_Ev32_01	-0.971504	-88.954280	366	Stylasteridae
23	FKt230918_S0585_Ev12_01	-0.530242	-90.179728	390	Scleractinia
24	FKt230918_S0585_Ev11_01	-0.530246	-90.179725	389	Scleractinia
25	FKt230918_S0585_Ev09_01	-0.528761	-90.178623	483	Scleractinia
26	FKt230918_S0585_Ev13_01	-0.530242	-90.179722	390	Scleractinia
27	FKt230918_S0587_Ev19_01	0.287815	-91.639057	622	Scleractinia
28	FKt230918_S0588_Ev05_01	0.035724	-91.601037	593	Scleractinia
29	FKt230918_S0588_Ev10_01	0.031448	-91.585617	472	Scleractinia
30	FKt230918_S0588_Ev14_01	0.025902	-91.582708	297	Stylasteridae
31	FKt230918_S0588_Ev14_02	0.025902	-91.582708	297	Stylasteridae
32	FKt230918_S0593_Ev09_01	-1.000734	-91.456035	492	Scleractinia
33	FKt230918_S0596_Ev17_01	-1.075228	-91.167144	430	Scleractinia
34	FKt230918_S0596_Ev14_01	-1.077855	-91.166939	541	Scleractinia
35	FKt230918_S0596_Ev04_01	-1.087331	-91.167213	900	Stylasteridae
36	FKt230918_S0596_Ev04_02	-1.087331	-91.167213	900	Stylasteridae
37	FKt230918_S0589_Ev04_01	-0.267168	-91.679371	1539	Bamboo coral

Two additional live coral skeleton samples were also collected and processed in the same manner, and these samples will be housed at the Charles Darwin Foundation. Their metadata are summarized in Table 5.

Table 5: List of samples of live coral skeletons collected during FKt230918 which will be housed at the Charles Darwin Foundation. The sample ID column indicates the ROV dive (e.g. S0577) and sampling event (e.g. Ev02) numbers.

Sample number	Sample ID	Latitude	Longitude	Depth (m)	Taxon
1	FKT230918_S0580_Ev12_01	-0.569112	-89.916005	497	Scleractinia
2	FKT230918_S0580_Ev10_01	-0.569698	-89.916941	477	Scleractinia

5.3. Biological sampling

The ROV *SuBastian* was used to collect most biological samples, mainly with the manipulator arms and to a lesser extent, the hydraulic suction sampler. Only a few species (<5) were bycatches, including a fish and a squid, that came out in the ROV basket and were also fixed as samples. In total 494 biological samples were recovered from 19 ROV *SuBastian* dives across a depth range of 123 m to 1619 m (Appendix 3).

Before *SuBastian* returned to the surface, the log sheet and the ROV map were used to create labels. The biological samples were processed in the cold room where each species was assigned a label with a unique number (e.g., FKT230918_####). Format of the specimen identification tags on ethanol proof paper was as follows:

Unique ID: FKT230918_00650
Parent ID:
Event:
ROV#:
Date:
A B C D E F G H

If a sample occurred on another sample (e.g., an ophiuroid on a coral), the relationship was preserved through a "parent-daughter" chain to ensure that information about associates was retained through the Parent ID field. At the bottom of the label, seven letters were displayed to each representing a specific sample treatment and sample owner as following:

Ana-Belen Yanez	ETOH96	A
	RNA	B
Tim Shank	ETOH96	C
	RNA	D
	Liquid Nitrogen	E
Charles Darwin Foundation (CDF) / University of Costa Rica (UCR)	ETOH96	F
	CDF Liquid Nitrogen or UCR ETOH96	G
	Voucher CDF	H

Figure 9: Ophiuroid sample with label ID FKt230918_134, the parent is the octocoral unique ID FKt230918_129, indicated by the "Parent ID: 129".

Several photos of every individual organism with a scale bar and label visible were recorded in the lab to ensure "live" color and state were recorded as soon as possible (Figure 9, Figure 10). A whole animal image and a close-up (if possible) were taken for each organism collected. Each image was then labelled with its unique specimen number.

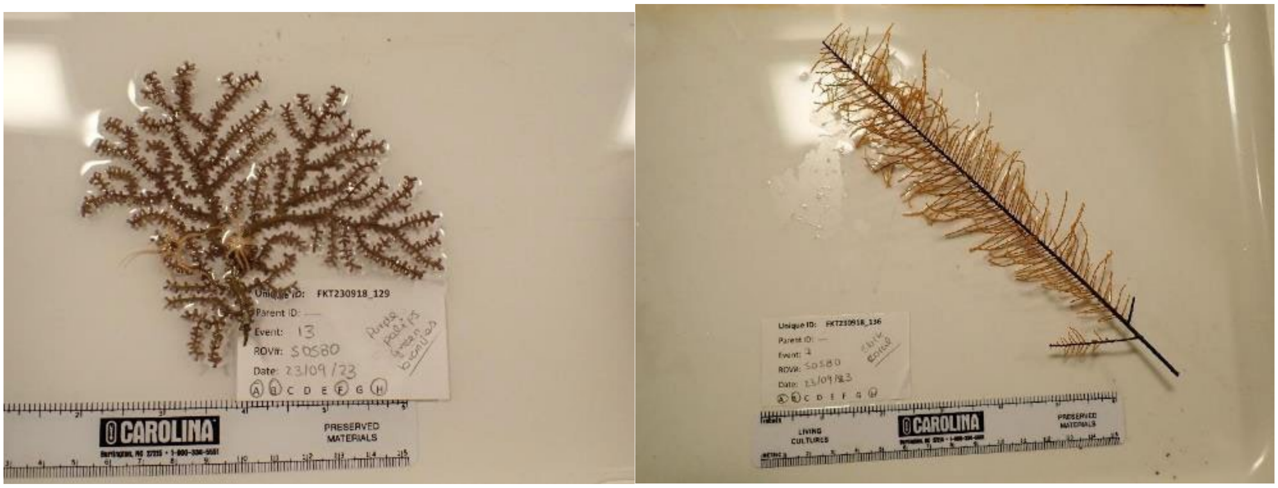

Figure 10: Images of samples recovered using ROV SuBastian for scientific interpretation.

5.3.1 Corals

To ensure future genetic research, every colonial hard coral, octocoral and black coral was sub-sampled and preserved in 96% ethanol and stored at – 4°C and - 30°C in 2ml cryotubes (Protocal A). The corals collected in situ in RNAlater were kept in a clean homemade RNAlater overnight, moved to lab-made RNA after 24h, and kept in cryotubes at -30°C (Protocol B). The portion of the corals that were not used for genetics will be kept at the Charles Darwin Foundation Research Station in the Galápagos (CDF) or to the University of Costa Rica (UCR) to be preserved in 50 ml Falcon tubes or Nalgene bottles depending on their size in ethanol 75% or 90% (Protocols F-H). In total, 115 coral samples were collected around the Galápagos Islands and 29 at Isla del Coco (Table 6).

Table 6: Total number of coral samples per order collected in the Galápagos and at Isla del Coco National Park.

Order	Galápagos	Isla del Coco
Malacalcyonacea	35	16
Scleralcyonacea	31	9
Antipatharia	16	3
Scleractinia	33	1
Total	**115**	**29**

5.3.2 Coral Associated species

Samples of host coral and associated epifaunal organism were collected, preserved and processed in multiple ways to conduct a variety of studies, including genetic analyses, such as DNA barcoding to identify species, assess phylogenetic/ co-evolutionary relationships, and stable carbon isotopes to identify trophic relationships with habitat types (e.g., vertical walls vs. low-relief mounds at different depths). Specifically, samples of coral associate tissues were subsampled, preserved in either 70% or 96% ethanol, for long-term back up storage (including for genetic analyses (Protocol

C) or fixed in RNA Later for 24 hours at 4°C, then moved to the -80°C for long-term storage for genetic analyses (Protocol D) or flash frozen in liquid nitrogen and stored at -80°C for genetic/isotope analyses (Protocol E). Voucher specimens and specimens too small for multiple subsampling were also preserved in 96% ethanol for the Charles Darwin Foundation and housed at the Research Station for morphological and taxonomic analyses (Protocol F).

In total, 190 specimens of coral associated epifauna across 13 taxonomic Orders were sampled over 15 dives (Table 7). More than 50 symbiotic associate morphospecies (e.g., ophiuroids, crabs, anemones, and polychaetes, living on 24 coral host species were observed. The highest observed diversity was in decapod crustaceans (crabs, shrimp, and squat lobsters) with over 25 species, with crabs maintaining the highest partnership fidelity with specific coral hosts (80 to 100%). The host coral accommodating the highest number of associate invertebrate species was *Madrepora* with 13 species.

Table 7: Summary of Coral Associate Samples

Dive ID	No of Events	Number of sampled coral associates with unique IDs
577	16	24
579	18	45
580	5	8
581	7	7
582	8	8
583	8	9
585	6	7
587	11	16
588	8	13
589	6	8
591	4	9
592	4	4
593	3	6
595	2	8
596	3	19
15 dives	**102**	**190**

5.4. Rock sampling

The geological objectives for the expedition consisted of opportunistic sampling of volcanic and other rocks from outcrops that were encountered during the ROV dives in the various environments around the Galápagos platform that were visited to study and image, optically and acoustically, the vertical cold-water reefs; the primary focus of the field program. In addition, there were several dives that were able to explore somewhat deeper areas, down to ~1600 m, to continue to investigate deep lava flows that form the foundation of the platform and to sample outcrops on flow fronts to help better understand geochemical and structural relationships between the deep flows and adjacent subaerial islands.

The primary focus areas where ROV diving took place consisted of the Cacho de Coral (Coral Crescent) Seamount northeast of Santa Cruz, a large seamount complex east of San Cristobal, the eastern segment of the submarine NW rift zone of Fernandina volcano (north flank and summit), and several targeted areas along the western margin of the Platform from Roca Redonda to the area south of Isabela Island.

Rock samples were predominantly collected *in situ*, using the ROVs manipulator, to positively confirm depth relationships with the eventual shore-based geochemical, petrographic and volatile analyses to be conducted by Prof. Dorsey Wanless and her group at Boise State University (BSU). 70 unique samples were collected (Table 8, Appendix 4). The BSU team is also working on rock samples collected on the R/V *Atlantis* and HOV *Alvin* program, which occurred in March-April 2023 (AT50-09 expedition). Many of the observations and mapping data from AT50-09 contributed to our focusing on specific sites for the Fkt230918 diving with ROV *SuBastian*.

Table 8: Final listing of rock samples collected on Fkt230918 expedition.

Bag No	Rock Sample No	Dive No	Event No	Bucket No		Bag No	Rock Sample No	Dive No	Event No	Bucket No
1	1	S0577	1	1		40	34	S0588	4	6
2	2	S0577	11	1		41	35	S0588	14	6
3	3	S0577	16	1		42	36	S0589	1	7
4	3	S0577	16	tyvek bag		43	37	S0589	3	7
5	3	S0577	16	tyvek bag		44	38	S0589	5	7
6	4	S0579	14	2		45	39	S0589	6	7
7	5	S0579	17	2		46	40	S0589	7	7
8	5	S0579	17	tyvek bag		47	41	S0589	8	7
9	6	S0580	15	2		48	42	S0589	9	7
10	7	S0581	1	3		49	43	S0589	10	7
11	8	S0581	2	3		50	44	S0589	12	7
12	9	S0581	3	3		51	45	S0589	14	7
13	10	S0581	6	3		52	46	S0589	15	7
14	11	S0581	13	3		53	47	S0590	3	6
15	12	S0581	15	3		54	48	S0591	14	6
16	13	S0581	16	3		55	49	S0592	1	8
17	14	S0581	18	3		56	50	S0592	11	8
18	15	S0582	1	4		57	51a	S0592	12	8
19	16	S0582	8	4		58	51b	S0592	15	8
20	17	S0582	11	4		59	52	S0593	1	8
21	18	S0582	14	4		60	53	S0593	11	8
22	19	S0582	21	4		61	54	S0593	15	8
23	20	S0583	1	5		62	55	S0595	5	8
24	20	S0583	1	tyvek bag		63	56	S0595	7	8
25	21	S0583	8	5		64	57	S0596	1	10
26	21	S0583	8	tyvek bag		65	58	S0596	3	9
27	22	S0585	1	5		66	59	S0596	5	10
28	23	S0585	2	5		67	60	S0596	6	9
29	23 & 26	S0585	2&5	tyvek bag		68	61	S0596	7	9
30	24	S0585	3	5		69	62	S0596	8	10
31	25	S0585	4	5		70	63	S0596	9	10
32	26	S0585	5	5		71	64	S0596	10	10
33	27	S0585	18	5		72	65	S0596	11	10
34	28	S0587	7	6		73	66	S0596	12	10
35	29	S0587	11	6		74	67	S0596	15	9
36	30	S0587	18	6		75	68	S0596	16	9
37	31	S0587	19	6		76	69	S0596	20	3
38	32	S0588	2	6		77	70	S0596	22	3
39	33	S0588	3	6						

5.4.1 Geotechnical analyses

Rock samples from 54 sites have been set aside for geotechnical analyses (Table 9). Two different studies are planned based on these geotechnical measurements:

Slope instability along the flanks of the Galápagos volcanic platform: Unlike other ocean island volcanoes, there is scant evidence of slope failure on the seafloor around the Galápagos. The objective of this project is to assess why this is the case and what factors are responsible for triggering slope failures in such a setting. Samples will be selected along a 2D transect across the flank of the platform. The following geotechnical measurements will be carried out:

a. Young's modulus
b. Poisson's ratio
c. Bulk density
d. Joint friction angle
e. Joint roughness coefficient
f. Joint compressive strength

Joint friction angle, roughness coefficient and compressive strength are likely going to be difficult to measure, and we might need to rely on measurements made on onshore samples. ROV footage will be used to determine joint density and its variation with depth. A 2D distinct element model will be developed to quantify factor of safety for: (i) slope with a range of geometries that are representative of the Galápagos platform and (ii) earthquakes with different locations, depths and magnitudes.

Fluid circulation in the Galápagos volcanic platform: Fluid circulation in siliciclastic margins and carbonate platforms has been investigated using field data and numerical approach. Fluid circulation patterns in volcanic platforms such as the Galápagos remain comparatively poorly understood. This knowledge gap needs to be addressed because such fluids can play an important role in modulating geomorphic processes and supplying nutrients to benthic ecosystems, among others. A 3D simplified geological model of the Galápagos platform will be developed using the available bathymetry and geological samples. The geotechnical samples will be used to measure porosity, whereas joint width and density will be derived from the ROV footage to infer hydraulic conductivity (and its potential variation with depth). A 3D finite element groundwater model will then be developed to take into consideration topographically-driven flow (recharged from the islands via precipitation), and geothermal convection. Simulations that take into consideration variable sea-levels and varying properties of the magma chambers (based on known and inferred location, size and temperature of magma chambers) will be run to determine the type and discharge rate of seeping fluids, its location and its variation during one glacial cycle.

Table 9: List of geological samples for geotechnical measurements.

Dive number	Event number	Rock number	Pieces	Latitude	Longitude	Depth (m)
S0577	16	-	1	-0.51926	-89.8937	137
S0577	1	1	1	-0.51837	-89.91431	498
S0577	11	2	1	-0.52483	-89.90826	370
S0579	14	4	1	-0.50754	-89.93558	398
S0579	27	5	1	-0.50592	-89.91126	251
S0580	15	6	1	-0.56755	-89.91318	456
S0581	1	7	1	-1.05918	-88.95840	644
S0581	2	8	1	-1.05918	-88.95840	644
S0581	3	9	1	-1.05921	-88.95862	643
S0581	15	12	1	-1.04903	-88.96133	363
S0581	18	14	1	-1.04387	-88.96323	338

S0582	1	15	1	-0.9751	-88.92345	674
S0582	8	16	1	-0.97474	-88.92397	700
S0582	11	17	1	-0.97297	-88.93972	552
S0582	14	18	1	-0.97283	-88.94042	549
S0582	21	19	1	-0.97217	-88.94576	464
S0583	1	20	2	-0.92257	-88.93353	710
S0583	8	21	1	-0.92449	-88.93401	599
S0585	1	22	1	-0.51317	-90.15906	915
S0585	2	23	1	-0.5128	-90.1597	910
S0585	3	24	1	-0.51522	-90.16097	847
S0585	4	25	1	-0.52156	-90.16645	779
S0585	5	26	1	-0.52155	-90.16648	778
S0585	18	27	1	-0.53052	-90.18266	312
S0587	7	28	1	0.28676	-91.64935	864
S0587	11	29	1	0.28879	-91.64165	796
S0587	18	30	7	0.28792	-91.63922	650
S0587	19	31	1	0.28782	-91.63906	622
S0588	2	32	2	0.03584	-91.60317	727
S0588	3	33	1	0.03576	-91.60146	624
S0588	4	34	5	0.03572	-91.60106	594
S0588	14	35	1	0.0259	-91.58271	297
S0589	6	39	1	-0.269322	-91.680093	1507
S0589	7	40	1	-0.27103	-91.68025	1437
S0589	12	44	1	-0.28019	-91.6806	1059
S0590	3	47	1	-0.42659	-91.36477	206
S0591	14	48	1	-0.4986	-91.59587	195
S0592	1	49	1	-0.29383	-91.66268	635
S0592	11	50	1	-0.29703	-91.66486	385
S0593	10	54	1	-1.00067	-91.45601	488
S0595	5	55	1	-1.093712	-90.861206	525.7
S0596	1	57	1	-1.089427	-91.166777	937.48
S0596	3	58	5	-1.087345	-91.167192	900.01
S0596	5	59	3	-1.086237	-91.167947	879.27
S0596	7	61	2	-1.083505	-91.165632	809.55
S0596	8	62	1	-1.08345	-91.165069	802.88
S0596	9	63	3	-1.082481	-91.1668	755.32
S0596	10	64	1	-1.08269	-91.165991	768.95
S0596	11	65	1	-1.08121	-91.1668	689.35
S0596	12	66	2	-1.080116	-91.166903	634.37
S0596	15	67	1	-1.077854	-91.166944	540.78
S0596	16	68	1	-1.075225	-91.167147	430.27
S0596	20	69	1	-1.074357	-91.16721	379.56
S0596	21	70	2	-1.074359	-91.167212	379.4

5.5. ROV mapping

Table 10: List of dedicated vertical mapping surveys

Dive	Location	Bottom Depth	Top Depth	System
S0578	Cacho de Coral	483m	460m	Laser
S0582	East of San Cristobal	690m	670m	Multibeam
S0582	East of San Cristobal	545m	580m	Multibeam
S0582	East of San Cristobal	375m	425m	Multibeam
S0584	East of San Cristobal	412m	390m	Laser
S0587	Roca Redonda	670m	640m	Multibeam
S0594	South of Isabela	540 m	520m	Multibeam
S0595	South of Isabela	711m	685m	Multibeam
S0595	South of Isabela	550m	530m	Multibeam
S0595	South of Isabela	372m	355m	Multibeam
S0597	Cacho de Coral	430m	370m	Laser
S0597	Cacho de Coral	430m	370m	Multibeam
S0597	Cacho de Coral	446m	390m	Multibeam
S0599	Cacho de Coral	143m	133m	Multibeam

5.5.1 Laser

A Voyis Micro laser scanner (1,000m, IP 192.168.50.101) with integrated digital still camera was mounted on the porch of the ROV with two led panels mounted on either side. The mounting bracket was designed to enable variable angles in 15° increment to be set prior to the dive (Figure 11).

Figure 11: Mounting of Voyis laser for dive S0584 at 75 degree, with LED panel on either side and Norbit MBES mounted on top.

For Dive S0578 a mounting angle of 45deg was selected while a 75deg one was set for Dive S0584, both times with the porch racked (Figure 12). During both dives the stills camera was set to record at 2Hz with an exposure time of 5ms while the laser was set to 100% power with an exposure time of 15ms. Range gating was enabled to allow for faster laser rates of ~50Hz. Other settings were tested either prior or after the main mapping objectives were accomplished. The rarefaction index was set based on CTD measurements (~1.347), time synch settings were set at TCP (10.23.11.31, Port 32101) and navigation parsing was enabled through serial a connection (COM1, baud rate: 115200, protocol: psonnav). All file types were saved on the topside computer (.las, .xyz. .raw, .tif, .jpg).

A) B)

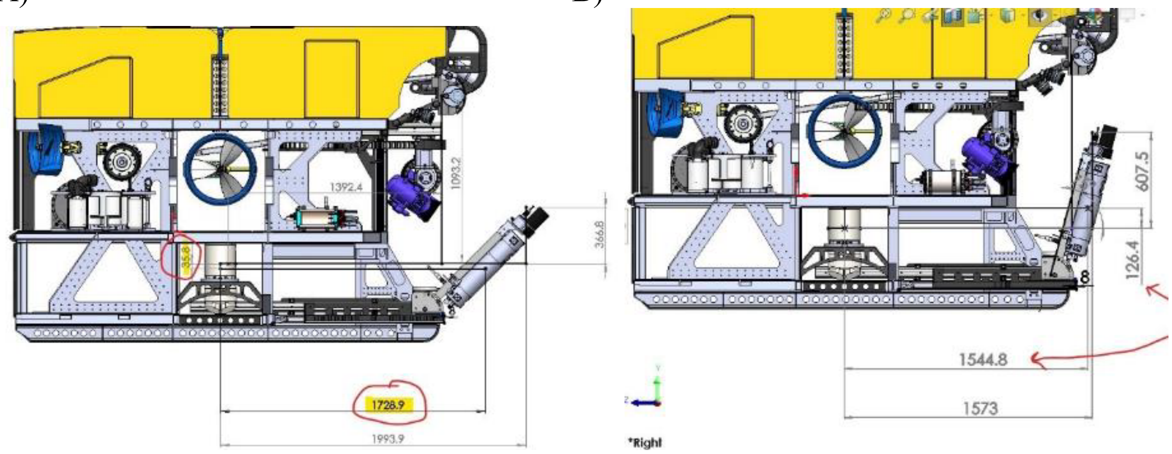

Figure 12: From instrument reference point to INS for dives A) S0578 and B) S0584 for both Voyis laser as well as Norbit MBES.

Processing was carried out in the Voyis ViewLS software v 6.0.7 on the .xyz files. Navigation .bin files were exported to psonnav .asc format files through the software Janus after each dive and imported into ViewLS where the date needed to be set. Offsets were entered based on mounting angle and distance from INS reference point (Table 11, reference frames for INS and laser in Figure 13). Navigation was applied, but noise filtering was not, and files were exported as .las (coordination North East Down). This process was done for each psonnav file separately as using multiple files seemed to cause the navigation to not get applied. Point clouds were visualised in the software CloudCompare (Figure 14).

Table 11: Offset used for the Voyis laser data processing

Dive No.	Mounting Angle (°)	Roll (°)	Pitch (°)	Yaw (°)	X offset (m)	Y offset (m)	Z offset (m)
S0578	45	135	0	-90	1.728	0	0.035
S0584	75	105	0	-90	1.545	0	0.126
S0597	45	135	0	-90	1.728	0	0.035

A) B)

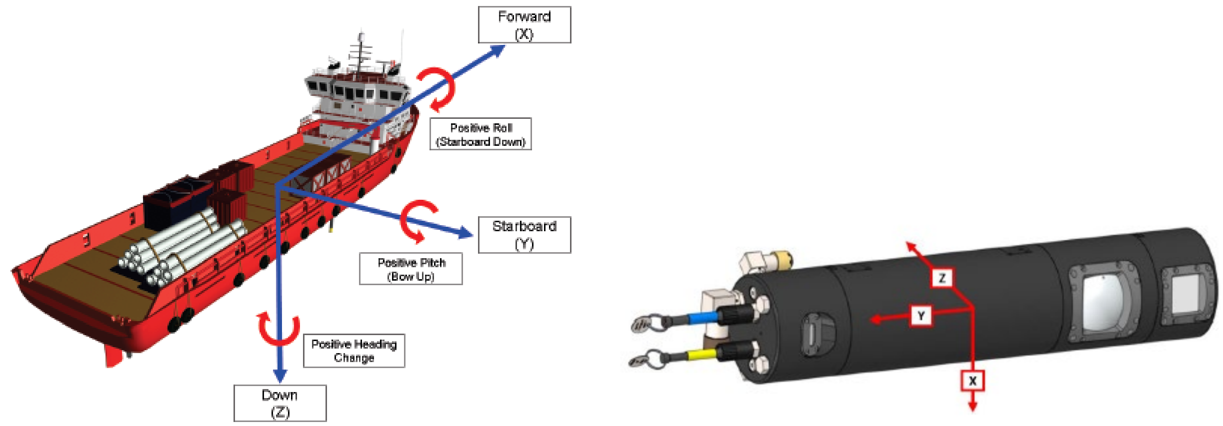

Figure 13: A) INS frame of reference and b) laser frame of reference. Images from the respective manual.

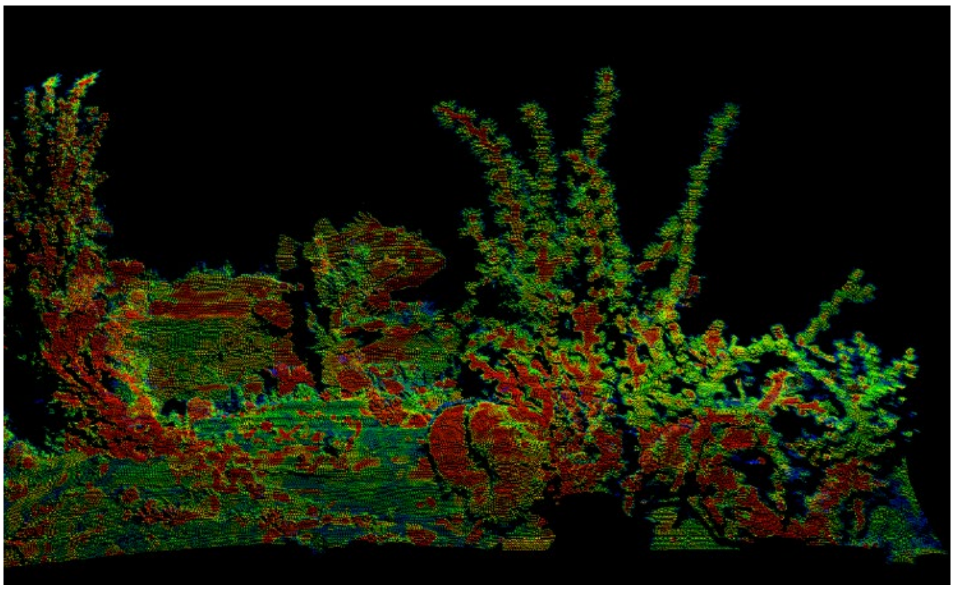

Figure 14: Example of laser data obtained on dive S0578. Colours represent the exposure level (blue: undersaturated, green: correct saturation, red: oversaturated).

5.5.2 Multibeam

A Norbit WBMS multibeam system, provided by the Marine Autonomous and Robotic Systems group at the National Oceanography Centre, UK, was mounted on the ROV for high-resolution mapping of steep, vertical and overhanging terrain. The system is capable of operating at a frequency of 200, 400 and 700 kHz, and with a swath angle up to 160 deg. It has 512 beams that were used in equiangular mode for most of the dives. Integration of the Norbit system on the ROV *SuBastian* was kindly performed by the SOI ROV team.

For most dives, the system was mounted on the light bar on the front of the vehicle, in a fully forward orientation, rotated 90 degrees to port (Figure 15). This configuration did not interfere with the normal video surveys or sampling operations and gave the science team the option to map vertical walls whenever they would be discovered during a dive. In this configuration, mapping is done in parallel, lateral passes at a constant distance from a vertical cliff (in this case mostly 10 or 20m, a balance between safe operation and obtaining sufficient resolution), keeping the heading as constant as possible. Most lines were carried out at constant depth, although for cliffs that were tilted, steps to shallower/deeper depths were needed along the lines to keep the cliff within the swath.

During the dedicated mapping dives, however, when the laser system was used, the Norbit system was mounted on top of the laser (see Figure 11), and surveys were carried out in a conventional way (i.e., flying the ROV forward). Note that in this configuration, the system has a 180° heading offset (i.e., it is mounted back-to-front). The offsets and lever-arms of the Norbit versus the INS of the ROV (and hence the central reference point) are shown in Figure 12 for the laser-mounted set-up, and in Figure 16 for the mount on the light bar.

An overview of the dives during which the Norbit was used, with settings and file names of data stored, is provided in Appendix 5.

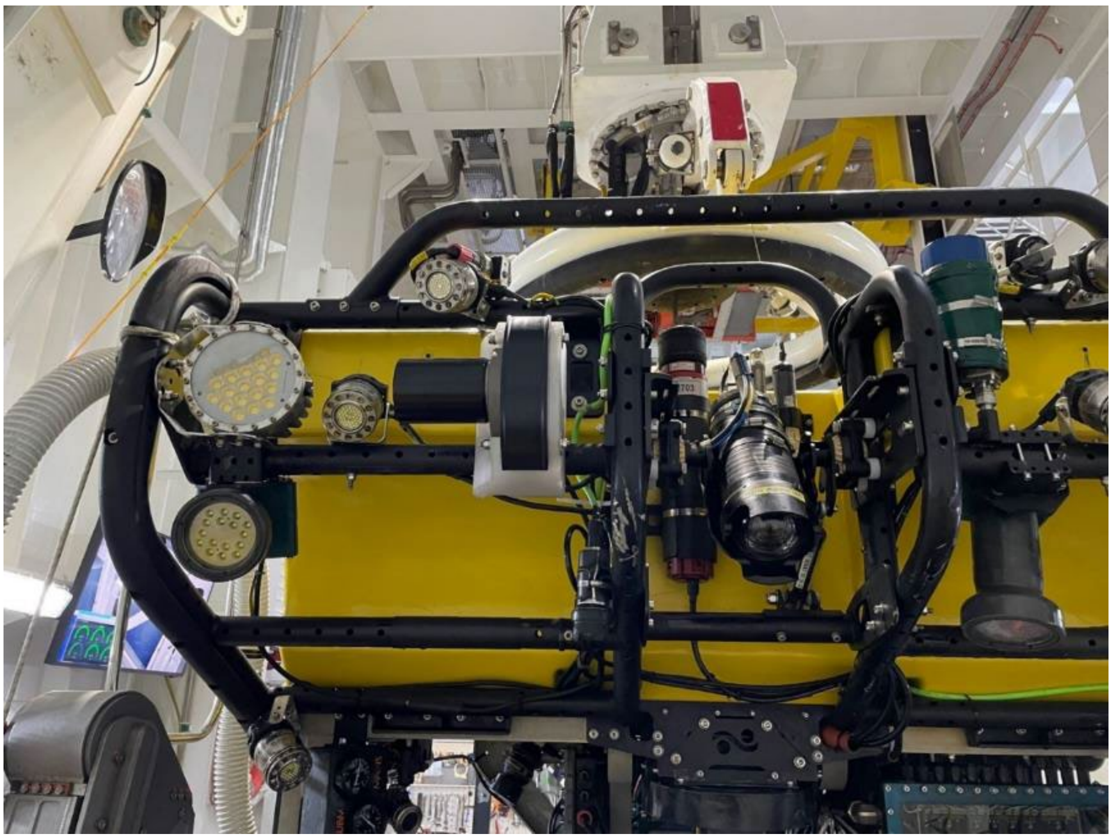

Figure 15: Photograph showing the mounting of the Norbit multibeam system on the front light bar of the SuBastian.

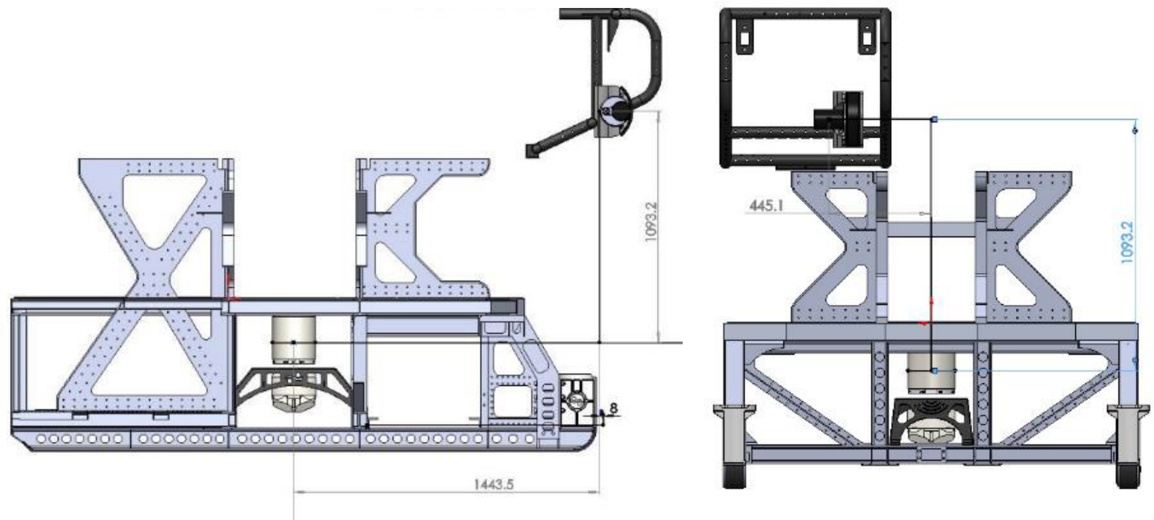

Figure 16: Offsets (lever-arms) of the Norbit multibeam system versus the ROV INS (central reference point) for the forward-looking configuration with the MBES mounted on the light bar. Top: side-view; bottom: frontal view

For data processing the navigation and attitude data from the SprintNav system was used, based on the 'psonav' ASCII outputs. All SprintNav information is provided for the central reference point of the ROV (the INS), hence no further offsets were needed for the depth sensor and the motion sensor during processing. A constant sound velocity was used, as measured by the Norbit system at the transducer. Given that sound velocity changes at depth are minimal, this was considered adequate.

Data processing was carried out in QPS Qimera. For the surveys where the system was mounted together with the laser, a simple pitch offset of was used to compensate for the angle of the bracket (together with the heading offset of 180°). However, for the surveys where the system was mounted on the light bar, rotated to port, a double coordinate transformation (2 x rotation) and double rotation of the attitude information was needed (as described in (*32*)). A bespoke routine in R was used for this, after which the new navigation and attitude data were imported in Qimera and the MBS data were processed in a user-based coordinate system, as if it was recorded in a conventional downward facing set-up. Once processed, the final point clouds/grids were back-rotated/transformed to their correct geographical location and displayed as point clouds. An example of a vertical wall, mapped with the Norbit on the light bar, is presented in Figure 17.

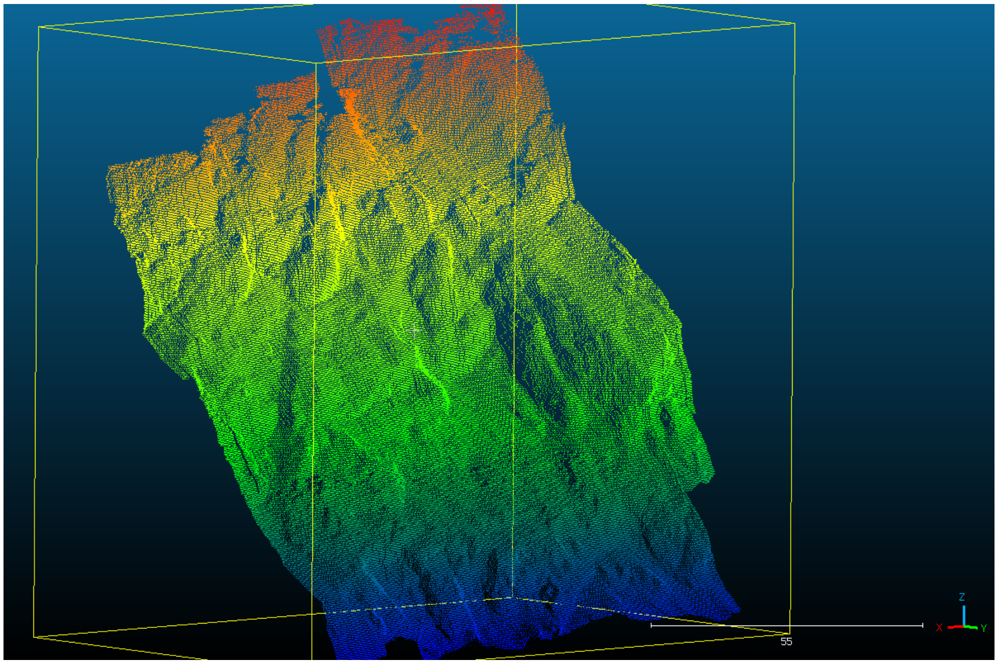

Figure 17: Example of vertical wall, mapped with the forward-facing Norbit configuration. Ca 690m water depth, Dive S0582. Scale bar is 55m.

5.5.3 ADCP

ADCP data were acquired from the ROV *SuBastian* using a Doppler velocity log (DVL) Sonardyne Syrinx integrated into SPRINT Navigation system (Figure 18). Syrinx can be acquired in DVL+ADCP mode, with concurrent ROV DVL navigation and current velocity profiling across the water column in the same system. The emitted frequency of the system is 600 kHz, with up to 2.5 Hz ADCP ping rate. Sonar configuration consisted of a 4-beam array with @ 30° beam angles. Integrated Syrinx - SPRINT INS system data were used to correct ADCP profiles for vessel speed during the acquisition of profiles.

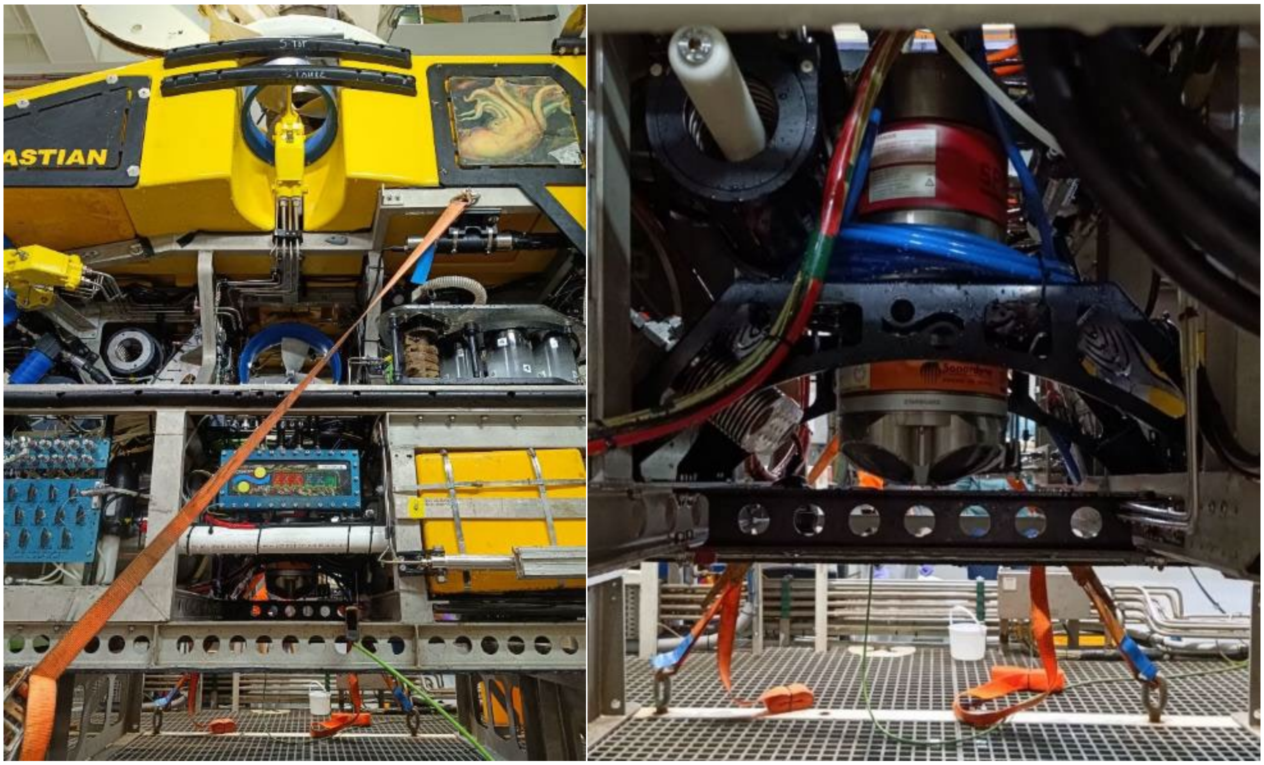

Figure 18: Position of the Doppler velocity log (DVL) Sonardyne Syrinx as mounted on the ROV SuBastian.

The ADCP settings were as following:

Configuration mode: DVL+ADCP
Velocity solution: Automatic
Vehicle Reference frame: Beam
Velocity limit: high
Trigger mode: automatic
DVL max range in m: 100 m
Water track start range in m: 4.6
Water track beam width: 75 m
Sound velocity: manual (1498 m/s)
Number of beams: 150
Beam width (cm): 50
Ensemble to average: 4
Transducer depth: 0 cm
Profile range: 7500 cm

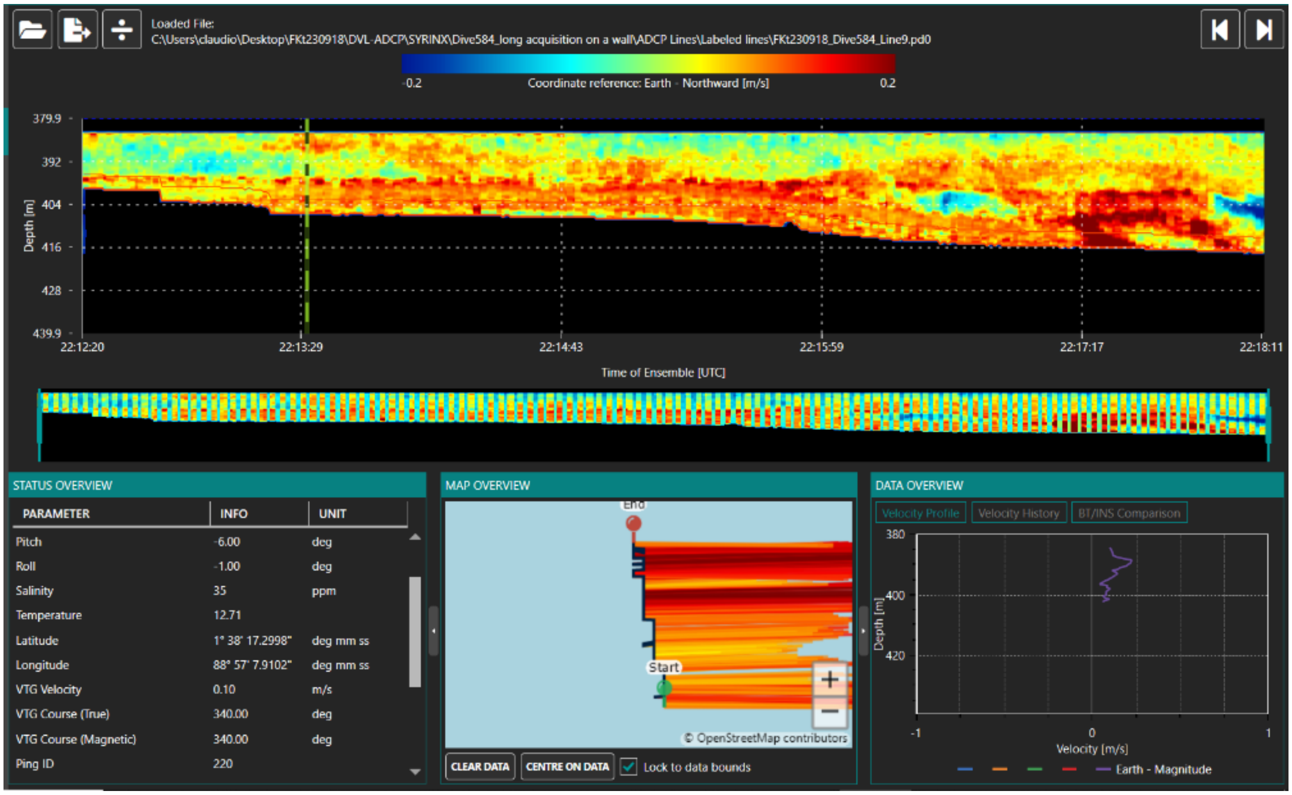

Figure 19: View of the Echo Observer for Syrinx software package used for data acquisition.

The ADCP data uses an extended PD0 format containing acoustic, GPS and inertial data. Data were inspected and exported using the Echo Observer for Syrinx software package (Figure 19). Surveys were carried out during dives 578, 582, 584, 593, and 597 (Appendix 6).

5.5.4 CTD

The ROV *SuBastian* was instrumented with a SBE 49 CTD to monitor environmental conditions during each dive. Temperature and salinity were recorded at 1 Hz and the ROV's geolocation recorded by the Sprint inertial navigation system (constrained by a Paroscientific Digiquartz pressure sensor), also at 1 Hz. Height above bottom was determined by a Sonardyne Syrinx DVL, although this system was not working properly on several dives. The data were postprocessed by averaging (median value) longitude, latitude, depth, height above bottom, in-situ temperature, practical salinity, and pressure in 10-second bins. In addition, the same properties (excluding depth, but including time) were averaged (median value) in 10-m bins to create depth profiles. Descent and ascent phases of the dive were depth-binned separately because typically they are considerably separated in both space and time. Derived properties, including conservative temperature, absolute salinity, and potential density, were calculated using the TEOS-10 Gibbs-SeaWater toolbox. Example CTD timeseries and profiles from an ROV dive are shown in Figure 20.

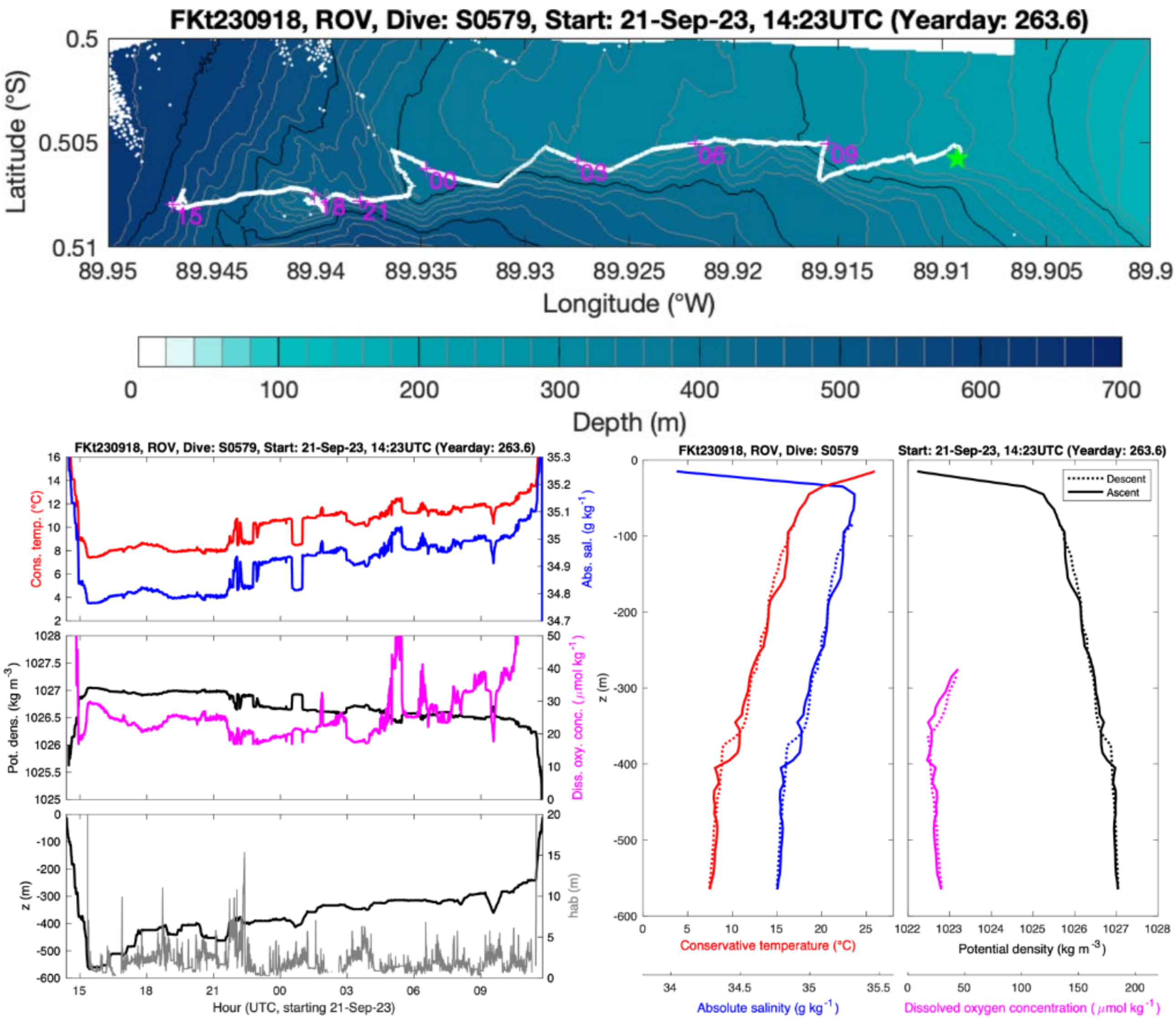

Figure 20: Example diagnostic figures of the ROV SuBastian CTD data: Dive S0579. Map of ROV path over multibeam bathymetry. Timeseries of conservative temperature, absolute salinity, potential density, dissolved oxygen concentration proxy, depth of ROV and height of ROV above bottom. Profiles of conservative temperature, absolute salinity, potential density, dissolved oxygen concentration proxy, for both the descent and ascent phases of the dive.

In the absence of a dissolved oxygen sensor on the ROV, a proxy for dissolved oxygen concentration proxy was calculated from potential density by assuming a constant relationship. Potential density was used as the predictor variable because, unlike depth, it follows the vertical advection by internal waves and other hydrodynamic processes. A relationship between dissolved oxygen concentration ($[O_2]$) and potential density (ρ) was determined for each of two sets of ship CTD profiles (those east of Isabela and those west of Isabela), after the data was averaged into 0.1 kg m^{-3} bins (Figure 21). Cubic equations were found to be the lowest order that gave a reasonable fit to the data between potential density limits (1026.4 and 1027.3 kg m^{-3}),

East: $[O_2] = -3.619x^3 + 12.70x^2 + 8.937x + 18.10,$ where $x = (\rho - 1026.85)/0.2739$

West: $[O_2] = -3.141x^3 + 14.79x^2 + 14.99x + 15.88,$ where $x = (\rho - 1026.85)/0.2739$

The equations were then applied to the relevant ROV potential density timeseries, between the same limits, to yield a proxy for dissolved oxygen concentration.

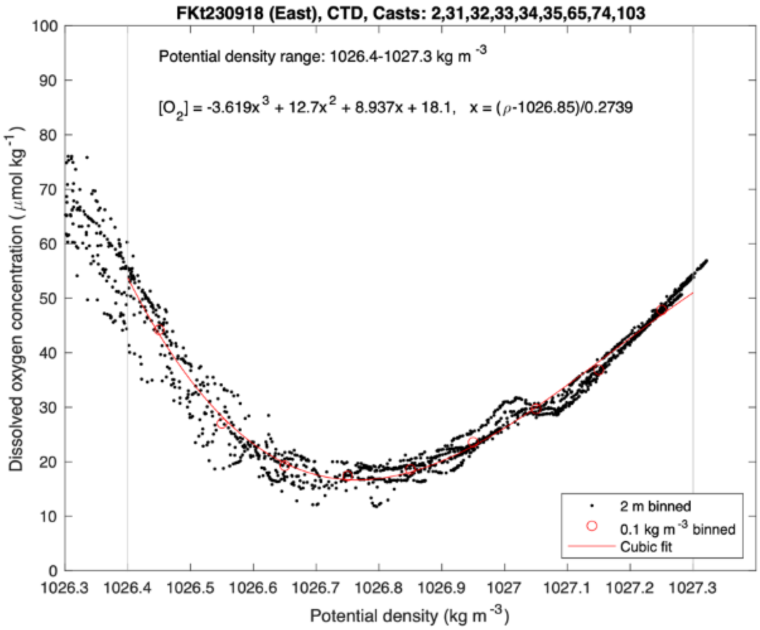

Figure 21: Relationship between potential density and dissolved oxygen concentration on the east of Isabela, along with the cubic line of best fit between 1026.4 and 1027.3 kg m⁻³.

Postprocessed ROV CTD data were saved as a .mat file (fkt230918_sxxxx_rovctd_10s_10m_binned.mat, where xxxx is dive number) and the timeseries also saved as a .csv file (fkt230918_sxxxx_rovctd_10s_binned.csv) with the following variables in the stated units:

Date		dd/mm/yyyy
Time	UTC	HH:MM:SS
Longitude	°E	Decimal degrees (negative west)
Latitude	°N	Decimal degrees (negative south)
Depth	m	Positive downwards (zero at surface)
Height above bottom	m	Positive upwards (zero at the seabed)
In-situ temperature	°C	
Practical salinity	PSU	
Pressure	dbar	
Absolute salinity	g kg^{-1}	
Potential temperature	°C	
Conservative temperature	°C	
In-situ density	kg m^{-3}	
Potential density	kg m^{-3}	
Dissolved oxygen concentration proxy	μmol kg^{-1}	

5.6. MISO Cameras

WHOI MISO imaging systems have been utilized on ROV deployments during the Fkt230918 expedition study area on and around the Galápagos Platform. On all ROV dives (except mapping dives when the laser and multibeam sensors were used), *SuBastian* was equipped with two MISO

GoPro cameras (Figure 22). One is a MISO GoPro (Hero 11 module) forward-looking brow camera, mounted on the starboard side upper rails (below the lights), capturing 23MP still images every 5 seconds of the work area in front of the ROV. The second camera is a MISO-OIS GoPro 5.3K cinematic video camera (Hero11 module) mounted on the front of the ROV basket, either fixed mounted or on a small 'selfie lander', that could be deployed on the seafloor to take video of seafloor scenes with the ROV operating. Both are self-contained, no power was required from the ROV and the system is fixed focus with a range of ~0.25m to infinity. Additionally, a MISO imaging elevator/lander with lights, power and switching capability as well as a front-mounted MISO GoPro camera (Hero11) was also available for more extensive imaging of the ROV at depth (Figure 23). This lander was only used once at the beginning of the expedition during dive S0586.

Total volume of both video and still MISO imagery collected during Fkt230918 is just under ~15TB. All imagery and video files were renamed to the creation date of acquired imagery to match UTC navigation for the vehicle, with a suffix that included the expedition name and dive number and a suffix labeled "-Processed".
Each dive's MISO imagery is contained in a directory with the following naming structure:

Fkt230918-S0595_MISO-Brow23MP-Processed
Fkt230918-S0595-MISO-5.3K-Basket-Processed

Highlights for each camera system kept the original name and are in a separate "Highlights" directory for each dive.

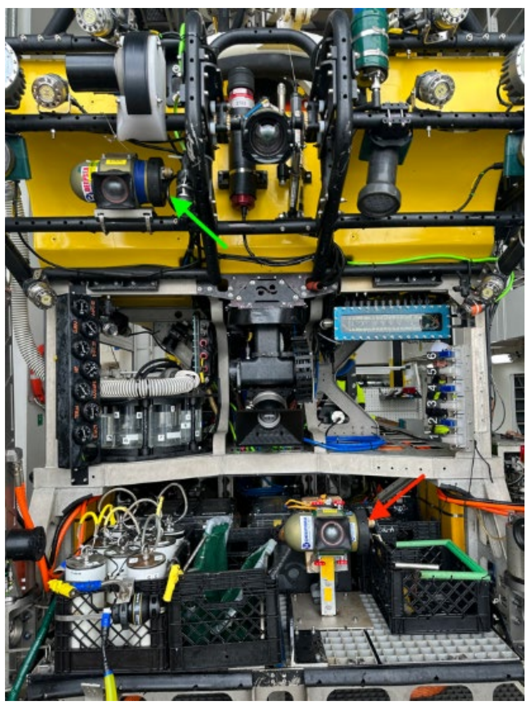

Figure 22: MISO GoPro cameras used on ROV SuBastian on Fkt230918. The Hero 11 cameras were set up to record 5.3k video at 30fps with automatic exposure and ISO range of 100-800 and 23MP with the same ISO range for the upper still-camera looking at the work area in front of the ROV which was taking pictures every 5 sec throughout the dive. Red arrow points to MISO GoPro 5.3k video camera, green arrow points to MISO GoPro 23MP digital still camera.

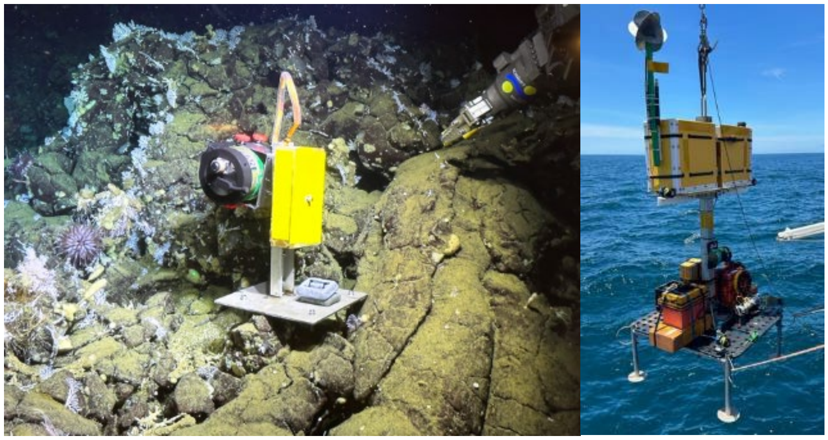

Figure 23: (left) MISO 'selfie-stand' deployed during some of the later dives on Fkt230918 that acquired 5.3k cinematic video. (right) Imaging elevator assembled with MISO floatation, power, lighting, and cameras for the Fkt230918 expedition.

5.7. Current meter deployments

Two TCM-3 tilt current meters depth rated to 4000m, donated to CDRS by Lowell Instruments and WHOI (refurbished) were deployed during ROVS0579 at the northern base across an extensive fossil coral rubble, and upper *Madrepora*-lined ridge of the Cacho de Coral seamount. Recovery of both instruments is scheduled for the 16-17th November 2023 as part of the subsequent Fkt231024 expedition led by Dr John Jamieson. Current meter #1 was installed at 561m depth on exposed slope at base of feature in dense fossil coral rubble field while current meter #2 was installed upslope at 409m depth along the northern edge of the NW ridge crest in dense living *Madrapora* reef framework (Table 12, Figure 24).

Table 12: TCM-3 tilt current meters deployment locations

Dive	Date	Time (UTC)	Event #	Equipment	Vehicle depth (m)	Latitude	Longitude
S0579	2023-09-21	15:31:17	1	Current Meter 1 (2 reflective stripes)	560.66	-0.50806	-89.9464
S0579	2023-09-21	18:48:43	10	Current Meter 2 (2 reflective stripes + Duct tape band)	408.67	-0.50784	-89.9399

Both current meters are tethered to two dive weights and have 2 bands of reflective tape on the upper part of the tilt sensor. Sensors are synced to UTC ship time and configured for 8 Hz burst sampling averaged over 20 seconds/ min for approx. 12-month run-time recording both current magnitude, vector components and temperature.

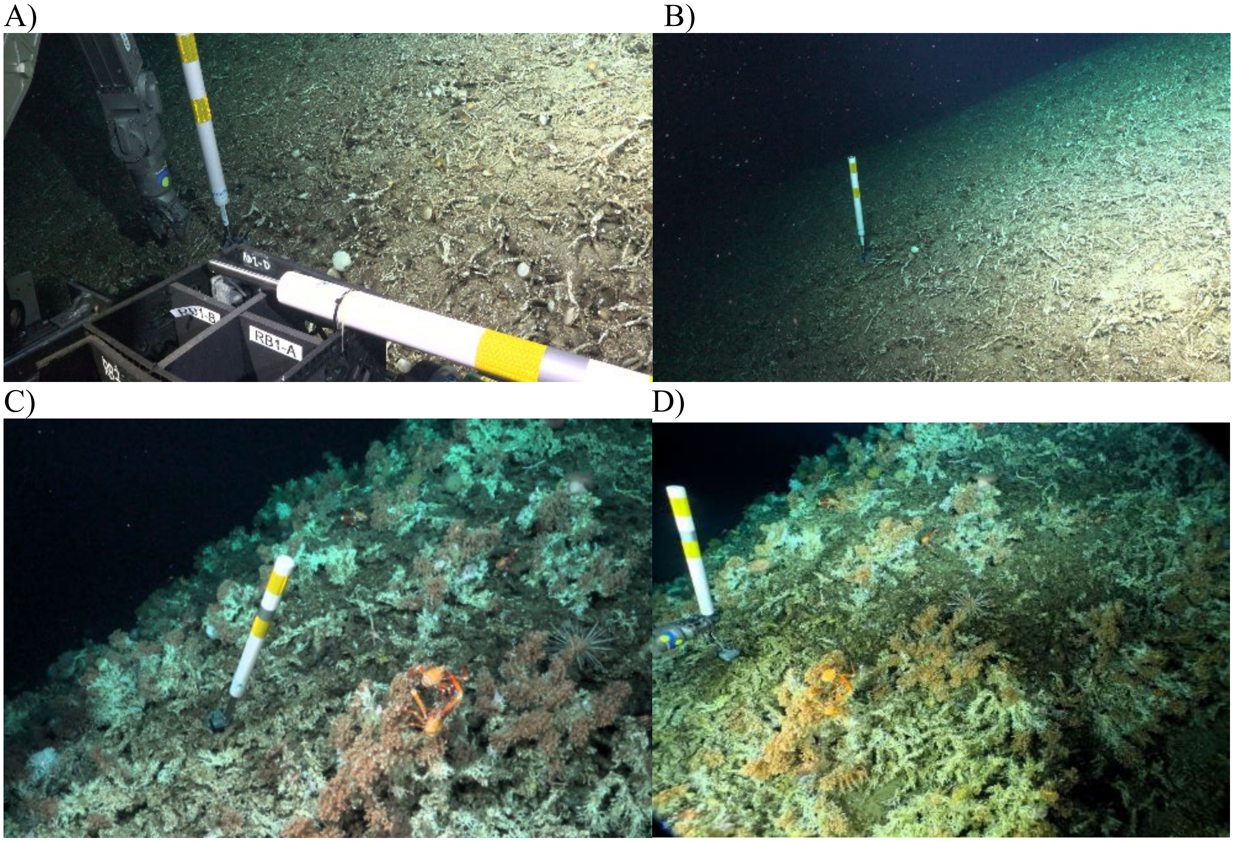

Figure 24: Tilt current meters deployed during ROVS0579 on the Cacho de Coral seamount, A-B) Current meter #1, C-D) Current meter #2.

5.8. CTD operations

Water column observations were made with a Sea-Bird Electronics (SBE) 911plus CTD rosette deployed from the port side J-frame (Figure 25). Core sensors were twin pumped temperature (SBE 3plus), conductivity (SBE 4C), and dissolved oxygen (SBE 43). In addition, the rosette was equipped with a WETLabs ECO FLNTU fluorometer/scattering meter, a WETLabs C-Star transmissometer, and a pair of Seapoint turbidity sensors. A Valeport VA500 altimeter was used to safely guide the rosette to within 10 m of the seabed during most casts. See Table 13 for the serial number and calibration date of each sensor. for A Sonardyne USBL transponder allowed accurate subsurface positioning and facilitated operation of the CTD during ROV dives. No water samples were collected.

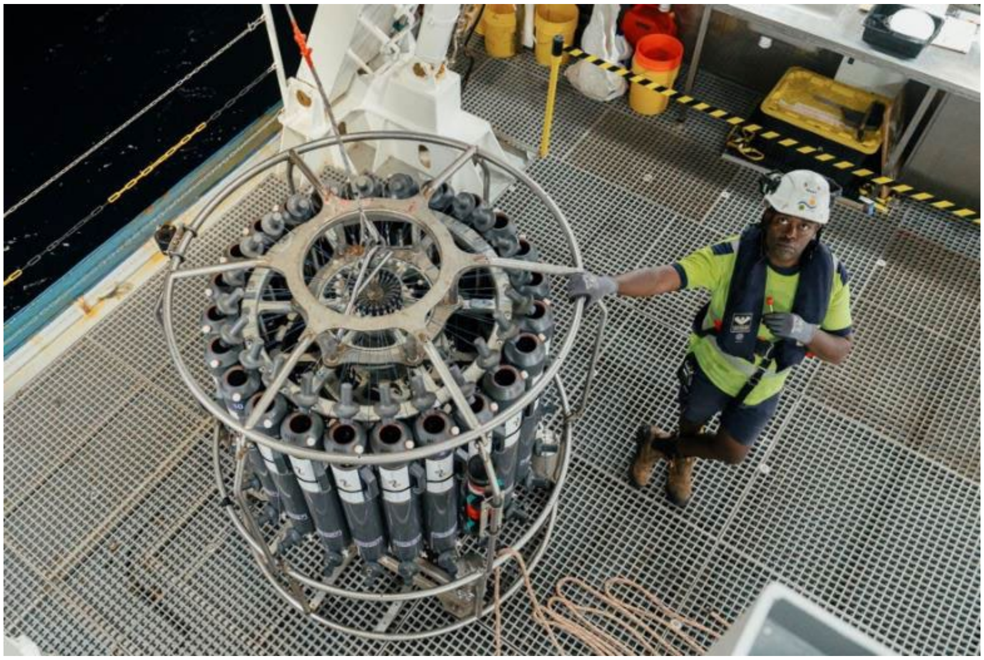

Figure 25: The CTD rosette about to be deployed from the port side J-frame. *Photo: Misha Vallejo Prut.*

Table 13: CTD sensor serial numbers and calibration dates.

Sensor	Serial number	Calibration date
SBE 9plus (pressure sensor)	1088	2 May 2022
SBE 3plus (temperature sensor 1)	5549	22 Mar 2022
SBE 3plus (temperature sensor 2)	5483	20 Mar 2022
SBE 4C (conductivity sensor 1)	3916	11 Mar 2022
SBE 4C (conductivity sensor 2)	4003	11 Mar 2022
SBE 43 (dissolved oxygen sensor 1)	3280	3 Mar 2023
SBE 43 (dissolved oxygen sensor 2)	2330	1 Feb 2023
WETLabs ECO FLNTU (fluorometer/scatter)	2578	1 Mar 2022
WETLabs C-Star (transmissometer)	2178	8 Feb 2022
Seapoint (turbidity meter 1)	15104	-
Seapoint (turbidity meter 2)	13277	-
Valeport VA500 (altimeter)	74033	16 Mar 2022

15 individual CTD casts were completed at unique stations (Figure 3; Table 14). With the exception of the cast 1 (a deep-water test cast), each CTD cast was located close to the start of an ROV dive in order to accurately measure the background hydrography and environmental conditions, specifically the depth of the oxygen minimum zone. In most instances, the CTD cast took place immediately before the ROV deployment (with 1 km and 1 hour). This effort was particularly valuable because the ROV was not equipped with a dissolved oxygen sensor. Thus, the depth of the oxygen minimum zone was identified in advance from the CTD profile and used to guide the biological sampling. An example CTD cast that features a defined oxygen minimum zone is shown in Figure 26.

In addition, 12.5-hour CTD yo-yo timeseries were completed at stations 17 (YoYo1), 47 (YoYo2), and 111 (YoYo3). During this mode of operation, the rosette is profiled up and down through the water column repeatedly at the same station, without bringing it on deck, to yield a timeseries of full-depth hydrographic profiles over a complete semidiurnal tidal cycle. Yo-yo CTD operations were only undertaken during the ROV mapping dives because the vessel was essentially stationary. As well as being easier and safer from a dual operations point of view, stationary vessel allows the CTD data to be interpreted as a fixed point timeseries. At all three yo-yo stations >25 casts over the 12.5 hours were completed, more than enough to robustly resolve the likely dominate semidiurnal internal tide (M_2, period: 12.42 hours). A visualisation of the potential density and dissolved oxygen concentration timeseries from CTD YoYo1 is shown in Figure 27 and suggests the presence of a semidiurnal internal tide with a vertical isopycnal displacement amplitude of order 50 m.

Table 14: Summary of CTD casts.

Stn no.	Cast no.	Latitude & longitude	Start & end date, time (UTC)	Max. depth (m)	Bathy. depth (m)	Comments
013	001	0.2997°S 88.8515°W	20 Sep, 02:35 20 Sep, 04:22	2085	2106	Deep-water test cast *Transmissometer bad*
017	002-030	0.5187°S 89.9147°W	20 Sep, 17:15 21 Aug, 05:50	~480	~500	During ROV dive S0578, 12.5-h CTD yo-yo (YoYo01): 29 casts
026	031	0.5685°S 89.9292°W	23 Sep, 11:56 23 Sep, 12:36	711	716	3 hours after ROV dive S0580 (starting location)
031	032	1.0733°S 88.9557°W	25 Sep, 01:26 25 Sep, 02:14	875	890	Immediately before ROV dive S0581
034	033	0.9773°S 88.9178°W	25 Sep, 19:17 25 Sep, 20:01	726	745	Immediately before ROV dive S0582
040	034	0.9346°S 88.9301°W	27 Sep, 14:37 27 Sep, 15:24	823	840	Immediately before ROV dive S0583 *Transmissometer bad*
047	035-060	0.9701°S 88.9515°W	28 Sep, 14:25 29 Sep, 02:47	~420	~430	During ROV dive S0584, 12.5-h CTD yo-yo (YoYo02): 30 casts
056	065	0.5142°S 90.1635°W	30 Sep, 16:18 30 Sep, 17:01	875	882	Four hours before ROV dive S0585
069	066	0.2872°N 91.6525°W	2 Oct, 20:24 2 Oct, 21:13	1048	1062	Immediately before ROV dive S0587
076	067	0.0413°N 91.6105°W	3 Oct, 20:48 3 Oct, 21:39	1147	1154	Immediately before ROV dive S0588 *Transmissometer bad*
079	068	0.2465°S 91.6749°W	4 Oct, 13:49 4 Oct, 15:30	2242	2248	Immediately before ROV dive S0589 *Transmissometer bad* *Both Seapoints bad*
86	069	0.5066°S 91.5959°W	6 Oct, 01:48 6 Oct, 02:24	615	647	Immediately before ROV dive S0591
87	070	0.2935°S 91.6679°W	6 Oct, 17:24 6 Oct, 17:55	572	571	Immediately before ROV dive S0592
96	071	1.0021°S 91.4650°W	7 Oct, 15:25 7 Oct, 16:10	906	917	Immediately before ROV dive S0593
103	072	1.0988°S 90.8662°W	7 Oct, 17:51 7 Oct, 18:21	578	600	Immediately before ROV dive S0595
108	073	1.0850°S 91.1679°W	9 Oct, 15:26 9 Oct, 15:56	602	833	Partial-depth cast during ROV dive 596
111	074-102	0.5085°S 89.9414°W	10 Oct, 15:09 11 Oct, 03:43	~425	~435	During ROV dive S0597, 12.5-h CTD yo-yo (YoYo03): 26 casts (excl. mini-yo-yos)
-	084	0.5081°S 89.9404°W	10 Oct, 19:14 10 Oct, 20:05	80	-	Mini-yo-yo to 80 m: 10 sub-casts (single data file)
-	090	0.5080°S 89.9408°W	10 Oct, 21:49 10 Oct, 22:38	80	-	Mini-yo-yo to 80 m: 10 sub-casts (single data file)
-	095	0.5077°S 89.9409°W	11 Oct, 00:20 11 Oct, 01:10	80	-	Mini-yo-yo to 80 m: 10 sub-casts (single data file)
116	103	0.4877°S 89.8724°W	11 Oct, 22:03 11 Oct, 22:28	447	455	Two hours after ROV dive S0599 (starting location)
121	104	5.00255°S 87.46023°W	15 Oct, 16:16 15 Oct, 16:51	696	730	Costa Rica
124	105	5.06612°S 87.66490°W	16 Oct, 11:00 16 Oct, 11:39	612	684	Costa Rica

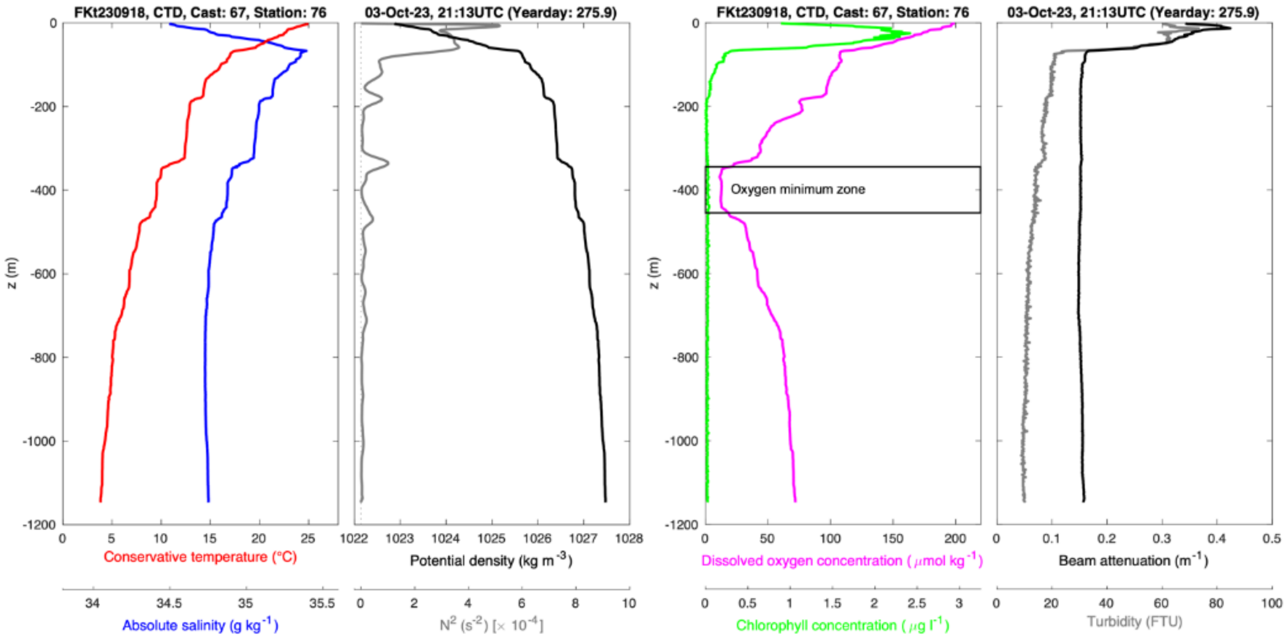

Figure 26: Example hydrographic, dissolved oxygen, and optical profiles: CTD cast 67 (station 76). Note the defined oxygen minimum zone between 350 m and 450 m.

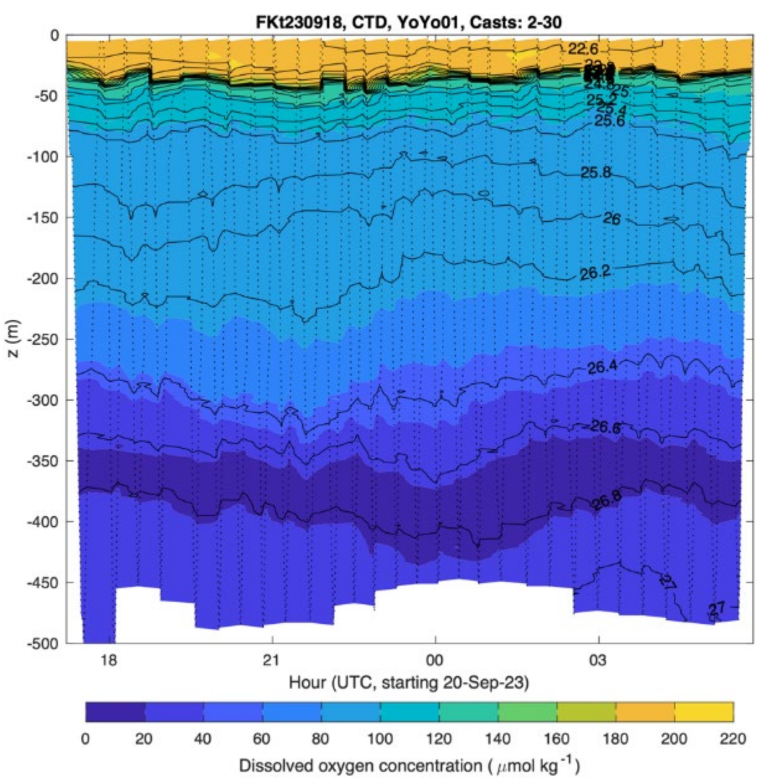

Figure 27: Dissolved oxygen concentration (colour contours) and potential density (black contours) timeseries from CTD YoYo1.

5.8.1 CTD data processing

All CTD sensors recorded at 24 Hz and the data logged using SBE Seasave software. The raw data from each cast were saved as a binary .hex file (FKt230918_CTD_xxx.hex, where xxx is cast number). Each cast (both down-cast and up-cast) was processed using SBE Data Processing software package in the following order. The programme setup file (.psa) for each stage is in brackets.

1) **Data Conversion** (FKt230918_CTD_DatConv.psa) – Convert to ASCII format .cnv file
2) **Filter** (FKt230918_CTD_Filter.psa) – Low-pass filter pressure (0.15-second cutoff)
3) **Align CTD** (FKt230918_CTD_AlignCTD.psa) – Advance dissolved oxygen (4 seconds).
4) **Cell Thermal Mass** (FKt230918_CTD_CellTM.psa) – Cell thermal mass correction (α = 0.03, 1/β = 7)
5) **Loop Edit** (FKt230918_CTD_LoopEdit.psa) – Flag pressure loops (minimum CTD velocity = 0.1 m s^{-1}, surface soak depth = 10 m)
6) **Derive** (FKt230918_CTD_Derive.psa) – Re-calculate depth, practical salinity, dissolved oxygen concentration, and dissolved oxygen saturation using EOS-80.
7) **Strip** (FKt230918_CTD_Strip.psa) – Remove old variables.

The full-resolution (24 Hz) data were saved as a .cnv file (FKt230918_CTD_xxx_FilterP_AlignDO_CTM_FlagLoops_Derive.cnv).

8) **Bin Average** (FKt230918_CTD_BinAve.psa) – Average all variables in 0.5-second bins.

The binned (2 Hz) data were also saved as a .cnv file (FKt230918_CTD_xxx_FilterP_AlignDO_CTM_FlagLoops_Derive_2Hz.cnv).

Notes on turbidity and transmissometer data

1) The scatter/turbidity channel of WETLabs ECO FLNTU fluorometer is considered bad. The measured values are order 0.05 NTU, close to the precision limit of the sensor. This channel was processed, but not postprocessed.

2) The SBE C-Star transmissometer developed a pressure dependant drift during deeper casts. When the rosette reached a depth of several hundred metres during the downcast, beam attenuation would start increasing progressively. Then during the up-cast, beam attenuation would stay unusually high before returning the background value at a depth shallower than the initial deviation. This pattern was not reflected in the profiles from the pair of Seapoint turbidity sensors. Casts with transmissometer issues are identified in Table 14.

3) The pair of Seapoint turbidity sensors were noisy but performed consistently for the duration of the cruise. The main exception is cast 68. At approximately 1700 m during the down-cast, both sensors started recording erratic turbidity values into the hundreds of FTUs and continued recording high, and highly variable, values for the whole up-cast. This pattern was not reflected in the beam attenuation profile from the transmissometer. Both turbidity sensors were cleaned upon recovery and consistent performance returned the following cast.

Issues (2) and (3) have not been removed from the postprocessed dataset.

5.8.2 CTD data postprocessing

For scientific analysis and cruise planning purposes, the full-resolution (24 Hz) CTD data were averaged (median value) in 2-m bins. Down- and up-casts were binned separately to maximise the temporal resolution for internal tide observations. The average time of each bin was retained, rather than assuming a fixed time for the whole cast, to allow accurate harmonic analysis on each depth level. Cast-averaged CTD profiles (i.e. down- and up-casts combined) were also calculated for conventional plotting. Derived properties, including conservative temperature, absolute salinity, and potential density, were calculated using the TEOS-10 Gibbs-SeaWater toolbox (https://www.teos-10.org/software.htm).

For variables with twin sensors (temperature, conductivity/salinity, dissolved oxygen concentration, and turbidity from the Seapoint sensors) the primary sensor was used. There was no significant difference between the primary (1) and secondary (2) temperature and conductivity sensors. For dissolved oxygen, the secondary had a larger deviation between down- and up-casts and was typical 10-15 μmol kg^{-1} lower than the primary in the surface layer. The primary sensor was chosen because it was closer to 100% saturation at the surface. For turbidity, the secondary sensor was offset by +2 FTU from the primary, but this was small compared to the range (~100 FTU). In the absence a physical justification, the primary sensor was chosen.

Postprocessed CTD data were saved as a .mat file (fkt230918_castxxx_ctd_2m_binned.mat) and the down-cast also saved as a .csv file (fkt230918_castxxx_ctd_2m_binned.csv) with the following variables in the stated units:

Date		dd/mm/yyyy
Time	UTC	HH:MM:SS
Longitude	°E	Decimal degrees (negative west)
Latitude	°N	Decimal degrees (negative south)
Depth	m	Positive downwards (zero at surface)
In-situ temperature	°C	
Practical salinity	PSU	
Dissolved oxygen concentration	μmol kg^{-1}	
Chlorophyll concentration	μg l^{-1}	
Beam transmission	%	
Beam attenuation	m^{-1}	
Turbidity	FTU	
Pressure	dbar	
Absolute salinity	g kg^{-1}	
Potential temperature	°C	
Conservative temperature	°C	
In-situ density	kg m^{-3}	
Potential density	kg m^{-3}	

5.9. Shipboard equipment

5.9.1 Shipboard ADCP

The RV *Falkor (too)'s* hull-mounted ADCPs, an RDI Ocean Surveyor 38 kHz and an RDI Workhorse 300 kHz, were run almost continuously for the duration of the cruise using the University of Hawaii Data Acquisition System (UH DAS). The 38 kHz was operated in both broadband and narrowband mode in parallel. During specific multibeam surveys, the ADCPs were occasionally turned off because they caused some interference. Data quality was monitored daily using 5-minute ensembles in 12-m and 24-m bins (75 kHz, broadband and narrowband, respectively) and 2-minute ensembles in 2-m bins (300 kHz), as output by UH DAS in NetCDF format. Data quality and range were good throughout the cruise, the 38 kHz typically yielding high-quality data to 800-1000 m (where depth allowed) and the 300 kHz to approximately 100 m.

The 38 kHz revealed the highly layered structure of the upper water column and semidiurnal tidal variability Figure 28. The 300 kHz revealed strong wind-driven surface currents. As the ship stayed roughly on-station during ROV dives, which typically lasted 12+ hours, the shipboard ADCP timeseries during dives provided a good indicator of the tidal and residual current structure and magnitude (e.g., Figure 28). This information was very helpful for the ROV operations. Three specific ADCP surveys were also undertaken, two around Cacho de Coral (29/09/2023, 17:55 to 30/09/23, 01:45 UTC and 11/10/2023, 23:25 to 12/10/2023, 07:25) and one around Roca Redunda (02/10/2023, 18:10 to 19:35 UTC).

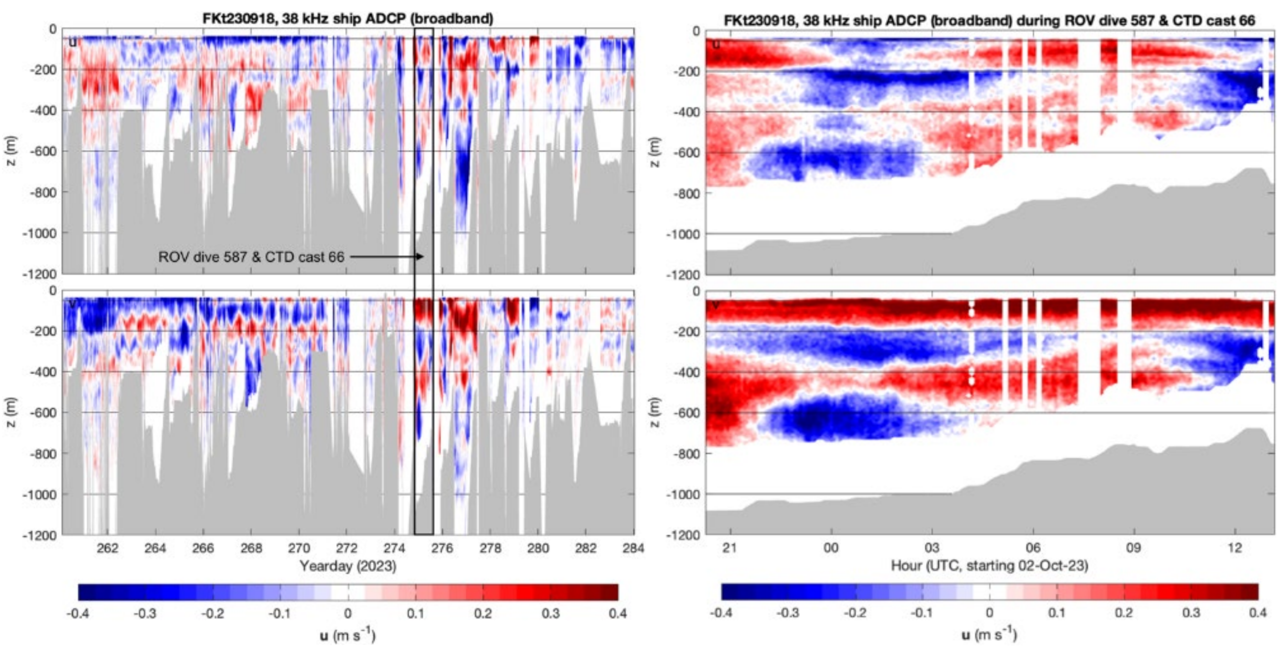

Figure 28: 38 kHz broadband shipboard ADCP timeseries for the duration of FKt230918 (left panels) and in detail during ROV dive 587 and CTD cast 66 (right panels).

5.9.2 Underway system

The RV Falkor (too)'s underway system consisted of twin SBE 45 thermosalinographs, twin WETLabs ECO FL fluorometers, twin SBE C-star transmissometers, twin SBE 38 external temperature sensors, twin Valeport miniSVS sound velocity sensors, and a Sunburst ATF pH sensor. See Table 15 for the serial number and calibration date of each sensor. Only data from the primary (1) thermosalinograph and secondary (2) WETLabs ECO FL were postprocessed, along with meteorological data from a Paroscientific Met4 weather station and a Gill anemometer. There was no significant difference between the primary (1) and secondary (2) thermosalinographs, but the primary fluorometer timeseries featured occasional unphysical jumps. Both transmissometers were compromised by rapid build-up of algae and so had considerable drift. Data from the pH sensor will need correcting for salinity as it was using a default value of 35 PSU.

Table 15: Underway sensor serial numbers and calibration dates.

Sensor	Serial number	Calibration date
SBE 48 (thermosalinograph 1)	0402	21 Mar 2022
SBE 48 (thermosalinograph 2)	0421	21 Mar 2022
WETLabs ECO FL (fluorometer 1)	7473	1 Apr 2022
WETLabs ECO FL (fluorometer 1)	7493	12 Apr 2022
WETLabs C-Star (transmissometer 1)	1476	24 Mar 2022
WETLabs C-Star (transmissometer 2)	1817	13 Apr 2022
SBE 38 (external temperature sensor 1)	1301	13 Oct 2022
SBE 38 (external temperature sensor 2)	1302	13 Oct 2022
Valeport miniSVS (sound velocity sensor FWD)	35831	15 Mar 2022
Valeport miniSVS (sound velocity sensor AFT)	44486	22 Feb 2022
Sunburst ATF (pH sensor)	AP0036	26 Apr 2022

Data from all the underway sensors were logged by the vessel data acquisition system (RVDAS) at 1 Hz, with the exception of the pH sensor (15 minutes). During postprocessing, daily timeseries from the chosen sensors were averaged (median value) in 10-second bins. Derived properties, including conservative temperature, absolute salinity, and potential density, were calculated using the TEOS-10 Gibbs-SeaWater toolbox. The postprocessed underway CTD and meteorological timeseries were saved as series of .mat files (fkt230918_ydayxxx_uwctdmet_10s_binned.mat, where xxx is yearday) and also .csv files (fkt230918_ydayxxx_uwctdmet_10s_binned.csv) with the following variables in the stated units:

Date		dd/mm/yyyy
Time	UTC	HH:MM:SS
Longitude	°E	Decimal degrees (negative west)
Latitude	°N	Decimal degrees (negative south)
In-situ temperature	°C	
Practical salinity	PSU	
Chlorophyll concentration	$\mu g\ l^{-1}$	
Pressure	dbar	Constant zero
Absolute salinity	$g\ kg^{-1}$	
Potential temperature	°C	
Conservative temperature	°C	
In-situ density	$kg\ m^{-3}$	
Potential density	$kg\ m^{-3}$	
Air pressure	hPa	
Air temperature	°C	
Humidity	%	
Wind u	$m\ s^{-1}$	Positive TOWARDS east
Wind v	$m\ s^{-1}$	Positive TOWARDS north

5.9.3 Multibeam

Shipboard multibeam data were acquired using hull mounted shipboard systems EM712 and EM124. For dedicated and shallow water surveys the EM712 was used, whilst the EM124 was used for deeper waters (Table 16). Survey lines were planned to complement existing bathymetry and survey upcoming ROV dive areas in higher resolution. XBT profiles were input into each system as required. We conducted several surveys (surrounding Santa Cruz, Redonda Rock, El Muñeco, Fernandina and Isabela) that approached islands or rocks which had not previously been surveyed. In these situations, a cautious approach was taken, whereby the ship would sail in previously surveyed waters, fully opening beams to the shoaling side and then progressing into these mapped waters. For higher resolution surveys over upcoming ROV dives, a beam angle of 40/40 was used to increase ping density over the features. A total area of 5660 km^2 was mapped using the shipboard multibeam echosounders (Figure 29). The data was processed in Qimera v2.5.3, removing noise, applying tide and exporting as .tif or .xyz grids of 5, 10, 25 and 50m resolution, depending on depth and beam angle. The .xyz files were imported to Fledermaus v7.8.11 and exported as .sd files.

Table 16: Multibeam echosounder files from each shipboard system for the survey areas.

Site	Files		Comment
	EM124	E712	
Transit 0		0-6	
Cacho de Coral		7-25 40-55 68-79	40/40 beam angle for higher resolution
ROV0579 Cacho de Coral		56-67	40/40 beam angle for higher resolution
Transit 1	1-9	26-33	40/40 beam angle for higher resolution
Seamount 1	10-28		
Transit 2	29-37		
Seamount 2	38-70	34-39	
Transit 3	71-96		
Transit 4	97-118		
Seamount 3, TGT4	119-231 (excl. 130, 177)	88,90,91,93	
Fault Survey		103-112	40/40 beam angle for higher resolution
Transit 5	232-251		
ROV0581 and 0583		113-128	40/40 beam angle for higher resolution
Transit 6	252-267	129-135	40/40 beam angle for higher resolution
ADCP Star	268-285		
Santa Cruz Northeast Bay		136-190	60/70 beam angle to approach coast
Transit 7	289-307	195-220	
Roca Redunda		221-245	60/70 beam angle to approach rock
Transit 8	308-311		
El Muneco		248-262	60/70 beam angle to approach coast
Transit 9	312-317		
Fernandina		264-297	60/70 beam angle to approach coast
Transit 10	318-323	303-325	
Transit 11	326-327	326-354 (excl. 330)	
Transit 12		357-376	
Transit 13		379-400	
Transit 14		400-417	

Although multiple multibeam surveys took place during FKt20231809, two specific areas included multi-day surveys, the Cacho de Coral seamount and a large seamount complex east of San Cristobal. The former is a ~10 km diameter volcano with a breached caldera (open to the south) that is ~6 km in diameter and with ~300-400 m of relief below the summit on the northernmost edge of the caldera rim to the caldera floor. Large areas on the northern and to a lesser extent southern rim of the caldera shoulder are covered with live and dead coral reef material, first discovered on Alvin dive 5162, and significantly expanded upon with the ROV *SuBastian* dives. The area east of San Cristobal Island (~40 km from the island) and contains at least four primary seamounts which have grown together to form a roughly polygonal volcanic structure covering an area of ~25 km E-W and ~15 km N-S. The shallowest peaks rise to ~120 m and the basal contour is at ~950 m on the eastern flank and likely shallower on the western side (~750 m depth), although the west side of the complex was not able to be completely mapped. The largest seamount is on the west side of the study area and covers ~60 km^2 and has a roughly E-W oriented mound morphology. There are no calderas or large craters on any of the volcanoes on the complex. However, two smaller, likely older, seamounts built along the eastern edge of the E-W fault explored on Dive S0583 have shallow craters and the western one appears to have a nested crater partially breached to the west. Another smaller group of cones/constructs lies east of the main western mound. At the base of the complex clear E-W structural features are present and the seamount complex appears to have overprinted them. The lineations may be relict abyssal hill features associated with the generation of Nazca plate crust at the eastern Galápagos Spreading Center, located north of the archipelago. Finally, some of the smaller seamounts east of the complex appear to have E-W fault structures that cut across the volcanoes suggesting post-construction deformation that may be influenced by Nazca plate abyssal hill tectonic processes.

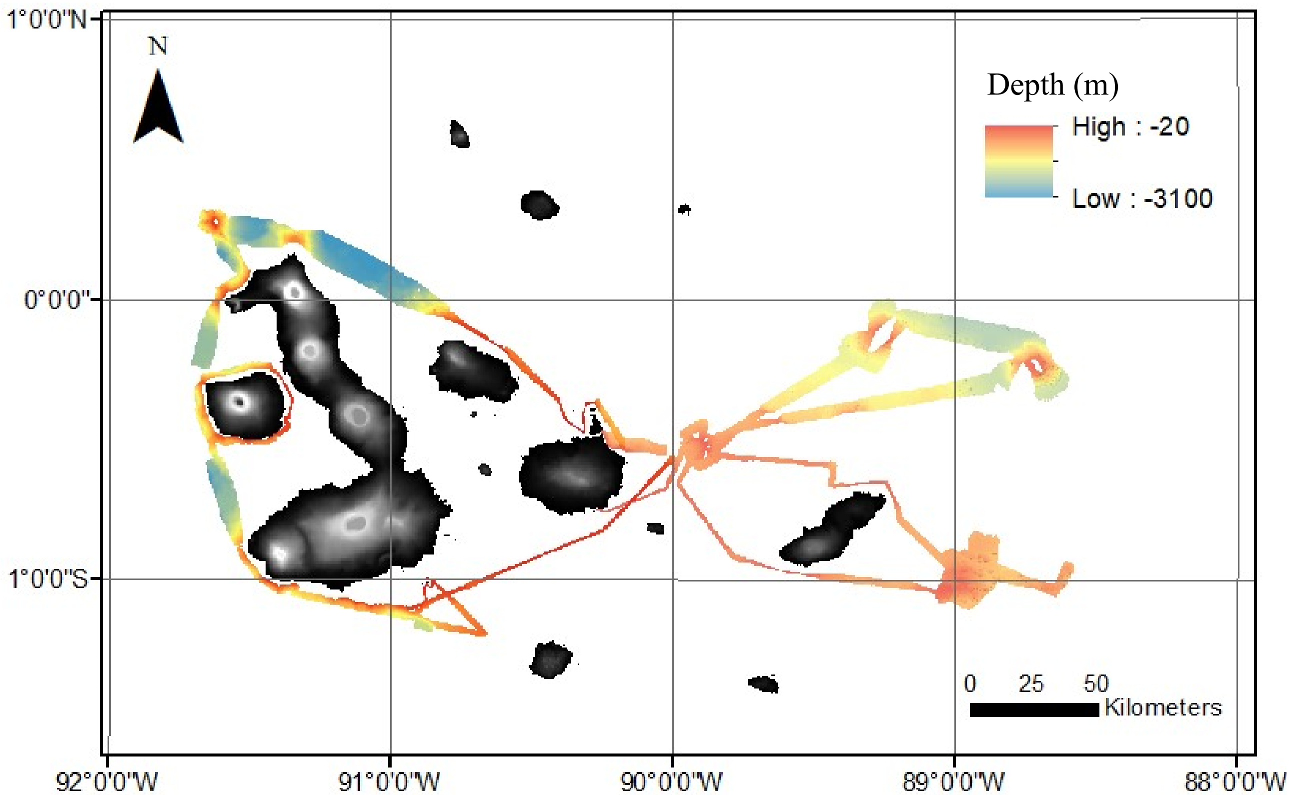

Figure 29: Map showing the total area mapped by shipboard multibeam echosounders around the Galápagos.

5. Outreach and Engagement

During the course of the expedition a series of educational and outreach activities were carried out involving schools of different nationalities.

5.1 Weekly Videos

- Oasis of Biodiversity: https://www.youtube.com/watch?v=OYQUPMJyZzE
- Deep sea details: https://www.youtube.com/watch?v=z7X2EW9z09w
- Coral Connections: https://youtu.be/VlQEekp4PdE?si=mrefRWQ0uJhJHy-A
- Studying Oxygen Minimum Zones: https://youtu.be/2WRbglQZUl0?si=KRbs1pA85XQKb0wC
- ROV Highlights: https://youtu.be/iBO0gy1GMSM?si=g8siMec_qcziDYDA

5.2 Ship-to-shore

A total of 4 ship-to-shore online streaming (1 in English and 3 in Spanish) were performed with very motivated students from Ecuador and Canada. During these, students interactively visited Falkor Too, and got the chance to see in real time the ROV *SuBastian* underwater along with main scientific activities in the lab, such as multibeam data cleaning, and the processing of both biological and fossil coral samples. At the end, students were eager to ask scientist many questions about Galápagos reef ecosystems and daily ship routines.

- September 22nd, 15h00 – Family and Friends of CDF, GNP and INOCAR
- September 29th, 10h00 – Charles Darwin Foundation
- October 4th, 9h00 - Explore by the Seat of Your Pants: https://www.youtube.com/watch?v=mxS7efGMkUA
- October 6th, 9h00 - Charles Darwin Foundation - Runakunapak, Tomás de Berlanga and Loma Linda schools

5.3 Website

https://schmidtocean.org/cruise/vertical-reefs-of-the-Galapagos/

Figure 30: Website developed by Schmidt Ocean Institute for the FKt20230918 expedition.

Blogs were provided to post on the website.

5.4 Research in Action

One member of the scientific team, Ariadna Martinez, participated in *Research in Action* program from the Catalan Foundation for Research and Innovation (FCRI) in collaboration with Schmidt Ocean Institute. *Research in Action* is a scientific dissemination portal with thousands of resources in Catalan for teachers and students, aiming to promote scientific culture and careers in STEM. This activity consisted of the following up of a scientific blog narrating life onboard Falkor Too and most important scientific discoveries. Until the end of the expedition, 480 pupils from six schools across Catalonia Region (Spain) followed the 8 entries and sent their questions to Ariadna twice a week. A total of eight blog entries were released in Catalan language and can be accessed at the following link:

https://www.recercaenaccio.cat/ra-aventures-cientifiques/expedicions/explorem-els-coralls-a-les-illes-galapagos/

Once the Expedition ended, *Research in Action* organized a closing act, with visits to three of the schools that participated in the program, so students could get first-hand experience of the expedition.

Figure 31: Image showing Ariadna explaining safety measures onboard Falkor (too) to pupils of Verdruna Escorial School (Catalonia, Spain).

The blog posts also had significant impact to broader audience, and according to data provided by FCRI on the 23rd November 2023, the blog posts and tweets were read by up to 1237 different users which accessed the website 2235 times (Table 17).

Table 17: Summary statistics of post and tweets readers provided by FCRI.

Blog post Nº	Title	Date	View	User
1	Comença l'Aventura	9/19/23	339	182
2	Embarquem al vaixell Falkor Too	9/21/23	223	122
3	De dilluns a diumenge, qui no fa feina no menja	9/27/23	183	111
4	Al mar! Al mar!	10/2/23	139	84
5	Avui va de processos	10/4/23	115	65
6	Les parets verticals, punts calents de biodiversitat	10/5/23	104	58
7	Diuen que es de valents baixar	10/10/23	27	11
8	Perseguint els climes passats	10/18/23	77	46
Tweets				
	Explorem els coralls a les Illes Galápagos	6/27/23	488	208
	Comencem l'expedició a les Illes Galápagos	9/19/23	212	133
	Expedicions	6/27/23	191	106
	Ariadna Martínez Dios - Recerca en acció	6/27/23	35	30
	Aventures científiques		102	81
	TOTAL		**2235**	**1237**

5.5 Public Presentation

Town Hall at the Charles Darwin Research Station on October 12th 2023.

5.6 Scientific presentations during the cruise

Talks by the scientists were organized by Dr Jorge Cortés for the crew and other scientists:

- Daniel Formari, Woods Hole Oceanographic Institution: Geology of the Galápagos Islands. 28 September 2023
- Stuart Banks, Senior Marine Scientist, Charles Darwin Foundation: The Galápagos Islands. 02 October 2023
- Ana Belén Yáñez Suárez, Memorial University, Newfoundland, Canada: Galápagos-Isla del Coco OMZ. 04 October 2023
- Verlee Huvenne, National Oceanography Centre, Southampton: Mapping complex environments. 06 October 2023
- Rob Hall, University of East Anglia: Hydrodynamic processes in and around submarine canyons: upwelling and internal tides. 08 October 2023.
- James Kershaw, University of Bristol: Fossil coral studies. 09 October 2023
- Tim Shank, Woods Hole Oceanographic Institution: Deep water coral ecosystem diversity. 10 October 2023
- Katleen Robert, Memorial University, Newfoundland, Chief Scientists: What we accomplished. 11 October 2023
- Jorge Cortés, University of Costa Rica: Isla del Coco. 14 October 2023
- Ana Belén Yáñez Suárez, Memorial University, Newfoundland: Highlights of Las Gemelas. 18 October 2023

5.7 BBC Filming

Filming for a BBC project took place during the expedition, imagery during the following time can be used for scientific purpose but cannot be made public (Table 18).

Table 18: List of dedicated BBC filming time.

Dive	Start Date/Time (UTC)	End Date/Time (UTC)
S0579	2023-09-21 14:39:01	2023-09-21 18:56:12
S0580	2023-09-22 15:20:32	2023-09-23 00:20:03
S0582	2023-09-25 21:09:25	2023-09-25 22:42:37
S0582	2023-09-26 14:29:06	2023-09-26 15:24:25
S0583	2023-09-27 16:35:18	2023-09-27 17:58:55
S0586	2023-10-01 18:37:56	2023-10-01 23:36:16
S0587	2023-10-03 01:59:47	2023-10-03 03:10:30
S0589	2023-10-04 16:35:10	2023-10-04 18:20:53
S0591	2023-10-06 04:04:05	2023-10-06 05:34:50
S0591	2023-10-06 06:38:52	2023-10-06 07:22:04
S0592	2023-10-07 02:40:49	2023-10-07 03:25:00
S0596	2023-10-09 21:29:20	2023-10-10 00:53:00

6. References

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APPENDICES

APPENDIX 1 Station List

APPENDIX 2 ROV Dive Summaries

APPENDIX 3 Faunal Samples

APPENDIX 4 Rock Inventory

APPENDIX 5 Norbit multibeam surveys

APPENDIX 6 ADCP surveys lines

APPENDIX 1 Station List

Site	Station No	Gear Code	Gear No	Event No	Event Gear No	Start Date	Start Time UTC	Start Lat	Start Long	Start Depth (m)	End Date	End Time UTC	End Lat	End Long	End Depth (m)
Galapagos	1	MBES	MBES01	1	EM712	18/09/2023	2:00:52	-0.75289	-90.29571	14.8	18/09/2023	8:19:06	-0.5182	-89.9146	490.2
Galapagos	2	XBT	XBT01	1	XBT01	18/09/2023	4:45:55	-0.60990	-89.99361	375.8					
Galapagos	3	XBT	XBT02	1	XBT02	18/09/2023	5:26:35	-0.52250	-89.95527	736.9					
Galapagos	4	ROV	ROV577	0	ROV577	18/09/2023	8:58:58	-0.52013	-89.91433		18/09/2023	19:25:08	-0.5182	-89.8934	
Galapagos	4	ROV	ROV577	1	RB001	18/09/2023	10:01:03	-0.51837	-89.91431	498.0					
Galapagos	4	ROV	ROV577	2	NET001	18/09/2023	10:31:25	-0.51845	-89.91446	502.2					
Galapagos	4	ROV	ROV577	3	NB001	18/09/2023	10:34:44	-0.51848	-89.91438	502.81					
Galapagos	4	ROV	ROV577	4	SS001	18/09/2023	10:53:35	-0.51852	-89.91460	508.06					
Galapagos	4	ROV	ROV577	5	SS002	18/09/2023	10:57:58	-0.51853	-89.91460	506.65					
Galapagos	4	ROV	ROV577	6	CQ001	18/09/2023	11:03:44	-0.51851	-89.91460	507.37					
Galapagos	4	ROV	ROV577	7	CQ002	18/09/2023	13:04:16	-0.52247	-89.91055	406.72					
Galapagos	4	ROV	ROV577	8	CQ003	18/09/2023	13:41:01	-0.52275	-89.91029	398.72					
Galapagos	4	ROV	ROV577	9	BB001	18/09/2023	15:04:05	-0.52475	-89.90826	369.78					
Galapagos	4	ROV	ROV577	10	BB002	18/09/2023	15:26:52	-0.52476	-89.90824	368.06					
Galapagos	4	ROV	ROV577	11	RB002	18/09/2023	15:43:11	-0.52483	-89.90826	370.28					
Galapagos	4	ROV	ROV577	12	NB002	18/09/2023	15:52:22	-0.52487	-89.90826	369.38					
Galapagos	4	ROV	ROV577	13	NB003	18/09/2023	17:13:58	-0.52104	-89.89833	300.89					
Galapagos	4	ROV	ROV577	14	NB004	18/09/2023	17:42:20	-0.51976	-89.89464	189.13					
Galapagos	4	ROV	ROV577	15	BB003	18/09/2023	18:20:00	-0.51926	-89.89363	135.58					
Galapagos	4	ROV	ROV577	16	RB003	18/09/2023	18:26:23	-0.51926	-89.89370	137.02					
Galapagos	4	ROV	ROV577	17	NB005	18/09/2023	18:45:52	-0.51891	-89.89287	122.41					
Galapagos	4	ROV	ROV577	18	CQ004	18/09/2023	18:59:47	-0.51886	-89.89286	123.03					
Galapagos	5	MBES	MBES02	1	EM712	18/09/2023	20:03:31	-0.51436	-89.89381	106.4	19/09/2023	0:54:41	-0.3316	-89.5582	1394.87
Galapagos	6	XBT	XBT03	1	XBT03	18/09/2023	20:24:05	-0.50216	-89.90363	180.07					
Galapagos	7	XBT	XBT04	1	XBT04	18/09/2023	20:29:09	-0.50744	-89.90059	138.29					
Galapagos	8	MBES	MBES03	1	EM124	18/09/2023	23:05:36	-0.44253	-89.74482	828.2	20/09/2023	2:03:26	-0.2987	-88.8501	2098.11
Galapagos	9	XBT	XBT05	1	XBT05	19/09/2023	0:19:40	-0.23016	-89.39213	1686.31					

Site	Station No	Gear Code	Gear No	Event No	Event Gear No	Start Date	Start Time UTC	Start Lat	Start Long	Start Depth (m)	End Date	End Time UTC	End Lat	End Long	End Depth (m)
Galapagos	10	XBT	XBT06	1	XBT06	19/09/2023	2:33:54	-0.23089	-89.39351	1683.19					
Galapagos	11	XBT	XBT07	1	XBT07	19/09/2023	13:30:55	-0.15263	-88.80204	2207.36					
Galapagos	12	XBT	XBT08	1	XBT08	19/09/2023	21:06:39	-0.19941	-88.76003	1239.23					
Galapagos	13	CTD	CTD01	1	CTD01	20/09/2023	2:29:38	-0.29969	-88.85154	2098.71	20/09/2023	4:25:54	-0.2999	-88.8531	2098.13
Galapagos	14	MBES	MBES04	1	EM124	20/09/2023	4:44:36	-0.30236	-88.87727	2074.12	20/09/2023	12:56:15	-0.5254	-89.9095	451.13
Galapagos	15	XBT	XBT09	1	XBT09	20/09/2023	10:28:36	-0.47023	-89.77470	726.57					
Galapagos	16	ROV	ROV578	0	ROV578	20/09/2023	14:19:21	-0.51919	-89.91562		21/09/2023	14:22:18	-0.5080	-89.9466	
Galapagos	16	ROV	ROV578	1	SURV01	20/09/2023	18:15:07	-0.51801	-89.91340	485.2	20/09/2023	19:00:03	-0.5180	-89.9136	483.56
Galapagos	16	ROV	ROV578	2	MBES01	20/09/2023	19:09:21	-0.51822	-89.91340	483.51	20/09/2023	19:54:04	-0.5187	-89.9139	459.35
Galapagos	16	ROV	ROV578	3	LSR01	20/09/2023	20:05:47	-0.51848	-89.91335	484.34	21/09/2023	5:53:45	-0.5181	-89.9132	483.38
Galapagos	16	ROV	ROV578	4	DVL01	21/09/2023	6:22:32	-0.51819	-89.91329	436.12	21/09/2023	9:14:06	-0.5185	-89.9131	436.48
Galapagos	17	CTD	CTD02	1	CTD02	20/09/2023	17:08:20	-0.51870	-89.91468	500.0					
Galapagos	17	CTD	CTD03	1	CTD03	20/09/2023	17:53:00	-0.51870	-89.91470	498.0					
Galapagos	17	CTD	CTD04	1	CTD04	20/09/2023	18:19:00	-0.51800	-89.91400						
Galapagos	17	CTD	CTD05	1	CTD05	20/09/2023	18:45:00	-0.51860	-89.91400	464.0					
Galapagos	17	CTD	CTD06	1	CTD06	20/09/2023	19:19:00	-0.51940	-89.91400	486.0					
Galapagos	17	CTD	CTD07	1	CTD07	20/09/2023	19:48:00	-0.51940	-89.91400	487.0					
Galapagos	17	CTD	CTD08	1	CTD08	20/09/2023	20:12:00	-0.51940	-89.91400	486.0					
Galapagos	17	CTD	CTD09	1	CTD09	20/09/2023	20:38:00	-0.51940	-89.91400	487.0					
Galapagos	17	CTD	CTD10	1	CTD10	20/09/2023	20:02:00	-0.51940	-89.91400	483.0					
Galapagos	17	CTD	CTD11	1	CTD11	20/09/2023	21:28:00	-0.51940	-89.91400	482.0					
Galapagos	17	CTD	CTD12	1	CTD12	20/09/2023	21:53:00	-0.51940	-89.91400	484.0					
Galapagos	17	CTD	CTD13	1	CTD13	20/09/2023	22:20:00	-0.51900	-89.91400	466.0					
Galapagos	17	CTD	CTD14	1	CTD14	20/09/2023	22:42:00	-0.51900	-89.91400	472.0					
Galapagos	17	CTD	CTD15	1	CTD15	20/09/2023	23:07:21	-0.51920	-89.91370	454.0					
Galapagos	17	CTD	CTD16	1	CTD16	20/09/2023	23:30:00	-0.51920	-89.91350	451.0					
Galapagos	17	CTD	CTD17	1	CTD17	20/09/2023	23:52:00	-0.51920	-89.91370	451.0					
Galapagos	17	CTD	CTD18	1	CTD18	21/09/2023	0:15:00	-0.51907	-89.91374	446.0					
Galapagos	17	CTD	CTD19	1	CTD19	21/09/2023	0:38:00	-0.51907	-89.91375	449.0					
Galapagos	17	CTD	CTD20	1	CTD20	21/09/2023	0:59:00	-0.51906	-89.91375	448.0					

Site	Station No	Gear Code	Gear No	Event No	Event Gear No	Start Date	Start Time UTC	Start Lat	Start Long	Start Depth (m)	End Date	End Time UTC	End Lat	End Long	End Depth (m)
Galapagos	17	CTD	CTD21	1	CTD21	21/09/2023	1:27:00	-0.51894	-89.91362	453.0					
Galapagos	17	CTD	CTD22	1	CTD22	21/09/2023	1:53:00	-0.51907	-89.91362	448.0					
Galapagos	17	CTD	CTD23	1	CTD23	21/09/2023	2:19:00	-0.51927	-89.91409	475.0					
Galapagos	17	CTD	CTD24	1	CTD24	21/09/2023	2:46:00	-0.51928	-89.91410	472.0					
Galapagos	17	CTD	CTD25	1	CTD25	21/09/2023	3:11:00	-0.51928	-89.91409	476.0					
Galapagos	17	CTD	CTD26	1	CTD26	21/09/2023	3:37:00	-0.51928	-89.91409	476.0					
Galapagos	17	CTD	CTD27	1	CTD27	21/09/2023	4:01:00	-0.51922	-89.91409	431.0					
Galapagos	17	CTD	CTD28	1	CTD28	21/09/2023	4:28:28	-0.51922	-89.91409	482.0					
Galapagos	17	CTD	CTD29	1	CTD29	21/09/2023	4:55:00	-0.51922	-89.91403	483.0					
Galapagos	17	CTD	CTD30	1	CTD30	21/09/2023	5:20:00	-0.51922	-89.91409	480.0	21/09/2023	5:51:35	-0.5192	-89.9141	
Galapagos	18	XBT	XBT10	1	XBT10	21/09/2023	10:23:13	-0.50666	-89.89914	129.93					
Galapagos	19	MBES	MBES05	1	EM712	21/09/2023	10:26:35	-0.50309	-89.89406	115.91	21/09/2023	1:54:13	-0.5060	-89.9296	
Galapagos	20	ROV	ROV579	0	ROV578	21/09/2023	14:22:18	-0.50802	-89.94664		22/09/2023	11:50:20	-0.5062	-89.9093	
Galapagos	20	ROV	ROV579	1	CRM001	21/09/2023	15:31:17	-0.50806	-89.94637	560.66					
Galapagos	20	ROV	ROV579	2	NET001	21/09/2023	15:52:49	-0.50808	-89.94638	560.3					
Galapagos	20	ROV	ROV579	3	BB001	21/09/2023	16:07:22	-0.50804	-89.94615	553.28					
Galapagos	20	ROV	ROV579	4	CQ001	21/09/2023	16:39:36	-0.507797	-89.94467	510.63					
Galapagos	20	ROV	ROV579	5	CQ002	21/09/2023	16:50:03	-0.507786	-89.94468	510.57					
Galapagos	20	ROV	ROV579	6	NET002	21/09/2023	17:24:20	-0.507339	-89.94269	483.58					
Galapagos	20	ROV	ROV579	7	CQ003	21/09/2023	18:13:37	-0.507534	-89.94007	424.0					
Galapagos	20	ROV	ROV579	8	BB001	21/09/2023	18:20:45	-0.507533	-89.94008	423.95					
Galapagos	20	ROV	ROV579	9	CRM002	21/09/2023	18:37:17	-0.50841	-89.94018	414.79					
Galapagos	20	ROV	ROV579	10	CRM002	21/09/2023	18:48:43	-0.50784	-89.9399	408.67					
Galapagos	20	ROV	ROV579	11	CQ004	21/09/2023	20:51:07	-0.507774	-89.93792	453.15					
Galapagos	20	ROV	ROV579	12	BB002	21/09/2023	20:59:58	-0.507772	-89.93791	453.24					
Galapagos	20	ROV	ROV579	13	CQ005	21/09/2023	21:20:25	-0.507763	-89.93711	462.78					
Galapagos	20	ROV	ROV579	14	RB001	21/09/2023	21:52:16	-0.507546	-89.93558	398.45					
Galapagos	20	ROV	ROV579	15	CQ006	21/09/2023	23:00:03	-0.505785	-89.93536	390.78					
Galapagos	20	ROV	ROV579	16	CQ007	21/09/2023	23:27:06	-0.505825	-89.93532	390.8					
Galapagos	20	ROV	ROV579	17	CQ008	22/09/2023	1:23:59	-0.505848	-89.92970	357.7					

Site	Station No	Gear Code	Gear No	Event No	Event Gear No	Start Date	Start Time UTC	Start Lat	Start Long	Start Depth (m)	End Date	End Time UTC	End Lat	End Long	End Depth (m)
Galapagos	20	ROV	ROV579	18	SS001	22/09/2023	1:30:11	-0.50585	-89.92970	357.72					
Galapagos	20	ROV	ROV579	19	CQ09	22/09/2023	2:04:15	-0.505381	-89.92865	334					
Galapagos	20	ROV	ROV579	20	CQ010	22/09/2023	2:17:30	-0.50538	-89.92866	333.94					
Galapagos	20	ROV	ROV579	21	NET003	22/09/2023	2:29:50	-0.505374	-89.92865	333.89					
Galapagos	20	ROV	ROV579	22	CQ011	22/09/2023	3:36:44	-0.506163	-89.92673	347.07					
Galapagos	20	ROV	ROV579	23	CQ012	22/09/2023	4:19:31	-0.505744	-89.92481	324.84					
Galapagos	20	ROV	ROV579	24	CQ013	22/09/2023	5:22:36	-0.505169	-89.92292	314.26					
Galapagos	20	ROV	ROV579	25	CQ014	22/09/2023	6:53:08	-0.504909	-89.92039	320.75					
Galapagos	20	ROV	ROV579	26	CQ015	22/09/2023	10:07:32	-0.50626	-89.91456	282.61					
Galapagos	20	ROV	ROV579	27	RB002	22/09/2023	10:59:09	-0.50593	-89.91127	251.17					
Galapagos	20	ROV	ROV579	28	CQ016	22/09/2023	11:26:18	-0.50508	-89.90943	241.9					
Galapagos	21	XBT	XBT11	1	XBT11	22/09/2023	12:26:29	-0.50604	-89.90960	235					
Galapagos	22	MBES	MBES06	1	EM712	22/09/2023	12:42:34	-0.50565	-89.91061	239.3	22/09/2023	14:48:36	-0.5693	-89.9296	
Galapagos	23	ROV	ROV580	0	ROV580	22/09/2023	15:05:12	-0.56915	-89.92950		22/09/2023	10:16:02	-0.5631	-89.9036	
Galapagos	23	ROV	ROV580	1	RB001	22/09/2023	16:46:25	-0.56749	-89.92856	720.6					
Galapagos	23	ROV	ROV580	1	RB001	22/09/2023	16:46:25	-0.56749	-89.92856	720.6					
Galapagos	23	ROV	ROV580	2	SS001	22/09/2023	16:56:53	-0.56746	-89.92857	720.28					
Galapagos	23	ROV	ROV580	3	SS001	22/09/2023	17:09:00	-0.56673	-89.92842	702.04					
Galapagos	23	ROV	ROV580	4	CQ001	22/09/2023	18:49:06	-0.56793	-89.92126	584.19					
Galapagos	23	ROV	ROV580	5	BB001	22/09/2023	19:09:00	-0.56824	-89.92059	568.78					
Galapagos	23	ROV	ROV580	6	CQ002	22/09/2023	19:32:32	-0.56829	-89.92041	561.29					
Galapagos	23	ROV	ROV580	7	CQ003	22/09/2023	20:08:18	-0.56872	-89.91934	537.83					
Galapagos	23	ROV	ROV580	8	CQ004	22/09/2023	20:24:59	-0.56889	-89.91908	530.18					
Galapagos	23	ROV	ROV580	9	NET001	22/09/2023	21:02:05	-0.56972	-89.91694	476.62					
Galapagos	23	ROV	ROV580	10	CQ006	22/09/2023	21:19:16	-0.56970	-89.91694	477.25					
Galapagos	23	ROV	ROV580	11	CQ007	23/09/2023	0:24:07	-0.56932	-89.91584	493.12					
Galapagos	23	ROV	ROV580	12	CQ008	23/09/2023	0:39:17	-0.56911	-89.91601	497.38					
Galapagos	23	ROV	ROV580	13	CQ009	23/09/2023	0:59:48	-0.56912	-89.91599	497.24					
Galapagos	23	ROV	ROV580	14	NET002	23/09/2023	1:49:12	-0.56815	-89.91428	471.9					
Galapagos	23	ROV	ROV580	15	RB002	23/09/2023	2:22:43	-0.56755	-89.91318	455.95					

Site	Station No	Gear Code	Gear No	Event No	Event Gear No	Start Date	Start Time UTC	Start Lat	Start Long	Start Depth (m)	End Date	End Time UTC	End Lat	End Long	End Depth (m)
Galapagos	23	ROV	ROV580	16	NET003	23/09/2023	4:28:36	-0.56689	-89.90960	373.38					
Galapagos	23	ROV	ROV580	17	CQ010	23/09/2023	6:37:55	-0.56489	-89.90772	379.77					
Galapagos	23	ROV	ROV580	18	CQ011	23/09/2023	7:37:16	-0.56518	-89.90700	374.01					
Galapagos	23	ROV	ROV580	19	CQ012	23/09/2023	7:40:44	-0.56518	-89.90700	374.01					
Galapagos	23	ROV	ROV580	20	CQ013	23/09/2023	8:38:02	-0.56417	-89.90517	379.6					
Galapagos	24	XBT	XBT12	1	XBT12	23/09/2023	10:44:14	-0.55575	-89.90409	422.62					
Galapagos	25	MBES	MBES07	1	EM712	23/09/2023	10:47:44	-0.55253	-89.89857	324.14	23/09/2023	11:48:19	-0.5685	-89.9292	705.76
Galapagos	26	CTD	CTD31	1	CTD31	23/09/2023	11:51:27	-0.56849	-89.92922	707.37	23/09/2023	12:37:35	-0.5684	-89.9292	
Galapagos	27	MBES	MBES08	1	EM124	23/09/2023	12:52:56	-0.57213	-89.93110	699.56	25/09/2023	0:48:59	-1.0593	-88.9898	126.26
Galapagos	28	XBT	XBT13	1	XBT13	23/09/2023	23:13:39	-1.08631	-88.96408	890.2					
Galapagos	29	XBT	XBT14	1	XBT14	24/09/2023	8:24:29	-0.85073	-88.91972	802.27					
Galapagos	30	XBT	XBT15	1	XBT15	24/09/2023	16:03:55	-0.97346	-88.96116	333.61					
Galapagos	31	CTD	CTD32	1	CTD32	25/09/2023	1:24:31	-1.07327	-88.95572	882.88	25/09/2023	2:16:58	-1.0726	-88.9559	873.31
Galapagos	32	ROV	ROV581	0	ROV581	25/09/2023	2:49:53	-1.06961	-88.95591		25/09/2023	17:07:13	-1.0401	-88.9648	
Galapagos	32	ROV	ROV581	1	RB001	25/09/2023	6:08:40	-1.05919	-88.95840	644.11					
Galapagos	32	ROV	ROV581	2	RB002	25/09/2023	6:12:11	-1.05918	-88.95840	644.12					
Galapagos	32	ROV	ROV581	3	RB003	25/09/2023	6:29:13	-1.05921	-88.95862	643.36					
Galapagos	32	ROV	ROV581	4	CQ001	25/09/2023	6:37:57	-1.05921	-88.95864	642.8					
Galapagos	32	ROV	ROV581	5	CQ002	25/09/2023	6:44:22	-1.05921	-88.95864	642.83					
Galapagos	32	ROV	ROV581	6	CQ003	25/09/2023	7:14:00	-1.05818	-88.95879	617.61					
Galapagos	32	ROV	ROV581	7	CQ004	25/09/2023	8:47:31	-1.05319	-88.95739	526.91					
Galapagos	32	ROV	ROV581	8	NET001	25/09/2023	9:54:32	-1.04993	-88.95930	408.81					
Galapagos	32	ROV	ROV581	9	CQ005	25/09/2023	10:14:25	-1.04972	-88.95975	389.83					
Galapagos	32	ROV	ROV581	10	CQ006	25/09/2023	10:28:36	-1.04963	-88.96014	375.45					
Galapagos	32	ROV	ROV581	11	CQ007	25/09/2023	10:38:52	-1.04959	-88.96021	372.01					
Galapagos	32	ROV	ROV581	12	CQ008	25/09/2023	11:11:03	-1.04912	-88.96105	358.75					
Galapagos	32	ROV	ROV581	13	RB004	25/09/2023	11:32:00	-1.04911	-88.96127	362.05					
Galapagos	32	ROV	ROV581	14	NET002	25/09/2023	12:08:02	-1.04911	-88.96130	362.57					
Galapagos	32	ROV	ROV581	15	RB005	25/09/2023	12:16:22	-1.04903	-88.96133	363.01					
Galapagos	32	ROV	ROV581	16	CQ009	25/09/2023	13:11:13	-1.04637	-88.96235	356.52					

Site	Station No	Gear Code	Gear No	Event No	Event Gear No	Start Date	Start Time UTC	Start Lat	Start Long	Start Depth (m)	End Date	End Time UTC	End Lat	End Long	End Depth (m)
Galapagos	32	ROV	ROV581	17	NET003	25/09/2023	15:04:56	-1.04387	-88.96324	338.29					
Galapagos	32	ROV	ROV581	18	BB001	25/09/2023	15:13:43	-1.04387	-88.96323	337.93					
Galapagos	32	ROV	ROV581	19	BB002	25/09/2023	15:39:54	-1.04326	-88.96330	328.16					
Galapagos	33	MBES	MBES09	1	EM124	25/09/2023	17:22:09	-1.03634	-88.96700	271.75	25/09/2023	18:53:21	-0.9774	-88.9170	712.5
Galapagos	34	CTD	CTD33	1	CTD33	25/09/2023	19:14:22	-0.97724	-88.91781	738.56	25/09/2023	20:01:11	-0.9772	-88.9178	733.31
Galapagos	35	ROV	ROV582	0	ROV582	25/09/2023	20:54:39	-0.97456	-88.92205		27/09/2023	1:42:09	-0.9704	-88.9564	
Galapagos	35	ROV	ROV582	1	RB001	25/09/2023	22:57:09	-0.97510	-88.92345	674.71					
Galapagos	35	ROV	ROV582	2	CQ001	25/09/2023	23:28:27	-0.97441	-88.92384	731.5					
Galapagos	35	ROV	ROV582	3	CQ002	26/09/2023	0:26:01	-0.97490	-88.92411	663.28					
Galapagos	35	ROV	ROV582	4	CQ003	26/09/2023	0:48:17	-0.97491	-88.92409	663.98					
Galapagos	35	ROV	ROV582	5	NET001	26/09/2023	1:31:15	-0.97495	-88.92474	661.59					
Galapagos	35	ROV	ROV582	6	MBES01	26/09/2023	2:02:34	-0.97450	-88.92493	690.3	26/09/2023	3:19:11	-0.9747	-88.9238	670.16
Galapagos	35	ROV	ROV582	7	DVL01	26/09/2023	3:43:55	-0.97463	-88.92413	685.49	26/09/2023	4:44:24	-0.9748	-88.9245	685.08
Galapagos	35	ROV	ROV582	8	RB002	26/09/2023	4:59:01	-0.97474	-88.92397	699.64					
Galapagos	35	ROV	ROV582	9	NET002	26/09/2023	7:42:30	-0.97531	-88.92931	540.72					
Galapagos	35	ROV	ROV582	10	CQ004	26/09/2023	10:35:56	-0.97342	-88.93639	539.94					
Galapagos	35	ROV	ROV582	11	RB003	26/09/2023	11:38:29	-0.97297	-88.93972	552.51					
Galapagos	35	ROV	ROV582	12	CQ005	26/09/2023	11:45:19	-0.97298	-88.93971	551.86					
Galapagos	35	ROV	ROV582	13	CQ006	26/09/2023	11:50:10	-0.97293	-88.93970	550.02					
Galapagos	35	ROV	ROV582	14	BB001	26/09/2023	12:25:06	-0.97283	-88.94042	549.38					
Galapagos	35	ROV	ROV582	15		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Galapagos	35	ROV	ROV582	16		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Galapagos	35	ROV	ROV582	17		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Galapagos	35	ROV	ROV582	18		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Galapagos	35	ROV	ROV582	19	MBES02	26/09/2023	13:14:09	-0.97263	-88.94062	545.34	26/09/2023	13:32:33	-0.9726	-88.9399	580.39
Galapagos	35	ROV	ROV582	20	DVL02	26/09/2023	13:42:30	-0.97256	-88.93988	547.02	26/09/2023	13:56:40	-0.9728	-88.9406	547.13
Galapagos	35	ROV	ROV582	21	RB004	26/09/2023	16:17:45	-0.97217	-88.94576	463.77					
Galapagos	35	ROV	ROV582	22	CQ007	26/09/2023	16:54:39	-0.97162	-88.94778	428.33					
Galapagos	35	ROV	ROV582	23	CQ008	26/09/2023	16:58:49	-0.97162	-88.94778	428.28					
Galapagos	35	ROV	ROV582	24	CQ009	26/09/2023	17:17:10	-0.97149	-88.94815	425.39					

Site	Station No	Gear Code	Gear No	Event No	Event Gear No	Start Date	Start Time UTC	Start Lat	Start Long	Start Depth (m)	End Date	End Time UTC	End Lat	End Long	End Depth (m)
Galapagos	35	ROV	ROV582	25	CQ010	26/09/2023	18:03:30	-0.97056	-88.94895	436.59					
Galapagos	35	ROV	ROV582	26	BB002	26/09/2023	18:52:11	-0.97148	-88.95033	418.27					
Galapagos	35	ROV	ROV582	27	CQ011	26/09/2023	19:38:17	-0.97146	-88.95231	402.02					
Galapagos	35	ROV	ROV582	28	NET003	26/09/2023	19:56:54	-0.97163	-88.95302	391.31					
Galapagos	35	ROV	ROV582	29	CQ012	26/09/2023	20:27:03	-0.97154	-88.95379	376.96					
Galapagos	35	ROV	ROV582	30	CQ013	26/09/2023	20:42:19	-0.97159	-88.95364	374.88					
Galapagos	35	ROV	ROV582	31	MBES03	26/09/2023	20:53:02	-0.97154	-88.95330	375.03	26/09/2023	22:50:55	-0.9713	-88.9521	397.57
Galapagos	35	ROV	ROV582	32	BB003	26/09/2023	0:06:39	-0.97150	-88.95428	365.7					
Galapagos	36	XBT	XBT16	1	XBT16	27/09/2023	1:47:54	-0.97083	-88.95646						
Galapagos	37	MBES	MBES10	1	EM712	27/09/2023	2:06:31	-0.96803	-88.96014	326.08	27/09/2023	4:06:12	-0.9720	-88.9695	278.79
Galapagos	38	MBES	MBES11	1	EM124	27/09/2023	4:06:22	-0.97203	-88.96960	280.58	27/09/2023	14:07:30	-0.9341	-88.9365	775.83
Galapagos	39	XBT	XBT17	1	XBT17	27/09/2023	9:54:04	-0.98578	-89.00477	351.95					
Galapagos	40	CTD	CTD34	1	CTD34	27/09/2023	14:33:08	-0.93463	-88.93012		27/09/2023	15:26:34	-0.9346	-88.9301	831.8
Galapagos	41	ROV	ROV583	0	ROV583	27/09/2023	16:20:38	-0.92052	-88.93420		28/09/2023	4:16:57	-0.9329	-88.9249	
Galapagos	41	ROV	ROV583	1	RB001	27/09/2023	18:33:30	-0.92257	-88.93353	710.67					
Galapagos	41	ROV	ROV583	2	CQ001	27/09/2023	18:53:03	-0.92289	-88.93367	699.15					
Galapagos	41	ROV	ROV583	3	CQ002	27/09/2023	19:32:08	-0.92340	-88.93392	622.93					
Galapagos	41	ROV	ROV583	4	CE003	27/09/2023	19:45:14	-0.92340	-88.93391	622.93					
Galapagos	41	ROV	ROV583	5	CQ004	27/09/2023	20:04:54	-0.92340	-88.93391	622.88					
Galapagos	41	ROV	ROV583	6	CQ005	27/09/2023	20:12:18	-0.92339	-88.93391	622.81					
Galapagos	41	ROV	ROV583	7	NET001	27/09/2023	21:11:12	-0.92437	-88.93417	606.67					
Galapagos	41	ROV	ROV583	8	RB002	27/09/2023	21:21:38	-0.92449	-88.93401	598.75					
Galapagos	41	ROV	ROV583	9	BB001	27/09/2023	21:48:03	-0.92614	-88.93383	605.75					
Galapagos	41	ROV	ROV583	10	CQ006	27/09/2023	23:54:39	-0.93000	-88.93263	797.64					
Galapagos	41	ROV	ROV583	11	SS001	28/09/2023	0:02:11	-0.93001	-88.93263	797.61					
Galapagos	41	ROV	ROV583	12	BB002	28/09/2023	0:09:27	-0.93001	-88.93263	797.49					
Galapagos	41	ROV	ROV583	13	CQ007	28/09/2023	1:27:36	-0.93066	-88.92974	758.27					
Galapagos	41	ROV	ROV583	14	BB003	28/09/2023	2:35:24	-0.93100	-88.92700	743.53					
Galapagos	41	ROV	ROV583	15	SS002	28/09/2023	2:36:48	-0.93100	-88.92698	743.54					
Galapagos	41	ROV	ROV583	16	CQ008	28/09/2023	2:44:42	-0.93099	-88.92700	746.55					

Site	Station No	Gear Code	Gear No	Event No	Event Gear No	Start Date	Start Time UTC	Start Lat	Start Long	Start Depth (m)	End Date	End Time UTC	End Lat	End Long	End Depth (m)
Galapagos	42	MBES	MBES12	1	EM124	28/09/2023	4:32:40	-0.93219	-88.92845	875.87	28/09/2023	12:25:09	-0.9701	-88.9515	421.73
Galapagos	43	MBES	MBES13	1	EM712	28/09/2023	4:32:40	-0.93219	-88.92845	874.11	28/09/2023	12:25:09	-0.9701	-88.9515	421.73
Galapagos	44	XBT	XBT18	1	XBT18	28/09/2023	4:47:17	-0.93641	-88.91425	757.01					
Galapagos	45	XBT	XBT19	1	XBT19	28/09/2023	4:48:41	-0.93740	-88.91188	813.7					
Galapagos	46	ROV	ROV584	0	ROV584	28/09/2023	14:00:23	-0.97013	-88.95152	421.73	29/09/2023	4:19:00	-0.9705	-88.9520	
Galapagos	46	ROV	ROV584	1	LSR01	28/09/2023	14:59:59	-0.97139	-88.95190	412.89	28/09/2023	20:27:28	-0.9715	-88.9527	392.41
Galapagos	46	ROV	ROV584	2	MBES01	28/09/2023	15:01:08	-0.97141	-88.95195	412.82	28/09/2023	20:28:12	-0.9715	-88.9527	389.4
Galapagos	46	ROV	ROV584	3	DVL01	28/09/2023	20:55:38	-0.97157	-88.95194	389.93	29/09/2023	3:14:54	-0.9708	-88.9522	389.26
Galapagos	47	CTD	CTD35	1	CTD35	28/09/2023	14:25:00	-0.97010	-88.95150	421.0					
Galapagos	47	CTD	CTD36	1	CTD36	28/09/2023	14:56:00	-0.97030	-88.95150	422.0					
Galapagos	47	CTD	CTD37	1	CTD37	28/09/2023	15:24:00	-0.97040	-88.95150	424.0					
Galapagos	47	CTD	CTD38	1	CTD38	28/09/2023	15:50:00	-0.97060	-88.95160	422.0					
Galapagos	47	CTD	CTD39	1	CTD39	28/09/2023	16:13:00	-0.97060	-88.95160	414.0					
Galapagos	47	CTD	CTD40	1	CTD40	28/09/2023	16:38:00	-0.97100	-88.95210	412.0					
Galapagos	47	CTD	CTD41	1	CTD41	28/09/2023	17:01:00	-0.97100	-88.95120	413.0					
Galapagos	47	CTD	CTD42	1	CTD42	28/09/2023	17:24:00	-0.97100	-88.95120	413.0					
Galapagos	47	CTD	CTD43	1	CTD43	28/09/2023	17:47:00	-0.97100	-88.95120	414.0					
Galapagos	47	CTD	CTD44	1	CTD44	28/09/2023	18:11:00	-0.97100	-88.95210	412.0					
Galapagos	47	CTD	CTD45	1	CTD45	28/09/2023	18:33:00	-0.97100	-88.95210	412.0					
Galapagos	47	CTD	CTD46	1	CTD46	28/09/2023	18:55:00	-0.97100	-88.95120	414.0					
Galapagos	47	CTD	CTD47	1	CTD47	28/09/2023	19:18:00	-0.97100	-88.95120	414.0					
Galapagos	47	CTD	CTD48	1	CTD48	28/09/2023	19:41:00	-0.97100	-88.85210	414.0					
Galapagos	47	CTD	CTD49	1	CTD49	28/09/2023	20:05:00	-0.97100	-88.95120	413.0					
Galapagos	47	CTD	CTD50	1	CTD50	28/09/2023	20:40:00	-0.97070	-88.96170	422.0					
Galapagos	47	CTD	CTD51	1	CTD51	28/09/2023	21:03:00	-0.97100	-88.95110	426.0					
Galapagos	47	CTD	CTD52	1	CTD52	28/09/2023	21:26:00	-0.97100	-88.95110	425.0					
Galapagos	47	CTD	CTD53	1	CTD53	28/09/2023	21:49:00	-0.97100	-88.95120	422.0					
Galapagos	47	CTD	CTD54	1	CTD54	28/09/2023	22:14:00	-0.97100	-88.95120	420.0					
Galapagos	47	CTD	CTD55	1	CTD55	28/09/2023	22:36:00	-0.97111	-88.51490	420.0					
Galapagos	47	CTD	CTD56	1	CTD56	28/09/2023	22:59:00	-0.97112	-88.95148	418.0					

Site	Station No	Gear Code	Gear No	Event No	Event Gear No	Start Date	Start Time UTC	Start Lat	Start Long	Start Depth (m)	End Date	End Time UTC	End Lat	End Long	End Depth (m)
Galapagos	47	CTD	CTD57	1	CTD57	28/09/2023	23:22:00	-0.97119	-88.95165	416.0					
Galapagos	47	CTD	CTD58	1	CTD58	28/09/2023	23:45:00	-0.97094	-88.95180	416.0					
Galapagos	47	CTD	CTD59	1	CTD59	29/09/2023	0:08:00	-0.97120	-88.95170	416.0					
Galapagos	47	CTD	CTD60	1	CTD60	29/09/2023	0:32:00	-0.97120	-88.95170	418.0					
Galapagos	47	CTD	CTD61	1	CTD61	29/09/2023	0:57:00	-0.97120	-88.95170	418.0					
Galapagos	47	CTD	CTD62	1	CTD62	29/09/2023	0:31:00	-0.97095	-88.95112	421.0					
Galapagos	47	CTD	CTD63	1	CTD63	29/09/2023	1:57:00	-0.97100	-88.95110	422.0					
Galapagos	47	CTD	CTD64	1	CTD64	29/09/2023	2:22:00	-0.97100	-88.95110	420.0	29/09/2023	2:48:54	-0.9710	-88.9511	427.83
Galapagos	48	MBES	MBES14	1	EM712	29/09/2023	4:37:49	-0.95845	-88.95261	453.3	29/09/2023	9:05:37	-0.9935	-88.9817	273.63
Galapagos	49	MBES	MBES15	1	EM124	29/09/2023	9:05:58	-0.99298	-88.98233	285.86	30/09/2023	3:02:27	-0.5254	-90.1343	633.69
Galapagos	50	XBT	XBT20	1	XBT20	29/09/2023	10:17:58	-0.87045	-89.10949	799.54					
Galapagos	51	ADCP	ADCP1	1	ADCP1	29/09/2023	17:40:59	-0.50919	-89.84753	550.55	30/09/2023	3:02:27	-0.5254	-90.1343	633.69
Galapagos	52	XBT	XBT21	1	XBT21	29/09/2023	19:39:11	-0.49275	-89.94788	636.38					
Galapagos	53	MBES	MBES16	1	EM712	30/09/2023	3:02:57	-0.52534	-90.13490	638.47	30/09/2023	16:09:41	-0.5141	-90.1637	184.6
Galapagos	54	XBT	XBT22	1	XBT22	30/09/2023	3:08:03	-0.52459	-90.14000	638.39					
Galapagos	55	XBT	XBT23	1	XBT23	30/09/2023	11:49:01	-0.53983	-90.16941	166.19					
Galapagos	56	CTD	CTD65	1	CTD65	30/09/2023	16:17:04	-0.51421	-90.16348	873.44	30/09/2023	17:01:39	-0.5139	-90.1638	875.4
Galapagos	57	MBES	MBES17	1	EM712	30/09/2023	17:22:40	-0.52106	-90.17150	764.11	30/09/2023	20:12:07	-0.5093	-90.1597	920.53
Galapagos	58	ROV	ROV585	0	ROV585	30/09/2023	20:24:14	-0.50977	-90.15925		1/10/2023	11:14:02	-0.5306	-90.1817	
Galapagos	58	ROV	ROV585	1	RB001	30/09/2023	21:30:13	-0.51217	-90.15906	914.64					
Galapagos	58	ROV	ROV585	2	RB002	30/09/2023	22:04:42	-0.51280	-90.15970	909.85					
Galapagos	58	ROV	ROV585	3	RB003	30/09/2023	22:54:15	-0.51522	-90.16097	846.97					
Galapagos	58	ROV	ROV585	4	BB001	1/10/2023	0:48:47	-0.52156	-90.16645	779.18					
Galapagos	58	ROV	ROV585	5	RB004	1/10/2023	1:02:27	-0.52155	-90.16648	777.89					
Galapagos	58	ROV	ROV585	6	CQ001	1/10/2023	1:53:31	-0.52321	-90.16781	701.04					
Galapagos	58	ROV	ROV585	7	CQ002	1/10/2023	1:56:02	-0.52322	-90.16782	701					
Galapagos	58	ROV	ROV585	8	CQ003	1/10/2023	2:25:21	-0.52409	-90.16904	696.3					
Galapagos	58	ROV	ROV585	9	CQ004	1/10/2023	4:56:30	-0.52876	-90.17862	483.17					
Galapagos	58	ROV	ROV585	10	SS001	1/10/2023	5:23:50	-0.52903	-90.17903	455.64					
Galapagos	58	ROV	ROV585	11	CQ005	1/10/2023	5:54:39	-0.53025	-90.17973	389.42					

Site	Station No	Gear Code	Gear No	Event No	Event Gear No	Start Date	Start Time UTC	Start Lat	Start Long	Start Depth (m)	End Date	End Time UTC	End Lat	End Long	End Depth (m)
Galapagos	58	ROV	ROV585	12	CQ006	1/10/2023	6:06:55	-0.53024	-90.17973	389.59					
Galapagos	58	ROV	ROV585	13	NET001	1/10/2023	6:20:14	-0.53024	-90.17972	389.66					
Galapagos	58	ROV	ROV585	14	SS002	1/10/2023	6:46:16	-0.53051	-90.17985	376.58					
Galapagos	58	ROV	ROV585	15	CQ005	1/10/2023	7:50:15	-0.52997	-90.18147	386.19					
Galapagos	58	ROV	ROV585	16	CQ006	1/10/2023	8:47:54	-0.52959	-90.18186	366.81					
Galapagos	58	ROV	ROV585	17	CQ007	1/10/2023	9:35:39	-0.53035	-90.18316	323.2					
Galapagos	58	ROV	ROV585	18	RB005	1/10/2023	10:48:20	-0.53052	-90.18266	312.22					
Galapagos	59	MBES	MBES18	1	EM712	1/10/2023	11:23:12	-0.52924	-90.18143	406.59	1/10/2023	17:04:33	-0.3574	-90.4097	225.26
Galapagos	60	LANDER	LANDER1	1	LANDER1	1/10/2023	18:19:16	-0.35837	-90.40899	231.544					
Galapagos	61	ROV	ROV586	0	ROV586	1/10/2023	18:42:16	-0.35837	-90.40999		1/10/2023	23:29:27	-0.3591	-90.4070	
Galapagos	62	MBES	MBES19	1	EM124	2/10/2023	0:21:56	-0.34894	-90.42007	250.79	2/10/2023	9:42:38	0.2487	-91.5841	1623.45
Galapagos	63	XBT	XBT24	1	XBT24	2/10/2023	1:06:29	-0.27716	-90.49737	344.32					
Galapagos	64	XBT	XBT25	1	XBT25	2/10/2023	1:09:12	-0.27272	-90.50214	346.9					
Galapagos	65	XBT	XBT26	1	XBT26	2/10/2023	9:31:38	0.24635	-91.56071	2158.19					
Galapagos	66	MBES	MBES20	1	EM712	2/10/2023	9:42:20	0.24869	-91.58378	1625.86	2/10/2023	18:00:50	0.2917	-91.6198	
Galapagos	67	XBT	XBT27	1	XBT27	2/10/2023	12:40:00	0.26533	-91.60630	666.06					
Galapagos	68	ADCP	ADCP2	1	ADCP2	2/10/2023	18:01:07	0.29185	-91.61956						
Galapagos	69	CTD	CTD66	1	CTD66	2/10/2023	20:22:57	0.28718	-91.65254	1052.02	2/10/2023	21:14:09	0.2871	-91.6525	1051.69
Galapagos	70	ROV	ROV587	0	ROV587	2/10/2023	22:38:56	0.28688	-91.65114	979.5	3/10/2023	13:02:33	0.2884	-91.6391	
Galapagos	70	ROV	ROV587	1	SS001	2/10/2023	23:48:00	0.28677	-91.65027	936.73					
Galapagos	70	ROV	ROV587	2	CQ001	2/10/2023	23:57:52	0.28677	-91.65027	936.18					
Galapagos	70	ROV	ROV587	3	CQ002	3/10/2023	0:12:19	0.28676	-91.65024	936.23					
Galapagos	70	ROV	ROV587	4	CQ003	3/10/2023	0:41:04	0.28676	-91.64991	909.1					
Galapagos	70	ROV	ROV587	5	CQ004	3/10/2023	1:02:09	0.28675	-91.65016	908.87					
Galapagos	70	ROV	ROV587	6	CQ005	3/10/2023	1:27:24	0.28674	-91.64968	890.49					
Galapagos	70	ROV	ROV587	7	RB001	3/10/2023	1:52:07	0.28676	-91.64935	864.21					
Galapagos	70	ROV	ROV587	8	SS002	3/10/2023	4:01:45	0.28695	-91.64746	865.95					
Galapagos	70	ROV	ROV587	9	CQ006	3/10/2023	4:08:56	0.28696	-91.64745	865.89					
Galapagos	70	ROV	ROV587	10	CQ007	3/10/2023	4:18:03	0.28695	-91.64747	865.88					
Galapagos	70	ROV	ROV587	11	RB002	3/10/2023	6:04:57	0.28879	-91.64165	796.34					

Site	Station No	Gear Code	Gear No	Event No	Event Gear No	Start Date	Start Time UTC	Start Lat	Start Long	Start Depth (m)	End Date	End Time UTC	End Lat	End Long	End Depth (m)
Galapagos	70	ROV	ROV587	12	CQ008	3/10/2023	6:48:51	0.28927	-91.64092	700.6					
Galapagos	70	ROV	ROV587	13	CQ009	3/10/2023	7:07:31	0.28932	-91.64078	690.65					
Galapagos	70	ROV	ROV587	14	BB001	3/10/2023	7:16:48	0.28931	-91.64079	690.7					
Galapagos	70	ROV	ROV587	15	CQ010	3/10/2023	7:28:23	0.28945	-91.64065	683.99					
Galapagos	70	ROV	ROV587	16	MBES01	3/10/2023	9:13:59	0.28761	-91.63918	641.35					
Galapagos	70	ROV	ROV587	17	CQ010	3/10/2023	10:45:37	0.28790	-91.63923	650.44					
Galapagos	70	ROV	ROV587	18	NET001	3/10/2023	11:04:58	0.28792	-91.63922	650.25					
Galapagos	70	ROV	ROV587	19	RB003	3/10/2023	11:30:04	0.28782	-91.63906	622.32					
Galapagos	70	ROV	ROV587	20	CQ011	3/10/2023	12:17:57	0.28752	-91.63586	468.14					
Galapagos	71	MBES	MBES21	1	EM124	3/10/2023	13:21:59	0.27089	-91.63781	329.11	3/10/2023	15:00:29	0.0978	-91.5212	1386.54
Galapagos	72	MBES	MBES22	1	EM712	3/10/2023	15:00:13	0.09837	-91.52159	1390.23	3/10/2023	20:30:46	0.0384	-91.6106	1129.2
Galapagos	73	XBT	XBT28	1	XBT28	3/10/2023	15:02:13	0.09504	-91.51919	1268.58					
Galapagos	74	XBT	XBT29	1	XBT29	3/10/2023	15:11:16	0.08144	-91.51784	1074.34					
Galapagos	75	XBT	XBT30	1	XBT30	3/10/2023	16:14:18	0.03395	-91.58017	558.8					
Galapagos	76	CTD	CTD67	1	CTD67	3/10/2023	20:44:15	0.04132	-91.61053	1144.87	3/10/2023	21:41:03	0.0413	-91.6105	1144.4
Galapagos	77	ROV	ROV588	0	ROV588	3/10/2023	22:21:07	0.03686	-91.60434		4/10/2023	11:00:03	0.0263	-91.5827	
Galapagos	77	ROV	ROV588	1	BB001	3/10/2023	23:35:40	0.03599	-91.60392	765.27					
Galapagos	77	ROV	ROV588	2	BB002	4/10/2023	0:11:52	0.03584	-91.60317	727					
Galapagos	77	ROV	ROV588	3	RB001	4/10/2023	0:59:03	0.03576	-91.60146	624.45					
Galapagos	77	ROV	ROV588	4	BB003	4/10/2023	1:26:31	0.03572	-91.60105	593.73					
Galapagos	77	ROV	ROV588	5	CQ001	4/10/2023	1:44:56	0.03572	-91.60104	593.41					
Galapagos	77	ROV	ROV588	6	CQ002	4/10/2023	1:56:46	0.03574	-91.60096	594.88					
Galapagos	77	ROV	ROV588	7	CQ003	4/10/2023	2:45:20	0.03587	-91.60086	583.93					
Galapagos	77	ROV	ROV588	8	CQ004	4/10/2023	3:02:22	0.03584	-91.60087	584.99					
Galapagos	77	ROV	ROV588	9	NET001	4/10/2023	7:09:20	0.03322	-91.58804	535.28					
Galapagos	77	ROV	ROV588	10	CQ004	4/10/2023	7:56:35	0.03145	-91.58562	471.58					
Galapagos	77	ROV	ROV588	11	CQ005	4/10/2023	8:06:53	0.03144	-91.58562	471.3					
Galapagos	77	ROV	ROV588	12	CQ006	4/10/2023	8:22:20	0.03093	-91.58501	449.07					
Galapagos	77	ROV	ROV588	13	SS001	4/10/2023	9:29:21	0.02760	-91.58317	371.96					
Galapagos	77	ROV	ROV588	14	RB002	4/10/2023	10:30:13	0.02590	-91.58271	297.23					

Site	Station No	Gear Code	Gear No	Event No	Event Gear No	Start Date	Start Time UTC	Start Lat	Start Long	Start Depth (m)	End Date	End Time UTC	End Lat	End Long	End Depth (m)
Galapagos	78	MBES	MBES23	1	EM124	4/10/2023	11:12:33	0.02713	-91.58296	338.79	4/10/2023	13:26:24	-0.2447	-91.6745	2282.58
Galapagos	79	CTD	CTD68	1	CTD68	4/10/2023	13:48:43	-0.24650	-91.67492	2241.46	4/10/2023	15:32:04	-0.2458	-91.6745	2281.24
Galapagos	80	ROV	ROV589	0	ROV589	4/10/2023	16:32:15	-0.26502	-91.67812		5/10/2023	10:17:43	-0.3013	-91.6668	
Galapagos	80	ROV	ROV589	1	RB001	4/10/2023	19:29:26	-0.26674	-91.67919	1619.67					
Galapagos	80	ROV	ROV589	2	CQ001	4/10/2023	19:59:36	-0.26711	-91.67939	1544.08					
Galapagos	80	ROV	ROV589	3	RB002	4/10/2023	20:08:49	-0.26710	-91.67939	1544.35					
Galapagos	80	ROV	ROV589	4	BB001	4/10/2023	20:17:16	-0.26717	-91.67937	1539.32					
Galapagos	80	ROV	ROV589	5	RB003	4/10/2023	20:35:17	-0.26791	-91.67963	1532.41					
Galapagos	80	ROV	ROV589	6	BB002	4/10/2023	21:18:07	-0.26932	-91.68009	1507.07					
Galapagos	80	ROV	ROV589	7	RB004	4/10/2023	21:58:52	-0.27103	-91.68065	1437.68					
Galapagos	80	ROV	ROV589	8	BB003	4/10/2023	22:12:43	-0.27170	-91.68075	1436.25					
Galapagos	80	ROV	ROV589	9	RB005	4/10/2023	22:42:02	-0.27242	-91.68068	1404.85					
Galapagos	80	ROV	ROV589	10	RB006	5/10/2023	0:35:09	-0.27640	-91.68143	1185.62					
Galapagos	80	ROV	ROV589	11	BB004	5/10/2023	0:44:21	-0.27664	-91.68131	1178.52					
Galapagos	80	ROV	ROV589	12	PCH01	5/10/2023	1:31:23	-0.28019	-91.68060	1059.89					
Galapagos	80	ROV	ROV589	13	BB005	5/10/2023	2:15:16	-0.28178	-91.68091	995.55					
Galapagos	80	ROV	ROV589	14	PCH02	5/10/2023	2:50:56	-0.28314	-91.68040	934.91					
Galapagos	80	ROV	ROV589	15	BB006	5/10/2023	4:26:49	-0.28806	-91.67605	719.94					
Galapagos	80	ROV	ROV589	16	CQ002	5/10/2023	5:02:45	-0.28917	-91.67533	626.8					
Galapagos	80	ROV	ROV589	17	CQ003	5/10/2023	6:15:12	-0.29377	-91.67288	601.85					
Galapagos	80	ROV	ROV589	18	CQ004	5/10/2023	6:18:01	-0.29374	-91.67288	601.81					
Galapagos	80	ROV	ROV589	19	CQ005	5/10/2023	6:52:34	-0.29564	-91.67236	550.37					
Galapagos	80	ROV	ROV589	20	CQ006	5/10/2023	6:59:50	-0.29565	-91.67239	550.76					
Galapagos	80	ROV	ROV589	21	CQ007	5/10/2023	7:23:13	-0.29674	-91.67224	486.6					
Galapagos	80	ROV	ROV589	22	CQ008	5/10/2023	7:43:28	-0.29735	-91.67145	421.48					
Galapagos	80	ROV	ROV589	23	CQ009	5/10/2023	7:46:56	-0.29734	-91.67146	421.49					
Galapagos	80	ROV	ROV589	24	DVL01	5/10/2023	9:40:01	-0.30141	-91.66766	341.7	5/10/2023	9:52:24	-0.3014	-91.6677	299.8
Galapagos	81	MBES	MBES24	1	EM712	5/10/2023	10:34:18	-0.29989	-91.66525	453.7	5/10/2023	14:12:29	-0.4207	-91.3785	91.9
Galapagos	82	XBT	XBT31	1	XBT31	5/10/2023	13:44:49	-0.41219	-91.35882	141.9					
Galapagos	83	ROV	ROV590	0	ROV590	5/10/2023	15:13:44	-0.42826	-91.36114		5/10/2023	20:18:02	-0.4225	-91.3753	

Site	Station No	Gear Code	Gear No	Event No	Event Gear No	Start Date	Start Time UTC	Start Lat	Start Long	Start Depth (m)	End Date	End Time UTC	End Lat	End Long	End Depth (m)
Galapagos	83	ROV	ROV590	1	BB001	5/10/2023	15:36:33	-0.42796	-91.36186	230.77					
Galapagos	83	ROV	ROV590	2	BB002	5/10/2023	17:21:13	-0.42746	-91.36329	216.51					
Galapagos	83	ROV	ROV590	3	RB001	5/10/2023	18:05:28	-0.42649	-91.36477	205.72					
Galapagos	84	MBES	MBES25	1	EM712	5/10/2023	20:29:53	-0.42294	-91.37542	118.25					
Galapagos	85	XBT	XBT32	1	XBT32	5/10/2023	21:26:36	-0.49416	-91.41379	490.73					
Galapagos	86	CTD	CTD69	1	CTD69	6/10/2023	1:45:34	-0.50665	-91.59592	638.64	6/10/2023	2:26:20	-0.5067	-91.5959	636.79
Galapagos	87	ROV	ROV591	0	ROV591	6/10/2023	2:52:38	-0.50618	-91.59774		6/10/2023	13:53:12	-0.4939	-91.6068	
Galapagos	87	ROV	ROV591	1	CQ001	6/10/2023	3:38:06	-0.50586	-91.59836	518.63					
Galapagos	87	ROV	ROV591	2	CQ002	6/10/2023	3:42:15	-0.50586	-91.59836	518.63					
Galapagos	87	ROV	ROV591	3	CQ003	6/10/2023	3:48:28	-0.50587	-91.59836	518.59					
Galapagos	87	ROV	ROV591	4	CQ004	6/10/2023	3:57:11	-0.50586	-91.59837	518.89					
Galapagos	87	ROV	ROV591	5	CQ005	6/10/2023	5:44:10	-0.50555	-91.59825	505.47					
Galapagos	87	ROV	ROV591	6	CQ006	6/10/2023	6:08:42	-0.50515	-91.59824	500.21					
Galapagos	87	ROV	ROV591	7	RB001	6/10/2023	7:53:57	-0.50377	-91.59752	430.88					
Galapagos	87	ROV	ROV591	8	CQ007	6/10/2023	8:09:31	-0.50299	-91.59732	400.54					
Galapagos	87	ROV	ROV591	9	CQ008	6/10/2023	8:22:45	-0.50294	-91.59728	395.58					
Galapagos	87	ROV	ROV591	10	CQ009	6/10/2023	8:34:49	-0.50283	-91.59735	394.2					
Galapagos	87	ROV	ROV591	11	RB002	6/10/2023	8:59:28	-0.50236	-91.59719	363.15					
Galapagos	87	ROV	ROV591	12	BB01	6/10/2023	10:26:04	-0.49861	-91.59587	194.81					
Galapagos	87	ROV	ROV591	13	CQ010	6/10/2023	10:39:45	-0.49861	-91.59587	194.85					
Galapagos	87	ROV	ROV591	14	RB002	6/10/2023	10:46:35	-0.49860	-91.59587	195.07					
Galapagos	87	ROV	ROV591	15	CQ010	6/10/2023	12:59:18	-0.49400	-91.60787	147.38					
Galapagos	87	ROV	ROV591	16	CQ011	6/10/2023	13:01:36	-0.49400	-91.60786	147.39					
Galapagos	87	ROV	ROV591	17	CQ012	6/10/2023	13:05:21	-0.49400	-91.60786	147.36					
Galapagos	87	ROV	ROV591	18	CQ013	6/10/2023	13:20:10	-0.49400	-91.60786	147.39					
Galapagos	88	MBES	MBES26	1	EM712	6/10/2023	14:02:39	-0.49394	-91.60686	184.1	6/10/2023	16:55:43	-0.3061	-91.6801	473.5
Galapagos	89	CTD	CTD70	1	CTD70	6/10/2023	17:23:11	-0.29347	-91.66801	562.95	6/10/2023	17:57:23	-0.2928	-91.6704	599.41
Galapagos	90	ROV	ROV592	0	ROV592	6/10/2023	18:36:23	-0.29363	-91.66359		7/10/2023	4:10:08	-0.3023	-91.6667	
Galapagos	90	ROV	ROV592	1	RB001	6/10/2023	19:33:37	-0.29383	-91.66268	634.7					
Galapagos	90	ROV	ROV592	2	CQ001	6/10/2023	20:15:01	-0.29511	-91.66339	549.98					

Site	Station No	Gear Code	Gear No	Event No	Event Gear No	Start Date	Start Time UTC	Start Lat	Start Long	Start Depth (m)	End Date	End Time UTC	End Lat	End Long	End Depth (m)
Galapagos	90	ROV	ROV592	3	CQ002	6/10/2023	20:30:21	-0.29534	-91.66356	533.63					
Galapagos	90	ROV	ROV592	4	CQ003	6/10/2023	20:45:36	-0.29565	-91.66392	504.02					
Galapagos	90	ROV	ROV592	5	CQ004	6/10/2023	20:52:35	-0.29565	-91.66392	503.99					
Galapagos	90	ROV	ROV592	6	CQ005	6/10/2023	21:01:44	-0.29562	-91.66394	504.23					
Galapagos	90	ROV	ROV592	7	NET001	6/10/2023	21:36:57	-0.29615	-91.66448	451.66					
Galapagos	90	ROV	ROV592	8	RB002	6/10/2023	22:10:04	-0.29683	-91.66477	388.78					
Galapagos	90	ROV	ROV592	9	CQ006	6/10/2023	22:22:44	-0.29683	-91.66476	388.85					
Galapagos	90	ROV	ROV592	10	CQ007	6/10/2023	22:50:20	-0.29686	-91.66477	387.31					
Galapagos	90	ROV	ROV592	11	RB003	6/10/2023	23:09:31	-0.29703	-91.66486	384.83					
Galapagos	90	ROV	ROV592	12	RB004	7/10/2023	0:50:04	-0.29977	-91.66932	368.42					
Galapagos	90	ROV	ROV592	13	RB005	7/10/2023	1:40:12	-0.30036	-91.66998	367.72					
Galapagos	90	ROV	ROV592	14	BB001	7/10/2023	1:45:32	-0.30036	-91.66999	367.71					
Galapagos	90	ROV	ROV592	15	BB002	7/10/2023	3:35:52	-0.30190	-91.66768	339.69					
Galapagos	91	MBES	MBES27	1	EM712	7/10/2023	4:28:16	-0.30498	-91.66976	493.2	7/10/2023	7:29:59	-0.6135	-91.6084	2397.8
Galapagos	92	XBT	XBT33	1	XBT33	7/10/2023	4:52:15	-0.33963	-91.68829	1530.4					
Galapagos	93	MBES	MBES28	1	EM124	7/10/2023	7:09:27	-0.57749	-91.62012	1848.4	7/10/2023	10:00:05	-0.8769	-91.5361	945.7
Galapagos	94	MBES	MBES29	1	EM712	7/10/2023	10:03:37	-0.88285	-91.53445	600.6	7/10/2023	15:07:58	-1.0022	-91.4632	840.34
Galapagos	95	XBT	XBT34	1	XBT34	7/10/2023	11:25:32	-1.00392	-91.45525	585.2					
Galapagos	96	CTD	CTD71	1	CTD71	7/10/2023	15:21:36	-1.00210	-91.46501	908.35	7/10/2023	16:12:33	-1.0021	-91.4650	
Galapagos	97	ROV	ROV593	0	ROV593	7/10/2023	16:42:32	-1.00100	-91.46220		8/10/2023	0:39:22	-1.0058	-91.4505	
Galapagos	97	ROV	ROV593	1	BB001	7/10/2023	17:32:23	-1.00092	-91.46114	738.46					
Galapagos	97	ROV	ROV593	2	BB002	7/10/2023	17:35:23	-1.00091	-91.46115	738.37					
Galapagos	97	ROV	ROV593	3	CQ001	7/10/2023	17:59:25	-1.00090	-91.46059	694.99					
Galapagos	97	ROV	ROV593	4	CQ003	7/10/2023	18:01:46	-1.00090	-91.46059	695.01					
Galapagos	97	ROV	ROV593	5	CQ004	7/10/2023	18:23:09	-1.00087	-91.46021	668.21					
Galapagos	97	ROV	ROV593	6	CQ005	7/10/2023	19:18:35	-1.00038	-91.45877	587.93					
Galapagos	97	ROV	ROV593	7	CQ006	7/10/2023	19:36:16	-1.00046	-91.45875	588.59					
Galapagos	97	ROV	ROV593	8	NET001	7/10/2023	20:46:22	-1.00079	-91.45616	501.17					
Galapagos	97	ROV	ROV593	9	CQ007	7/10/2023	21:03:50	-1.00073	-91.45604	492.22					
Galapagos	97	ROV	ROV593	10	RB001	7/10/2023	21:17:56	-1.00067	-91.45601	488.11					

Site	Station No	Gear Code	Gear No	Event No	Event Gear No	Start Date	Start Time UTC	Start Lat	Start Long	Start Depth (m)	End Date	End Time UTC	End Lat	End Long	End Depth (m)
Galapagos	97	ROV	ROV593	11	CQ008	7/10/2023	22:21:35	-1.00380	-91.45057	409.33					
Galapagos	97	ROV	ROV593	12	CQ009	7/10/2023	22:31:08	-1.00402	-91.45033	400.5					
Galapagos	97	ROV	ROV593	13	DVL001	7/10/2023	23:08:09	-1.00359	-91.45054	354.97	8/10/2023	0:04:07	-1.0032	-91.4502	344.94
Galapagos	98	MBES	MBES31	1	EM124	8/10/2023	5:55:51	-1.14697	-90.91254	1855.57	8/10/2023	6:33:39	-1.1640	-90.8456	1117.77
Galapagos	99	XBT	XBT35	1	XBT35	8/10/2023	6:18:19	-1.15715	-90.87305	1701.18					
Galapagos	100	MBES	MBES32	1	EM712	8/10/2023	6:31:25	-1.16299	-90.84959	1112.42	8/10/2023	8:13:08	-1.2018	-90.6656	669.13
Galapagos	101	ROV	ROV594	0	ROV594	8/10/2023	8:34:07	-1.20146	-90.66691		8/10/2023	12:54:00	-1.1970	-90.6656	
Galapagos	101	ROV	ROV594	1	MBES01	8/10/2023	11:02:52	-1.19560	-90.66603	517.3	8/10/2023	12:21:55	-1.1959	-90.6656	546.23
Galapagos	102	MBES	MBES33	1	EM712	8/10/2023	13:03:21	-1.19654	-90.66646	544.59	8/10/2023	17:46:16	-1.0988	-90.8662	589.77
Galapagos	103	CTD	CTD72	1	CTD72	8/10/2023	17:48:34	-1.09894	-90.86636		8/10/2023	18:23:12	-1.0992	-90.8665	592.8
Galapagos	104	ROV	ROV595	0	ROV595	8/10/2023	19:03:38	-1.10039	-90.86259		9/10/2023	7:58:31	-1.0833	-90.8556	
Galapagos	104	ROV	ROV595	1	MBES01	8/10/2023	20:50:50	-1.09849	-90.86389	685.59	8/10/2023	21:13:31	-1.0987	-90.8637	708.25
Galapagos	104	ROV	ROV595	2	MBES02	8/10/2023	23:37:41	-1.09270	-90.86093	540.25	9/10/2023	0:45:47	-1.0944	-90.8617	530.49
Galapagos	104	ROV	ROV595	3	VIDEO001	9/10/2023	0:47:43	-1.09432	-90.86169	530.49	9/10/2023	1:34:36	-1.0943	-90.8613	557.05
Galapagos	104	ROV	ROV595	4	CQ001	9/10/2023	1:57:44	-1.09371	-90.86121	525.58					
Galapagos	104	ROV	ROV595	5	RB001	9/10/2023	2:02:54	-1.09371	-90.86121	525.7					
Galapagos	104	ROV	ROV595	6	BB001	9/10/2023	5:50:07	-1.08221	-90.85499	360.59					
Galapagos	104	ROV	ROV595	7	RB002	9/10/2023	6:04:13	-1.08223	-90.85500	360.48					
Galapagos	105	MBES	MBES34	1	EM712	9/10/2023	8:16:41	-1.08680	-90.86675	366.85					
Galapagos	106	XBT	XBT36	1	XBT36	9/10/2023	10:14:59	-1.09158	-91.12215	330.61					
Galapagos	107	ROV	ROV596	0	ROV596	9/10/2023	12:29:01	-1.09035	-91.16687		10/10/2023	2:51:01	-1.0729	-91.1687	
Galapagos	107	ROV	ROV596	1	RB001	9/10/2023	13:36:24	-1.08943	-91.16678	937.48					
Galapagos	107	ROV	ROV596	2	CQ001	9/10/2023	13:44:54	-1.08936	-91.16680	936.2					
Galapagos	107	ROV	ROV596	3	RB002	9/10/2023	14:07:43	-1.08735	-91.16719	900.01					
Galapagos	107	ROV	ROV596	4	BB001	9/10/2023	14:14:46	-1.08733	-91.16721	900.07					
Galapagos	107	ROV	ROV596	5	RB003	9/10/2023	14:47:55	-1.08624	-91.16795	879.27					
Galapagos	107	ROV	ROV596	6	BB002	9/10/2023	15:20:25	-1.08452	-91.16812	835.48					
Galapagos	107	ROV	ROV596	7	RB004	9/10/2023	16:07:46	-1.08351	-91.16563	809.55					
Galapagos	107	ROV	ROV596	8	RB005	9/10/2023	16:41:32	-1.08345	-91.16507	802.88					
Galapagos	107	ROV	ROV596	9	RB006	9/10/2023	17:01:11	-1.08248	-91.16680	755.32					

Site	Station No	Gear Code	Gear No	Event No	Event Gear No	Start Date	Start Time UTC	Start Lat	Start Long	Start Depth (m)	End Date	End Time UTC	End Lat	End Long	End Depth (m)
Galapagos	107	ROV	ROV596	10	RB007	9/10/2023	17:18:48	-1.08269	-91.16599	768.95					
Galapagos	107	ROV	ROV596	11	CQ002	9/10/2023	17:54:31	-1.08121	-91.16680	689.35					
Galapagos	107	ROV	ROV596	12	RB008	9/10/2023	18:31:13	-1.08012	-91.16690	634.37					
Galapagos	107	ROV	ROV596	13	CQ003	9/10/2023	19:15:55	-1.07785	-91.16694	540.75					
Galapagos	107	ROV	ROV596	14	BB002	9/10/2023	19:23:42	-1.07786	-91.16694	540.73					
Galapagos	107	ROV	ROV596	15	BB003	9/10/2023	19:33:59	-1.07785	-91.16694	540.78					
Galapagos	107	ROV	ROV596	16	RB009	9/10/2023	20:17:10	-1.07523	-91.16715	430.27					
Galapagos	107	ROV	ROV596	17	CQ004	9/10/2023	20:21:46	-1.07523	-91.16714	430.32					
Galapagos	107	ROV	ROV596	18	CQ005	9/10/2023	20:41:59	-1.07432	-91.16720	378.68					
Galapagos	107	ROV	ROV596	19	RB010	9/10/2023	20:49:04	-1.07432	-91.16720	378.7					
Galapagos	107	ROV	ROV596	20	BB003	9/10/2023	21:14:48	-1.07436	-91.16721	379.56					
Galapagos	107	ROV	ROV596	21	CQ006	9/10/2023	21:25:59	-1.07436	-91.16721	379.4					
Galapagos	107	ROV	ROV596	22	PCH001	10/10/2023	0:58:04	-1.07311	-91.16729	302.76					
Galapagos	107	ROV	ROV596	23	CQ007	10/10/2023	1:21:21	-1.07243	-91.16792	250.31					
Galapagos	108	CTD	CTD73	1	CTD73	9/10/2023	15:24:36	-1.08499	-91.16787		10/10/2023	15:59:04	-1.0841	-91.1671	
Galapagos	109	MBES	MBES35	1	EM712	10/10/2023	2:56:35	-1.07286	-91.16874	264.55	10/10/2023	14:21:01	-0.5083	-89.9415	426.54
Galapagos	110	ROV	ROV597	0	ROV597	10/10/2023	14:45:36	-0.50811	-89.94117		11/10/2023	4:11:15	-0.5078	-89.9408	
Galapagos	110	ROV	ROV597	1	MBES01	10/10/2023	15:32:58	-0.50829	-89.94056	407.9	10/10/2023	17:30:24	-0.5074	-89.9406	420.81
Galapagos	110	ROV	ROV597	2	MBES02	10/10/2023	17:33:16	-0.50740	-89.94057	421.23	10/10/2023	17:42:49	-0.5074	-89.9406	413.27
Galapagos	110	ROV	ROV597	2	LSR01	10/10/2023	17:33:16	-0.50740	-89.94057	421.23	10/10/2023	17:42:49	-0.5074	-89.9406	413.27
Galapagos	110	ROV	ROV597	3	MBES03	10/10/2023	17:50:12	-0.50781	-89.94011	406.13	10/10/2023	23:53:27	-0.5082	-89.9401	389.98
Galapagos	110	ROV	ROV597	3	LSR02	10/10/2023	17:50:12	-0.50781	-89.94011	406.13	10/10/2023	23:53:27	-0.5082	-89.9401	389.98
Galapagos	110	ROV	ROV597	4	DVL001	10/10/2023	23:50:37	-0.50826	-89.94008	390	10/10/2023	3:11:58	-0.5073	-89.9401	432.23
Galapagos	110	ROV	ROV597	5	MBES03	11/10/2023	3:22:43	-0.50730	-89.94008	394.78	11/10/2023	3:43:42	-0.5078	-89.9401	364.78
Galapagos	111	CTD	CTD74	1	CTD74	10/10/2023	15:09:53	-0.50821	-89.94123		11/10/2023	3:44:15	-0.5077	-89.9413	
Galapagos	111	CTD	CTD75	1	CTD75	10/10/2023	15:34:00	-0.50850	-89.94140	451					
Galapagos	111	CTD	CTD76	1	CTD76	10/10/2023	15:57:00	-0.50830	-89.94120	447					
Galapagos	111	CTD	CTD77	1	CTD77	10/10/2023	16:23:00	-0.50840	-89.94120	444					
Galapagos	111	CTD	CTD78	1	CTD78	10/10/2023	16:48:00	-0.50840	-89.94130	447					
Galapagos	111	CTD	CTD79	1	CTD79	10/10/2023	17:12:00	-0.50840	-89.94130	448					

Site	Station No	Gear Code	Gear No	Event No	Event Gear No	Start Date	Start Time UTC	Start Lat	Start Long	Start Depth (m)	End Date	End Time UTC	End Lat	End Long	End Depth (m)
Galapagos	111	CTD	CTD80	1	CTD80	10/10/2023	17:36:00	-0.50840	-89.94130	448					
Galapagos	111	CTD	CTD81	1	CTD81	10/10/2023	18:02:00	-0.50840	-89.94130	431					
Galapagos	111	CTD	CTD82	1	CTD82	10/10/2023	18:27:00	-0.50830	-89.94080	440					
Galapagos	111	CTD	CTD83	1	CTD83	10/10/2023	18:51:00	-0.50820	-89.94030	429					
Galapagos	111	CTD	CTD84	1	CTD84	10/10/2023	19:14:00	-0.50810	-89.94040	80					
Galapagos	111	CTD	CTD85	1	CTD85	10/10/2023	20:06:00	-0.50740	-89.94070	398					
Galapagos	111	CTD	CTD86	1	CTD86	10/10/2023	20:27:00	-0.50740	-89.94070	398					
Galapagos	111	CTD	CTD87	1	CTD87	10/10/2023	20:48:00	-0.50750	-89.94060	394					
Galapagos	111	CTD	CTD88	1	CTD88	10/10/2023	21:08:00	-0.50760	-89.94050	395					
Galapagos	111	CTD	CTD89	1	CTD89	10/10/2023	21:27:00	-0.50760	-89.94050	394					
Galapagos	111	CTD	CTD90	1	CTD90	10/10/2023	21:49:00	-0.50800	-89.94080	80					
Galapagos	111	CTD	CTD91	1	CTD91	10/10/2023	22:39:00	-0.50830	-89.94090	437					
Galapagos	111	CTD	CTD92	1	CTD92	10/10/2023	23:02:00	-0.50830	-89.94090	437					
Galapagos	111	CTD	CTD93	1	CTD93	10/10/2023	23:40:00	-0.50830	-89.94090	407					
Galapagos	111	CTD	CTD94	1	CTD94	11/10/2023	0:01:00	-0.50770	-89.94090	406					
Galapagos	111	CTD	CTD95	1	CTD95	11/10/2023	0:20:00	-0.50770	-89.94090	80					
Galapagos	111	CTD	CTD96	1	CTD96	11/10/2023	1:11:00	-0.50770	-89.94090	405					
Galapagos	111	CTD	CTD97	1	CTD97	11/10/2023	1:33:00	-0.50770	-89.94090	403					
Galapagos	111	CTD	CTD98	1	CTD98	11/10/2023	1:54:00	-0.50770	-89.94130	410					
Galapagos	111	CTD	CTD99	1	CTD99	11/10/2023	2:16:00	-0.50770	-89.94130	408					
Galapagos	111	CTD	CTD100	1	CTD100	11/10/2023	2:37:00	-0.50770	-89.94130	404					
Galapagos	111	CTD	CTD101	1	CTD101	11/10/2023	3:00:00	-0.50770	-89.94130	404					
Galapagos	111	CTD	CTD102	1	CTD102	11/10/2023	3:22:00	-0.50770	-89.94130	402					
Galapagos	112	XBT	XBT37	1	XBT37	10/10/2023	4:56:13	-1.10308	-90.99320	716.53					
Galapagos	113	MBES	MBES36	1	EM712	11/10/2023	4:32:20	-0.50309	-89.93350	366	11/10/2023	5:45:37	-0.5074	-89.9435	508.39
Galapagos	114	ROV	ROV598	0	ROV598	11/10/2023	6:14:24	-0.50688	-89.94286		11/10/2023	10:28:15	-0.5065	-89.9390	
Galapagos	114	ROV	ROV598	1	STK001	11/10/2023	9:26:51	-0.50792	-89.94008	407.07					
Galapagos	114	ROV	ROV598	2	STK002	11/10/2023	9:37:55	-0.50753	-89.93976	438.52					
Galapagos	114	ROV	ROV598	3	STK003	11/10/2023	9:48:19	-0.50683	-89.93895	454.11					
Galapagos	114	ROV	ROV598	4	STK004	11/10/2023	9:55:32	-0.50606	-89.93881	472.33					

Site	Station No	Gear Code	Gear No	Event No	Event Gear No	Start Date	Start Time UTC	Start Lat	Start Long	Start Depth (m)	End Date	End Time UTC	End Lat	End Long	End Depth (m)
Galapagos	115	ROV	ROV599	0	ROV599	11/10/2023	12:10:51	-0.48713	-89.87175		11/10/2023	20:22:19	-0.4994	-89.8942	
Galapagos	115	ROV	ROV599	1	BB001	11/10/2023	15:32:05	-0.49536	-89.88241	302.72					
Galapagos	115	ROV	ROV599	2	SS001	11/10/2023	15:48:10	-0.49565	-89.88298	291.76					
Galapagos	116	CTD	CTD103	1	CTD103	11/10/2023	22:02:06	-0.48778	-89.87235		11/10/2023	22:30:00	-0.4878	-89.8723	
Galapagos	117	ADCP	ADCP3	1	ADCP3	11/10/2023	22:35:04	-0.48777	-89.87235		12/10/2023	7:24:00	-0.5541	-89.9583	
Galapagos	118	MBES	MBES37	1	EM712	11/10/2023	10:45:55	-0.50349	-89.92943	337.2	11/10/2023	11:50:30	-0.4873	-89.8731	
Galapagos	119	MBES-ADCP	EM712	1	EM712	13/10/2023	19:29:17	-0.75278	-90.22345		13/10/2023	21:38:33	-0.5042	-90.0300	
Galapagos	120	MBES	EM124	1	EM124	13/10/2023	21:38:42	-0.50388	-90.03446		15/10/2023	16:09:19	5.0026	-87.4603	
Coco	121	CTD	CTD104	1	CTD104	15/10/2023	16:16:27	5.00255	-87.46023	730	15/10/2023	16:51:00	5.00255	-87.46023	
Coco	122	ROV	ROV600	0	ROV600	15/10/2023	16:35:30	5.00254	-87.46020	730	16/10/2023	1:53:49	5.0025	-87.5602	
Coco	122	ROV	ROV600	1	BB002	15/10/2023	17:25:00	5.001308	-87.45984	690.24					
Coco	122	ROV	ROV600	2	CQ001	15/10/2023	18:12:00	4.998979	-87.45695	621					
Coco	122	ROV	ROV600	3	CQ002	15/10/2023	18:47:00	4.998072	-87.45503	583					
Coco	122	ROV	ROV600	4	CQ005	15/10/2023	19:32:00	4.997644	-87.45317	553.03					
Coco	122	ROV	ROV600	5	SS006	15/10/2023	20:34:00	4.99499	-87.44880	425					
Coco	122	ROV	ROV600	6	CQ010	15/10/2023	21:02:00	4.99440	-87.44810	404					
Coco	122	ROV	ROV600	7	CQ009	15/10/2023	21:06:00	4.99439	-87.44811	405					
Coco	122	ROV	ROV600	8	CQ011	15/10/2023	21:36:00	4.99290	-87.44694	359					
Coco	122	ROV	ROV600	9	SS005	15/10/2023	21:51:00	4.99234	-87.44632	343					
Coco	122	ROV	ROV600	10	CQ008	15/10/2023	22:14:00	4.99189	-87.44572	327					
Coco	122	ROV	ROV600	11	CQ013	15/10/2023	22:37:00	4.99137	-87.44481	303					
Coco	122	ROV	ROV600	12	CQ014	15/10/2023	23:00:00	4.99132	-87.44476	301					
Coco	122	ROV	ROV600	13	CQ003	15/10/2023	23:41:00	4.99095	-87.44333	273					
Coco	122	ROV	ROV600	14	CQ004	16/10/2023	0:15:00	4.99073	-87.44252	261					
Coco	122	ROV	ROV600	15	BB1A1	16/10/2023	0:42:00	4.99079	-87.44170	252					
Coco	122	ROV	ROV600	16	BB2C	16/10/2023	0:43:00	4.99080	-87.44170	251					
Coco	122	ROV	ROV600	17	CQ006	16/10/2023	1:05:00	4.99081	-87.44096	246					
Coco	123	MBES	EM712	1	EM712	16/10/2023	2:02:25	4.98960	-87.44186	222	16/10/2023	10:38:01	5.068462	-87.66256	
Coco	124	CTD	CTD105	1	CTD105	16/10/2023	11:00:00	5.06612	-87.66490	684	16/10/2023	11:39:00	5.0661	-87.6649	
Coco	125	ROV	ROV601	0	ROV601	16/10/2023	12:17:51	5.06576	-87.66493	608	17/10/2023	3:04:30	5.0813	-87.6432	

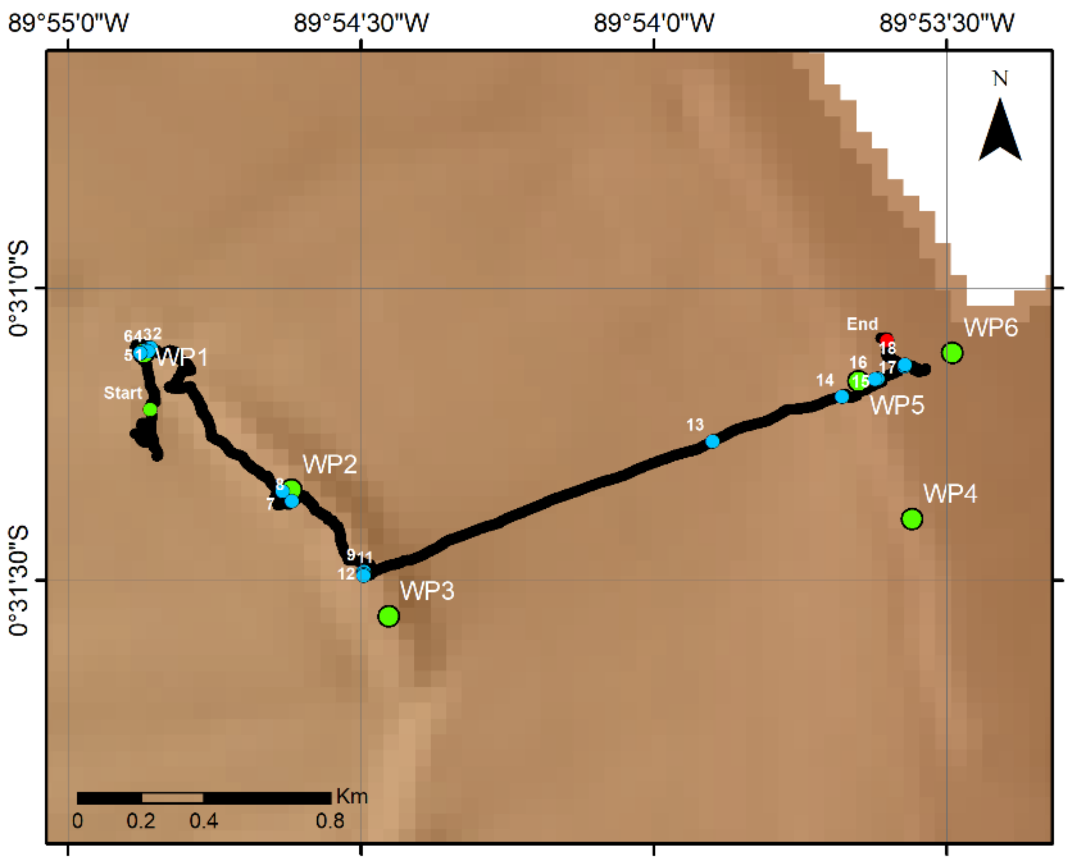
Site	Station No	Gear Code	Gear No	Event No	Event Gear No	Start Date	Start Time UTC	Start Lat	Start Long	Start Depth (m)	End Date	End Time UTC	End Lat	End Long	End Depth (m)
Coco	125	ROV	ROV601	1	CQ009	16/10/2023	13:07:00	5.06835	-87.66506	609					
Coco	125	ROV	ROV601	2	CQ011	16/10/2023	13:20:00	5.06835	-87.66504	609					
Coco	125	ROV	ROV601	3	CQ008	16/10/2023	13:32:00	5.06833	-87.66503	607					
Coco	125	ROV	ROV601	4	CQ012	16/10/2023	13:39:00	5.06833	-87.66503	606					
Coco	125	ROV	ROV601	5	CQ005	16/10/2023	13:44:00	5.06833	-87.66482	606					
Coco	125	ROV	ROV601	6	CQ012	16/10/2023	13:58:00	5.06833	-87.66482	606					
Coco	125	ROV	ROV601	7	BB2-C	16/10/2023	14:21:00	5.06832	-87.66462	577.9					
Coco	125	ROV	ROV601	8	CQ002	16/10/2023	14:33:00	5.06832	-87.66451	568					
Coco	125	ROV	ROV601	9	BB2-C	16/10/2023	14:48:00	5.06834	-87.66443	562					
Coco	125	ROV	ROV601	10	CQ007	16/10/2023	14:52:00	5.06834	-87.66443	562					
Coco	125	ROV	ROV601	11	CQ003	16/10/2023	15:15:00	5.06841	-87.66419	550					
Coco	125	ROV	ROV601	12	CQ001	16/10/2023	15:26:00	5.06837	-87.66418	551					
Coco	125	ROV	ROV601	13	CQ004	16/10/2023	15:38:00	5.06842	-87.66406	549					
Coco	125	ROV	ROV601	14	CQ006	16/10/2023	15:58:00	5.06858	-87.66381	539					
Coco	125	ROV	ROV601	15	SS002	16/10/2023	17:02:00	5.07025	-87.65938	533					
Coco	125	ROV	ROV601	16	SS003	16/10/2023	17:21:00	5.07026	-87.65938	532					
Coco	125	ROV	ROV601	17	CQ013	16/10/2023	19:18:00	5.07050	-87.65549	501					
Coco	125	ROV	ROV601	18	CQ010	16/10/2023	19:51:00	5.07075	-87.65498	498					
Coco	125	ROV	ROV601	19	CQ014	16/10/2023	20:03:00	5.07075	-87.65498	498.89					
Coco	125	ROV	ROV601	20	CQ016	16/10/2023	20:13:00	5.07074	-87.65480	496					
Coco	125	ROV	ROV601	21	CQ012	16/10/2023	21:18:00	5.07150	-87.65332	412					
Coco	125	ROV	ROV601	22	SS004	16/10/2023	21:27:00	5.07150	-87.65332	414					
Coco	125	ROV	ROV601	23	VV1-A1	16/10/2023	22:03:00	5.07156	-87.65173	365					
Coco	125	ROV	ROV601	24	BB3-E	16/10/2023	22:32:00	5.07172	-87.65116	362					
Coco	125	ROV	ROV601	25	SS005	17/10/2023	1:14:00	5.07840	-87.64388	221					
Coco	126	MBES	EM124	1	EM124	17/10/2023	3:30:10	5.08309	-87.62971	423	18/10/2023	16:27:00			

APPENDIX 2 ROV Dive Summaries

Dive S0577

1. Dive Plan: Dive S0577 was planned to traverse the ~1.2 km-long, NW-SE trending ridge feature in the breached caldera floor of the Cacho de Coral Seamount and traverse up to the summit to investigate several questions: 1) whether the ridge in the caldera floor is a relict central dike plug of the volcano, 2) observer whether the feature is a habitat for various coral species, live and fossil, and sample them, and 3) to observe and sample biology on this portion of the volcano and compare it to the pristine reef terrain on the northern shoulder of the caldera rim found on Alvin Dive 5162 in April 2023 (red dots on overall map below).

2. Dive Overview: The dive began at the west end of the ridge feature in ~500 m depth, with an initial traverse up slope to the NW to intersect the ridge. Basalt outcrops were observed with a wide variety of biology, both sessile and mobile on the walls. The outcrops had variable relief on steep 30-40° slopes that generally faced to the south as indicated by the bathymetric data. As expected, the local relief and re-entrants in the ridge were complex. Several ascents of the steeper section of the ridge were done by lateraling across to the SW and S, and then backing the ROV down slope in a generally SW direction. The ridge feature was explored for ~900 m along strike. At the eastern end of the ridge, at ~370 m depth, near the shallowest point of the ridge, the ROV went to the ESE to ascend the slope and reach the seamount summit where the dive ended.



3. Biological Sampling and Observations: Between waypoints 1-3 we encountered high diversity of corals on a hard substrate, including large colonies of *Madrepora*. We observed and sampled fauna associated with octocorals and black corals rock, fossil corals, cup coral, stylasterids, squat lobstersand, and black coral. During the transit between the dike ridge and the caldera rim large aggregates of brittle stars were observed. Rocks and fossil corals were encountered at the base of the rim. During the ascent to the rim, organisms were collected and observations made of Madrepora and cup corals. At the rim and summit, at ~130 m depth, basaltic rock outcrops had a cover of calcareous red algae and there were extensive rhodoliths beds at ~120 m depth. Importantly, no extensive coral reef, such as had been observed and sampled on the Alvin dive (5162) in April 2023, was observed.

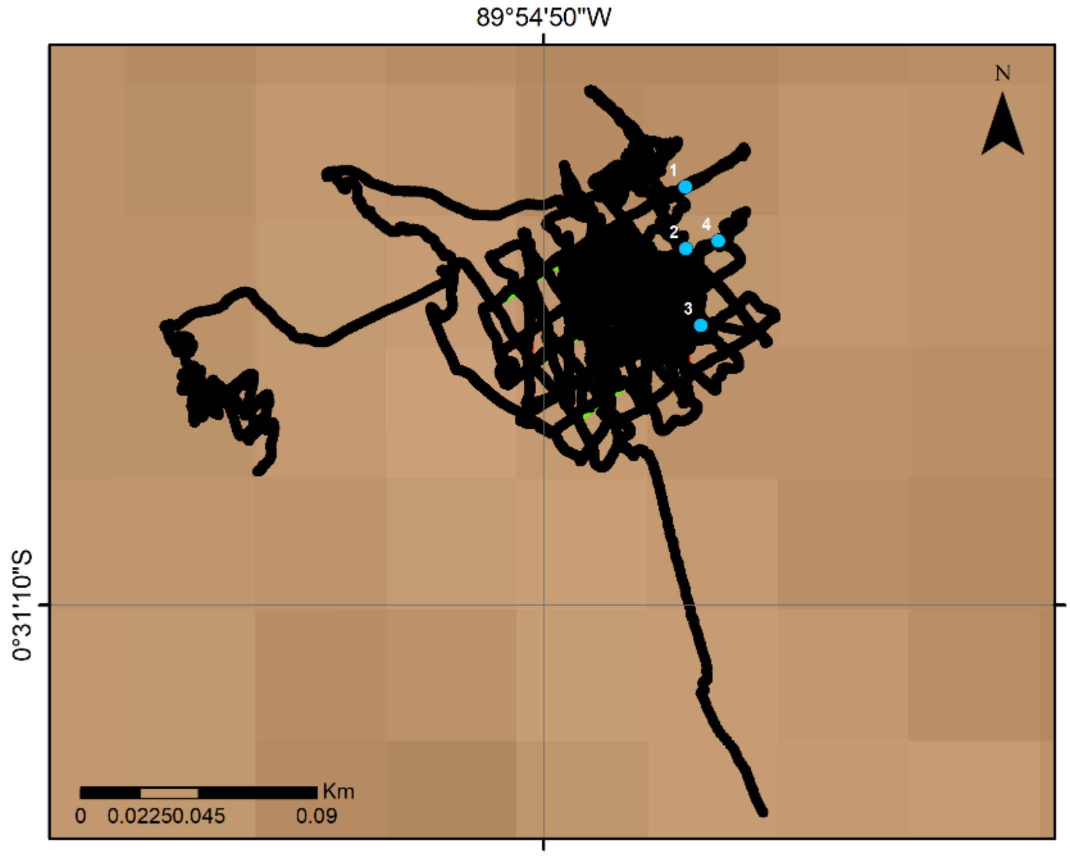
4. Rock Sampling and Observations: Three rock samples were collected during the dive at Events 1, 11 and 16. Event 1 (Rock #1; 10:01Z) is a rock sample from the area visited at the start of the dive and is a dense, diabase-like, fine grained basalt collected in situ from the outcrop at 498m depth. Rock#2 (Event 11; 15:43Z) is a rock collected in situ from an outcrop at 370 m depth near shallowest point of ridge prior to heading NE up to the top of the smt. The rock is a vesicular basalt. Rock #3 (Event 16; 18:26Z) was collected at 137m depth in situ from a large slab outcrop with extensive pink algal grown and small stylastrid corals. The rock is very dense, dike-like, diabase, similar in character to Rock #1. Rock #3 is a very large slab that was placed on the ROV basket and once on deck hammered into pieces to be able to properly store it.

5. Coral Sampling and Observations: Between WP1 and WP3, live hard coral specimens were abundant, and consisted mostly of the colonial scleractinian group *Madrepora sp.*, with some *Dendrophylia sp.* and *Desmophylum sp.*. Stylasterid corals were also abundant throughout this section, with at least 3 distinct skeletal colours (white, pink and purple) observed. The purple type were often found living in association with (i.e., growing on) *Madrepora sp.*. The substrate was often composed of a dead coral reef framework, samples of which are colonial scleractinian corals, possibly *Madrepora sp.*. Between WP1 and 3, we sampled fossil corals (using a net and also by picking pieces of the framework using the ROV arm), as well as live *Madrepora sp.* and *Desmophylum sp.*. We tried to sample a live stylasterid, however this sample became lodged in the slurp tubing and was not successfully collected. On transiting over the flat topography between WP3 and WP5, coral biomass was entirely absent. During our ascent of the sharp cliff from WP5 to WP6, no scleractinian corals were observed, but stylasterid specimens were observed, sparsely distributed, across the entire transect and on the top of the cliff north of WP6. We sampled one large individual stylasterid, as well as smaller individuals attached to a rock.

Dive S0578

1. Dive Plan: Dive S0578' objective was to map a small feature of the plug ridge identified as having abundant corals during dive S0577 at very high definition using the Norbit WMBS multibeam system (700kHz), the Micro Insight laser scanner, and the DVL in ADCP mode (600kHz).

2. Dive Overview: We prioritized settling up the Voyis software to talk directly to the Insight laser, trouble shooting and obtaining the best laser scanner settings for scanning in different benthic habitats. Initial dive objectives were delayed by problem solving how to store XYZ data and laser images on the ship NAS rather then the laser's internal memory, which was solved by correcting default software settings. We also resolved some issues with the NORBIT sonar, it was required to update the firmware during descent as there were problems connecting the NORBIT to the ROV navigation and attitude sensors. Additionally, the ROV DVL system had some connectivity issues unrelated to the NORBIT or Voyis laser system which were resolved by the ship marine technicians. During this time, mid-water imagery was collected by the ROV team of gelatinous fauna (siphonophores and ctenophores) and a seven armed cephalopod. When the ROV reached the seabed, some time was spent calibrating the laser, including the laser intensity, laser image exposure, and CTD measurement of seawater for index of refraction required for laser settings.



First transects were successful calibration transects (from 18:15 20-Sep-23 UTC) to determine post-dive processing offsets (ROV pitch and roll). A solo multibeam survey with the NORBIT sonar was conducted across the ridge at a higher altitude (10m). Transact lines for laser data acquisition in tandem with the NOBIT multibeam in overlapping vertical transects (56 in total) were conducted for coverage of one small feature: a ridge within the El Cacho de Coral site. The ridge features a steep rocky incline supporting a mixed invertebrate community including coral and sponge taxa, mobile invertebrates and fish mostly observed and described in the first ROV dive SO577. The base of the feature was surrounded by fairly coarse sediment, with indications of current influence through ripples at the ridge base and scour marks around small boulders. It is possible the ridge is formed of basalt but this was not confirmed. The ridge edge and slope were predominantly lined with cold-water corals (*Madrepora*, *Dendrophilia*, *Primnoa*, *Callogorgia*) and Stylasterids. An arborescent hexactinellid morphotype and demosponge fans occurred within the coral habitat along the ridge slope, with larger demosponge (cups and barrel shaped) became more abundant across the flatter top.

One outcrop from the feature was scanned again separately to test laser settings for a high resolution laser scan. This was a rocky surface supporting *Madrepora* with many associates (brittle stars, squat lobster, urchins, *Acesta* clams, encrusting demosponge & smaller cup corals). Note: laser settings for first scan: camera exposure 10ms, laser profile rate 50Hz, second scan: camera exposure 5ms and 100Hz laser exposure which dropped automatically to 70Hz (camera images were paused for this setting), third scan: 1.0ms laser camera exposure with 100Hz laser profile (also images paused).

Additionally, a Hexactinellid sponge and a crab on sandy bottom was scanned with the laser with the following settings:

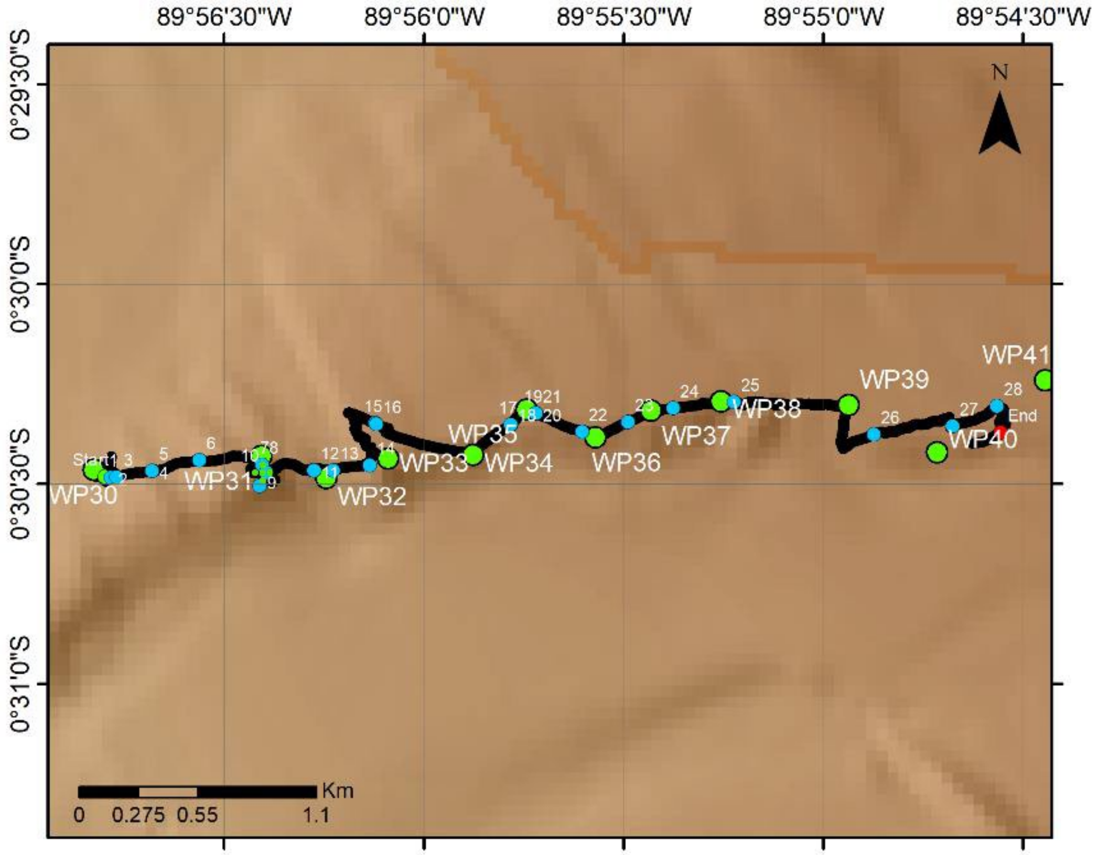
1. laser camera exposure 0.5ms, 100Hz (over exposed) (ROV altitude unknown)
2. laser camera exposure 1.0ms, then 2.0ms (both bad) (ROV altitude unknown)
3. At an altitude of 3m and 10mn laser camera exposure and 100Hz is okay, 5mn and 100Hz okay, 1.0ms with 100Hz at 2 meter ROV altitude is better.
4. 0.5ms laser exposure and 100Hz with 2 m ROV altitude, seems okay. Tried to reduce laser exposure to 0.2, but Voyis software automatically raised it to 0.5ms.
5. Final scan laser camera exposure 1.0ms, laser profile 100Hz with altitude of < 1.0m may be okay too.

A final ADCP+DVL+ NORBIT multibeam survey at 50m altitude. Along 100m transact lines at an ROV speed of 0.2 knots.

Dive S0579

1. Dive Plan: Dive S0579 was planned to traverse ~4.5 km along, the northern caldera rim of Cacho de Coral Seamount from a depth of ~590 m to ~212 m near the seamount summit plateau on the NE rim of the caldera. The objectives of the dive are to accomplish a broader investigation of the extent of pristine reef features discovered on Alvin dive 5162 in April 2023, carry out more detailed biological video transects along the caldera rim and sample biology and rocks from this portion of the volcano and determine the extent of the reef structure with repect to the O_2 min. layer (~320-380 m depth). We also plan to deploy two TCM-3 current meters that the Charles Darwin Research Foundation observers wish to leave for long term (~1 month and longer) measurements.

2. Dive Overview: The dive began west of the reef area observed on the Alvin dive on the WNW slope of the seamount outside the caldera rim and deeper than the terrain covered in the Alvin dive. The dive generally progressed from west to east covering the shoulder of the caldera rim and occasionally taking the ROV laterally down the inside slope of the caldera (while facing into the slope) and then ascending the upper caldera rim while moving to the E and NE. Fossil coral samples were taken from deeper depths than those collected on Alvin 5162 as well as further north at shallower depth from the Alvin sampling site. Biological samples were collected along the dive track to cover the diversity of species as well as locations that are below, in, and above the O_2 min. layer. Some coral samples were preserved in RNA-later. Additionally, some larger biological samples were taken to collect 'associates', animals living on the various coral communities.



3. Biological Sampling and Observations: Observations began at 565 m depth on a large area covered by dense coral rubble. Abundant living coral dominated by *Madrepora* was observed as we ascended the slope towards the Alvin Dive 5162 area, with a sparse presence of *Dendrophyllia*, squat lobster and an increase in the biodiversity with the presence of living coral, including octopus, rat tail fish, anemones, sea urchins, sharks, and scorpionfish. The amount of living coral reef-dominated living *Madrepora* increased and decreased across the dive with a higher abundance at ~460m. Eventually, the substrate changed to a mix of sand and coral rubble with a few corals; in these environments the primary fauna were rat tail fish, sea pens and tube anemones. The fish community was rich with many rat tail fish, green eyed fish, and cat-sharks. Rocky outcrops are colonized by *Madrepora* and Stylasterids, and diverse massive encrusting and few glass sponges. We also observed and sampled *Paragorgia arborea* and observed several octopus. There werecorals communities that presented a high number of associates (squat lobsters of various sizes and brittle stars) and several of these corals and associates were sampled.

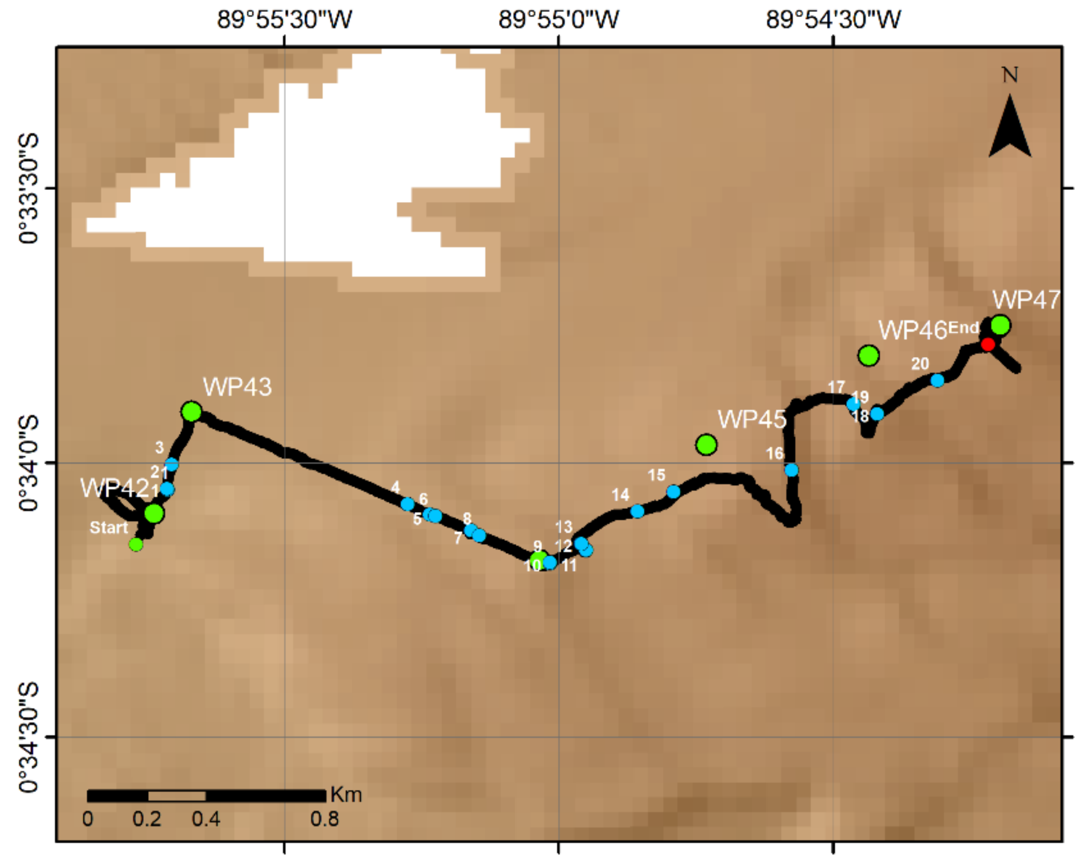
4. Rock Sampling and Observations: Two rock samples (#4 and #5) were collected during the dive at Events 14 and 27 (398 m and 251 m depths, respectively) from outcrops of basalt associated with the NW-SE trending ridge features on the shoulder of the caldera rim. These features appear to be underlying structures that served as the host substrate for the development of the coral reefs observed. The orientation of the features is puzzling given the generally radial/circumferential orientation of feeder dikes that are commonly found in Galápagos volcanoes that control caldera geometry. The NW-SE trending structures may be subsidence related and appear to be at a slightly different orientation than similar features on the southern rim / shoulder of the caldera where they are oriented more WNW-ESE.

5. Fossil Coral Sampling and Observations: The substrate on landing was composed entirely of coral rubble, dominantly Madrepora sp.. Many organisms were clearly living in this substrate, but live coral cover was sparse. 1 net of fossil corals was taken close to the start of the dive (event 2, 560 m depth) – the net handle snapped under the weight of the sample taken but handle and full net were successfully recovered. On transiting toward the live reef found during Alvin dive 5162, coral rubble continued to be the dominant substrate feature. Coral cover became more consolidated and more like a framework toward the base of the live reef. A second net of fossil corals was sampled as close to the start of the live reef as possible (event 6, 480 m depth). Transit through the live reef was much as expected, with significant cover of live coral with a diversity of species. A third and final net of fossil corals was taken in another dense aggregation of fossil corals (possible dead reef framework) at shallower depth (event 21, 330 m).

Dive S0580

1. Dive Plan: Dive S0580 was planned to traverse ~3.4 km along the basal southern caldera rim of Cacho de Coral Seamount from a depth of 720 m to 360 m to compare the biological communities ~6 m south of the area traversed on Dive D0579 and determine if the extensive coral reef observed on the northern caldera rim also extends on the southern caldera.

2. Dive Overview: There was about 1.5 hrs of BBC filming of mid-water critters during the descent to the seafloor, and again mid-dive around 2200 UTC in an area of large, isolated basalt outcrops that hosted large and diverse coral communities. We landed in the small depression at the southern end of the caldera shoulder and ascended to the NNW over a moderate slope of mostly carbonate gravel/sands with few outcrops and many white holothurians. The traverse to the ESE took us to the steeper portion of the caldera rim and we began to see corals at ~609 m depth, although the main coral framework of Madrepora was not observed until we got above ~580 m depth. There were indistinct current indicators in the sediment - at times there was mottled dark/light areas where the volcanic sand had been winnowed, but no well-defined current marks were observed until shallower in the dive when the long axis of the ripples was generally E-W. The prominent E-W ridge like features that cut across the caldera shoulder were founds to be outcrops of basalt and talus. A rock sample (#6) was collected at 456 m depth approx. mid-way along the track from one of these outcrops. The dive progressed up slope encountering numerous talus and boulder fields (some may be outcrops) where abundant coral communities were established. Coral samples were collected where larger aggregations of corals were observed in a variety of environments and depth intervals. Similarly, fossil coral scoops were collected at 3 locations (Events 9, 14 and 16) between 476 and 373 m depth.



3. Biological Sampling and Observations: We observed continuous fields of coral rubble and coarse carbonate sediment with a community of cerianthids, flat-fish, eels and small invertebrates. We searched for the reef along the feature and found coral communities present intermittently on boulder outcrops, we never found an expansive reef (similar to what was observed on the north rim of the seamount) to warrant the amount of coral rubble we witnessed. Below the OMZ (400-500 m) the coral community included large colonies of primnoids, black corals, large sponges, and various species of pexaurids. Colonies of *Madrepora*, *Dendrophyllia* and cup corals were present on rock and rubble. We saw cat shark, scorpion fish, rat tail fish and octopus, *Bathyraja abyssicola*. We documented and sampled fauna associated with octocorals and black corals, rocks, fossil coral, cup coral, and stylasterid.

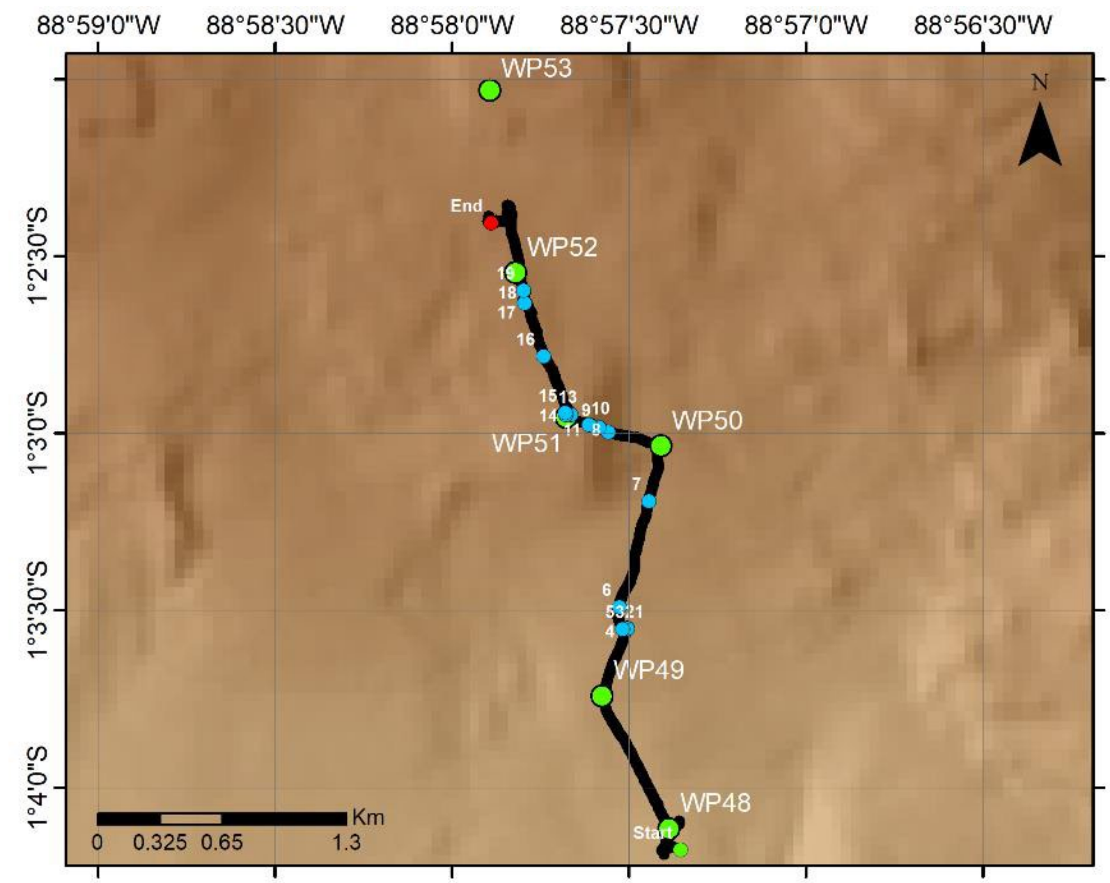
4. Rock Sampling and Observations: One rock sample (#6) was collected during the dive at 02:22 (Sept. 23) at Event 15 (456 m depth) from an outcrop of basalt associated with the WNW-ESE trending ridge feature on the shoulder of the caldera rim. After cutting rock #6, it appears to be a volcaniclastic/hyaloclastite with clear small pumice fragments, some rounded, and other shards of lava and with possible baked carbonate sediment and calcareous shells, & coral fragments in the volcanic matrix which is sparsely vesicular.

5. Coral Sampling and Observations: No fossil (or live) corals were found in the early stages of this dive. As the dive progressed to shallower depths, the first substantial aggregation of dead coral was sampled at 480 m (event 9). The substrate in this region was dominated by dead coral rubble, which consisted mostly of Dendrophyllia sp. and Madrepora sp.. Later in the dive, a second fossil coral net was taken at 470 m depth (event 14). At this site, cover of fossil rubble was not as extensive, with metre-scale variations between sand-dominated and rubble-dominated substrate. The third net was taken at a shallower depth of 370 m (event 16). On the approach to this sample, substantial quantities of dead coral were observed in the substrate. Live corals, although present, were relatively rare.

Dive S0581

1. Dive Plan: Dive S0581 was planned to investigate the southern flank of part of the large seamount complex east of San Cristobal (Smt 4) to collect lava samples on the deeper flows as well as look for possible coral communities and vertical scarps and sample corals and other fauna below and within the oxygen minimum zone (~375 m).

2. Dive Overview: There was about 1 hr of BBC filming of mid-water critters during the descent to the seafloor. The start of the dive was on a moderate slope of largely carbonate sediment/sand covered seafloor from ~820 m up to 648 m depth, at which point basaltic and carbonate outcrops were observed. The first rock samples were taken between ~642 -616 m depth. Additional coral samples were collected from a range of environments between ~600 to ~355 m depth, where rocky outcrops and substrate hosted various coral communities. Aggregations of fossil corals were observed in several locations and samples collected at 408 and 337 m depth. A prominent feature was encountered near the end of the dive at 337 m depth that was clearly a resistant rib of dike rock sticking out of the sedimented terrain (total relief of ~1-1.5 m), oriented ~N-S (current was mostly from the west), that was continuous for 20-30 m along strike and hosted a wide variety of corals and other animals. In situ rock sample (rock#14) and animals were sampled from this feature.



3. Biological Sampling and Observations: Between waypoints 48-50, we encountered a sandy sediment community including xenophyophores, cerianthids, polychaetes (*Biremis* sp.?), holothurians, sea pens and multiple fish species. Boulders were rare but provided substrate for small Primnoid, a thin morphotype of *Madrepora* and Stylasterids. Between waypoint 50-51 rocky volcanic substrate increased and supported an anemone-dominant community. Moving up slope from waypoint 50 to 51 the area was covered by anemones, a few fish and sponges with scattered presence of corals. At the top of the sea mount were large rocks covered with *Madrepora* and several crustaceans, and the sediment was covered with crinoids. There was only one colony of *Dendrophyllia* visible. Moving from waypoint 51 to 52, the sea bed showed significant changes in fauna initially; the sediment was covered with sea pens, then many sea urchins and fewer sea pens. A vertical outcropping dike was observed covered in corals, sponges and different echinoderms, especially crinoids and a few brisingids. Octopus and diverse fish were observed, including a few Red Gurnad.

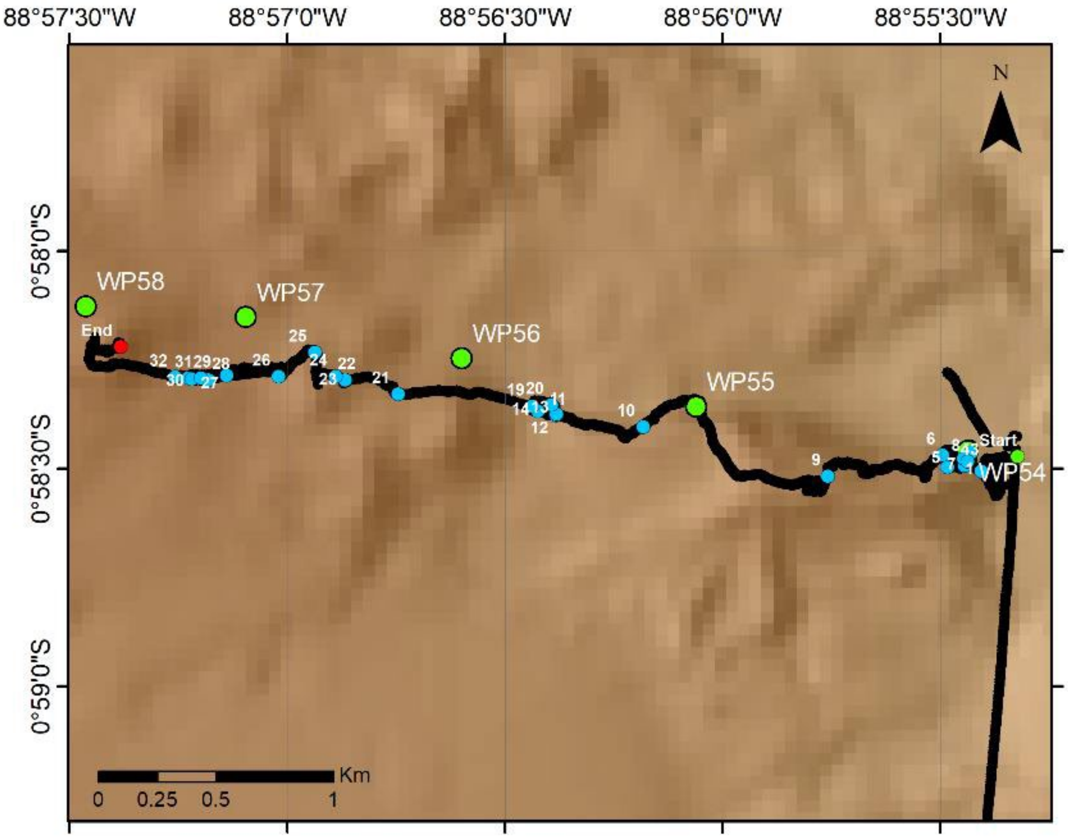
4. Rock Sampling and Observations: Eight (8) rock samples were collected during the dive along the full length of the traverse. Rocks 7&8 were of sedimentary origin, consolidated, coarse grained carbonate with admixed angular volcanic fragments. Rock 9 was a loose piece of talus that when cut was noted to be vesicular and with possible carbonate fragments incorporated into the lava matrix- similar to rock#6 on Dive S0580 where a volcaniclastic/hyaloclastite showed clear incorporation of carbonate material into the lava.
Additional rock samples were collected from outcrops between 616 to 358 m depth (Rocks #10-13). At the end of the dive a prominent, linear spine of rock outcrop was observed that extended for ~20-30 m along a strike of approx. north that hosted abundant coral and other fauna. Rock #14 was sampled from the dike in situ, and showed a surprisingly vesicular matrix for a presumed dike rock, possibly due to the shallow nature of the feeder on eruption.

5. Coral Sampling and Observations: The start of this dive was somewhat deeper than previous dives, and a primary aim of the fossil coral sampling on this expedition is to sample corals from as great a depth as possible. Unfortunately, significant aggregations of fossil corals were not encountered until around 400 m water depth, where a sample of framework-forming fossil coral was taken (event 8). A second net was taken at 360 m (event 14), close to an outcrop heavily colonized by live corals. Interestingly, this net included multiple large (5 to 10 cm) and robust stylasterid fossil samples, which are rarely found owing to their small size and the highly porous nature of their skeletons, which promotes dissolution. A final net was taken from the underside of the prominent dike feature encountered toward the end of the dive (340 m, event 17), with specimens in the net largely reflecting the diversity observed in living corals on the outcrop.

Dive S0582

1. Dive Plan: Dive S0582 was planned to investigate a vertical wall along a fault on the eastern flank of the seamount that cuts across the basal flank and continues to near the crest of the northern peak. The aim is to look for high-resolution mapping targets and collect benthic imagery, coral samples and lava samples between a depth range of ~720 m to ~500 m.

2. Dive Overview: The dive was successful in sampling a diversity of corals at various depths with respect to the O2 min. zone along the generally E to W traverse along the scarp face, as well as representative rock outcrops. The traverse was done with the ROV pointing into the scarp - generally heading north, while the vehicle lateralled up and down and diagonally across the scarp. Several areas towards the middle to west end of the scarp were identified as good targets for detailed mapping and some video and forward-looking multibeam traverses were carried out in preparation for the high-res. laser and multibeam mapping dive.



3. Biological Sampling and Observations: A vertical wall close to way point 54 was the focus of mapping and as a result the ROV only reached waypoint 55 at shift change. The first observation was to the bottom of the feature, which was measured to be roughly 115 meters high. The bottom of feature was marked by volcanic rock feeding into coarse gravely sediment organised within ripples. Biological imagery was collected laterally across the wall, and environmental data was collected in the same area with Multibeam, and ADCP with DVL surveys. *Madrepora*, primnoids, *Acanthogorgia*, chrysogorgids, *Victorgorgia* and sponges (notable large Euplectinellidae vases) occupied the wall at ~657 m. The ridge edges as the ROV moved towards waypoint 55 ~ 630 m and shallower supported patches of high diversity including *Acesta* clams, anemones and large giant blue and yellow *Muricea* (Plexauridae) with associates, and fan sponge taxa colonising the rocky substrate. Large (>2 m^2) *Callogorgia* species were positioned on the outer edges of walls hosted numerous crabs of at least 3 species (chirostylid, *Munida*, and homolid) with one colony hosting as many as 15 individuals poised on the branches. A number of fish species were present, including sharks (one potential identified as a rough shark) and chimaeras. Transiting from 55 to 56 there was no visible fauna, with the exception of a few ophiuroids that are partially buried in the biogenic sediment. But when the sediment changed to hard substrate, diversity increased, including several yellow octocorals, some of them *Acanthogorgia*. A few white sea urchins and several fish, including Ateleopodiformes, Gadiformes and two elasmobranch species, catshark and chimera (Galápagos ghost shark) were observed. In some vertical walls, the communities of corals were rich and dominated by different species of white primnoids, some of them very large with many associated crustaceans and ophiuroids. The sedimentary environments consisted of coarse sand with biogenic (shells and dead corals) and clastic material. Some sections had very large numbers of fly-catching anemones, in other sections white sea urchins and sea pens. Closer to the rocks, there were fossil corals. Moving up wall, every horizontal patch was covered with fossil rubble and the verticals walls with prinmoids, other small species of octocorals, many species of sponges, cup corals and *Madrepora* (some were thin). Decorating crabs with very long chelae were present. Top of features had dead coral framework. Moving along other vertical walls were encountered and on and below ledges there were sponges, crabs, basket stars, urchins and fishes. On the rocks *Madrepora* and several species of octocorals were observed. The top of every feature visited had dead coral framework. In shallower waters (300-350 m) the walls had seastar (cushion star), *Madrepora*, octocorals and sponges. Some sections had 1-2 m wide and several meter long chasms.

4. Rock Sampling and Observations: 5 rocks were sampled during the dive from exposed outcrops along the scarp face. Well-developed submarine lava forms (pillows, tubes and some lobate flows/crusts) were observed on flow front/eges as well as within some of the exposed sections of the scarp face. At other times the scarp face was near vertical, rugged and with variable talus at the base. There was heavy Mn coating on most of the rock surfaces.

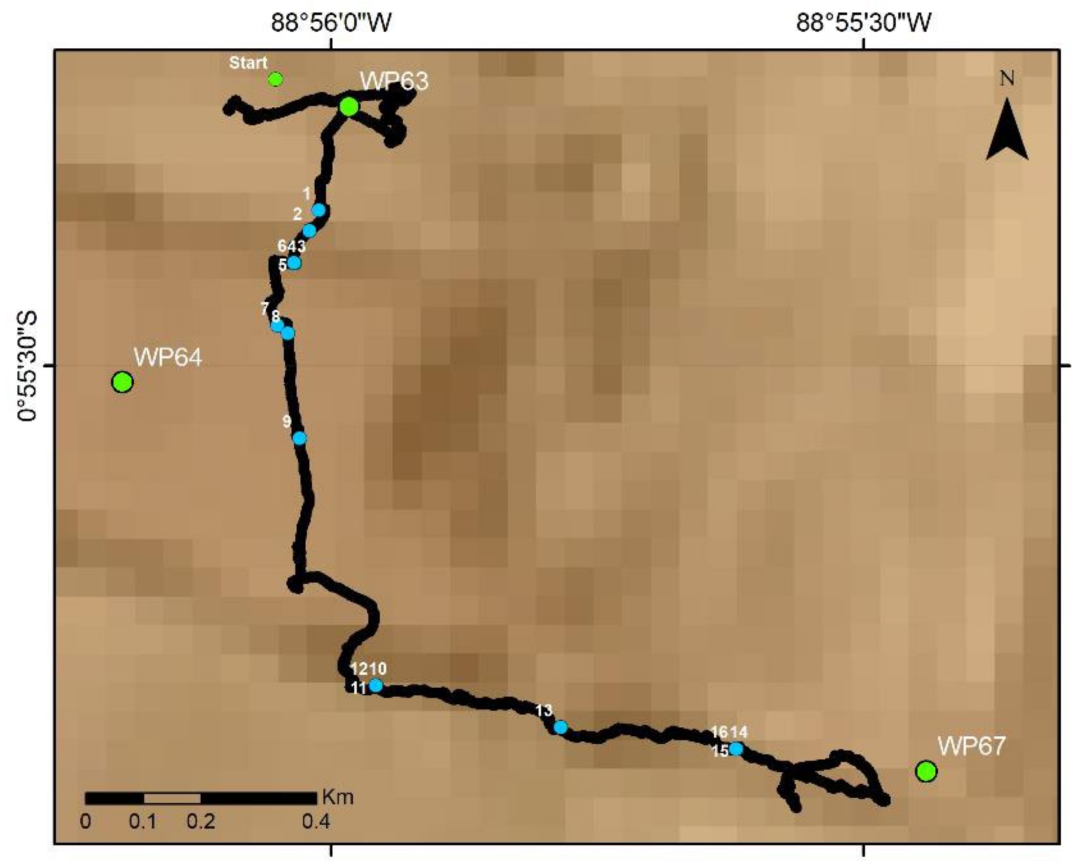
5. Coral Sampling and Observations: Owing to a break of the handle on one of the previous dive, we only had 2 fossil coral nets for this dive. The first specimens taken were found while transiting a substantial vertical wall, where dead Desmophyllum were encountered still attached to the wall. 5 of these were sampled using the slurp tube – these were well-preserved, fairly pristine but clearly dead. Two nets of coral were then sampled from sediments at 660 m (event 5) and 540 m (event 9). Some solitary cup corals were observed in the sediment during sampling. A final fossil coral sample was taken between waypoints 57 and 58, where a substantial amount of dead coral framework was found. This framework was observed throughout the shallower portions of this dive. 3 very large (> 20 cm) pieces of this framework were sampled using the grabber. These could contribute to efforts to date the substantial accumulations of coral framework found on the east of the Platform. Whether all these specimens died contemporaneously is an interesting hypothesis worthy of further investigation.

Dive S0583

1. Dive Plan: Dive S0583 was planned to investigate a plateau feature that trends E-W with N- and S-facing vertical walls (~80+ m in height) to the north of our previous dives (S0581 and S0582). The aim is to collect benthic imagery and lava samples.

2. Dive Overview: The dive proceeded from the seafloor north of the plateau feature, up the north-facing wall and across the top of the plateau and then down the south-facing scarp that is continuous for several kilometers in a generally E-W trend. The seafloor north of the plateau is sedimented and relatively featureless with occasional outrcops of what appear to be the tops of broad lobate flows, with some outcrops forming large piles of fractured basalt pieces. The N and S walls are very steep- often vertical and at times with some overhangs. The face of the walls is smooth suggesting a faulting origin. Representative samples of the basalt were recovered from the north side of the feature. Corals were sampled along the traverse at various depths, and fossil corals, especially fossil cup corals at one outcrop where they were abundant at the base.

3. Biological Sampling and Observations: Water column filming on the descend, observed *Solmissus* and *Pelagothuria,* ctenophores and squid. The bottom was sandy with an organic cover and few organisms, some observed were: cerianthid, anemone, and a few sea urchins. Between 720-690 m there were basalt blocks with a veneer of sediments, and had few organisms, some stylsterids, sponges, hydroids, anemone. The first Rough shark was observed. Rocks with less sediments and what appear to be hydroids had rich biota. Basalt rock with thin morpho of *Madrepora* and sediment with at least two species of seapens. The presence of *Madrepora* was common in this area. A huge black coral probably *Leiopathes* was observed. A rare cat shark was observed . Moving over the edge of the cliff continue to observe volcanic rocks colonised by *Madrepora*, stylasterids and some octocorals. At the base of the outcrop ripples were observed at the very edge. A vertical wall was explored which covered by *Acesta*, some octocorals (*Chrysogorgia* and muricids) as well as some other tubular organisms that seem to be polychaetes. As the ROV goes deeper diversity and abundance seem to decrease, but a around 720-730 m water depth the wall presents a protuberance with much more diverse and abundant fauna growing on it; base of the vertical wall. The wall was mostly bare rock with no major fauna on it, only tiny stylasterids, small tunicates, holothurians and orange hag fish. The wall is covered with organic matter. But at the cliff corners there is much more life. At 770m, another isolated aggregation of primnoid with anthomastid corals appear on a cliff corner and base sponges.



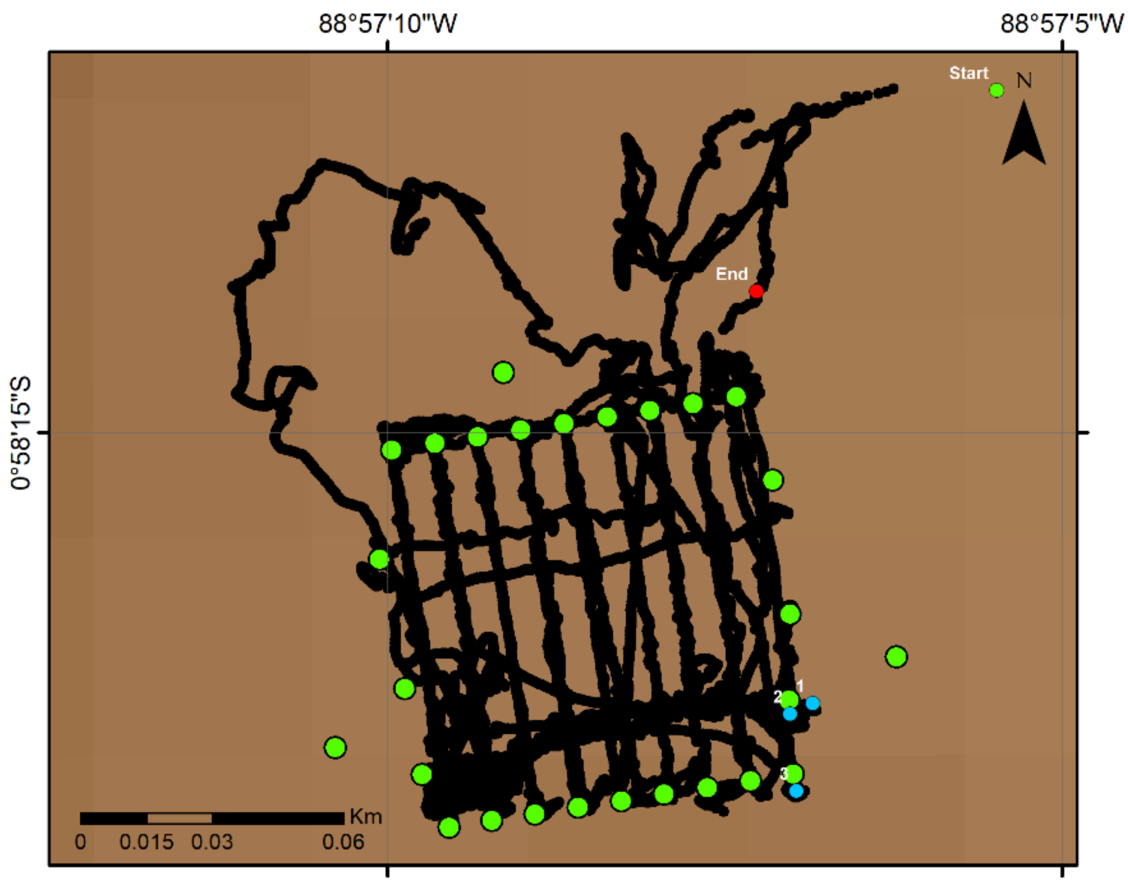
4. Rock Sampling and Observations: 2 rocks were sampled in the first part of the dive near the northern side of the plateau feature.
Some of the outcrops on the top of the plateau appeared to be broad massive lobate flows that had fractured and broken up in place creating mounds of large angular talus, some up to ~1 m in size.
All of the outcrops appeared to be heavily coated in Mn.

5. Coral Sampling and Observations: Near the top of the feature at WP64 was a sandy plateau, with numerous rock outcrops. Many of these approx. 1 - 2 m high rocks hosted a large number of live cup corals, dominantly Desmophyllum. At the base of one of these rocks, we sampled a net which yielded a large number (approx. 50) of fossil cup corals. The sediment pile was deep enough that we were able to dig down into the sediment, which exposed more fossil cup corals of presumably older age. More fossil coral sampling was expected at the base of the large vertical wall, however no large aggregations were sampled. Instead, a live stylasterid colony was sampled (800 m), whose longest branch (10 cm) could represent around 100 years of growth and thus be a valuable oceanographic record.

Dive S0584

1. Dive Plan: Dive S0584's objective was to explore a vertical walls on the terraces south of Isabela. The aim was to look for high-resolution mapping targets and carry out vertical multibeam mapping.

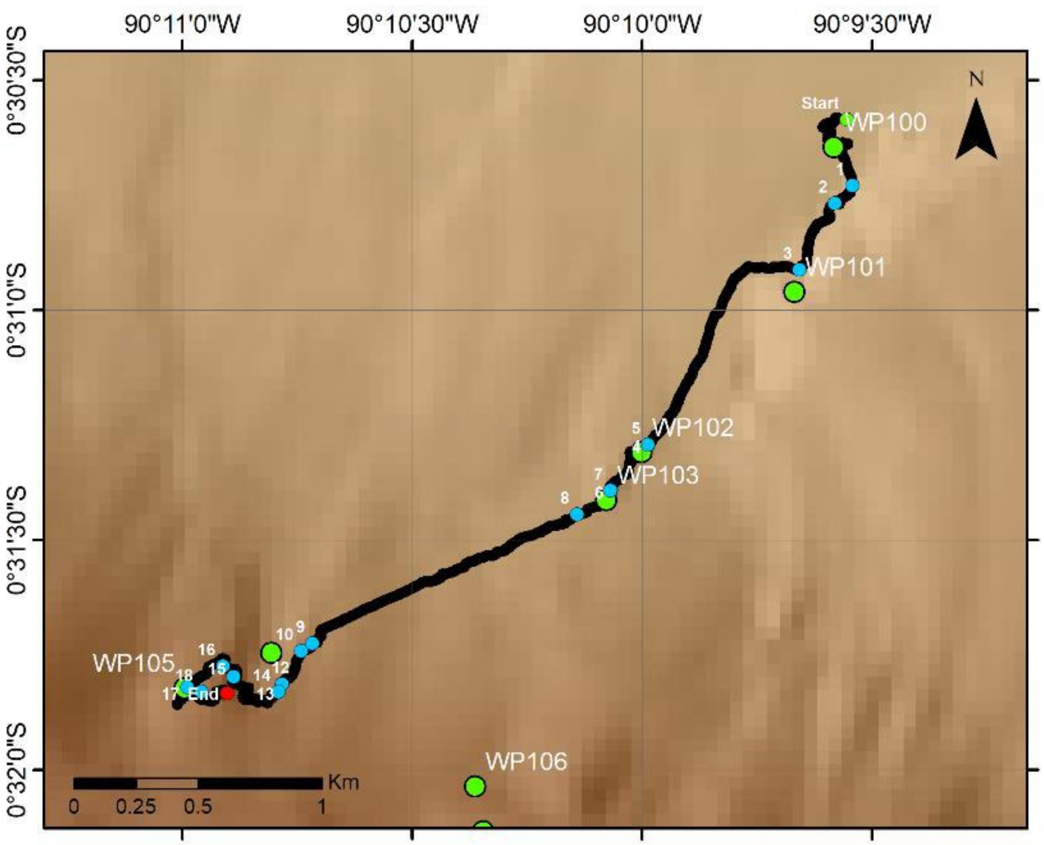
2. Dive Overview: This dive carried out laser mapping of a rocky vertical wall which had been previously surveyed with the MBES on the bumper bar (S082). The base of the outcrop had fossil *Madrepora* with anemones. The rock formation had live *Madrepora*, anemones, basket stars and other organisms. Laser and multibeam mapping started at 15:01:28 and 79 lines were collected (completed at 20:26:12). Every so often, with no apparent pattern, small fish will appear swim for a few minutes in front of the ROV and leave. It will be interesting to see if the fish caused additional noise to the laser scanner data. 32 lines of ADCP surveys were then carried out (completed at 9/29/2023 03:14:54). Norbit MBES tests then followed with the ROV off bottom at 03:46 UTC.



Dive S0585

1. Dive Plan: Dive S0585 was planned to investigate deeper flow fronts at the base of the platform in ~920 m depths and SSW traverse along the front to collect lava samples *in situ* and then traverse the slope up to a ~N-S trending scarp feature to collect benthic imagery, coral samples and additional lava samples. This portion of the shallow slope margin had not been previously mapped nor have there been any direct observations of the biology and geology of the deep seafloor in this portion of platform

2. Dive Overview: The dive began in sedimented seafloor at ~920 m depth with some holothurians, rat tail fish and brittle stars. After a 30-40 min traverse up slope a contact was observed at ~912 m depth with well formed pillows. Two lava samples were collected at events 1&2 from 912 m and 907 m depth. There was a brief interruption in ops because of a power brown-out on the ship that affected the internet, GPS positioning/DP, and comms from the bridge to the ROV control room. At about 880 m along the traverse the rock outcrops diminished and more sedimented slope began. Another rock outcrop was observed along the track at the event 3 location (844 m depth) where a crumbly lava crust was sampled in situ. Another sedimented bench was traversed up to ~777 m depth where events 4&5 sampled angular basalt pieces from the flow front. Numerous biological samples were collected during the traverse up to ~450 m depth (events 6-16) that included coral samples placed in RNAlater to correlate with other samples on previous dives that were found below and within the O2 min zone. The dive ended at 311 m depth after sampling a lava outcrop with some biology at Event 18 (Rock#27). Because of time constraints, the W to E transit along the shallower portion of the slope was not able to be accomplished.



3. Biological Sampling and Observations: Bottom consisted of rocks with a high coverage of sediments; observed sea cucumbers, a stylasterid with worms and an octopus protecting its eggs. Moved up slope on a sediment substratum dominated by ophiuroids and some holothurians. Followed by soft sediment with very low diversity and bioturbation was evident. Substrate changed to rubble near Waypoint 102, followed by alternations of homogenous sandy sediments and rubble fields. On the lava there was a patchy community, at 760 m, with different primnoids, paramurids(?) *Crysogorgia*, anemones, stylastrids and basket stars. On another lava field, large stalked crinoids and small stylasterids were observed. Moving up slope, species of paramuriceids and pseudo-anthomastids were observed, as well as octocorals and hard corals. At 700 m the bottom consisted of sand with the occacional rocky outcrop with corals, and the sandy areas with abudance of echinomers (holutharians, sea stars and brittle stars), and a variety of chimeras and ratail fish. At 682 m there were more rock outcrops with stylasterids and white primnoids. Observed a blob sculpit (*Psychrolutes* sp.). Sandy areas were traversed where a red brittle star was abundant, one with an octopus. The dive ended on a rocky outcrop at 306 m. The rocks had sponges (several species) and stylasterids.

4. Rock Sampling and Observations: 6 rocks were sampled along the dive transect. The basal lavas collected in situ at ~900 m depth were both plagioclase rich basalts with little to no vesicles with some Mn coating and no apparent glass (perhaps some glass can be found when the rocks are processed at BSU). This is the first sampling of basalt on flow fronts at the base of the north-central portion of the Galápagos Platform. Rock 24 at event 3 location, which was observed to be very crumbly, is a hyaloclastite with angular to sub-angular shards (~<0.5 cm) of basalt in a weathered matrix of altered glass and carbonate sand. Rocks 25&26 were collected within 2 m of each other and are also plagioclase rich basalts with little to no vesicles. The final rock (#27) collected at shallow depth (311 m) is a fine-grained vesicular basalt that had abundant biological material attached.

5. Fossil Coral Sampling and Observations: Fossil coral sampling during this dive was made challenging by the substrate and a general lack of fossils. However, 1 net of fossil corals was sampled toward the end of the dive, at a dense aggregation of dead colonial scleractinians (event 13; 390 m). The net included large pieces of Madrepora and one extremely long and robust branch of fossil Dendrophyllia. The size of the pieces of coral was such that sampling was more effective when the grabber was used to pick up individual pieces of coral, rather than using the net.

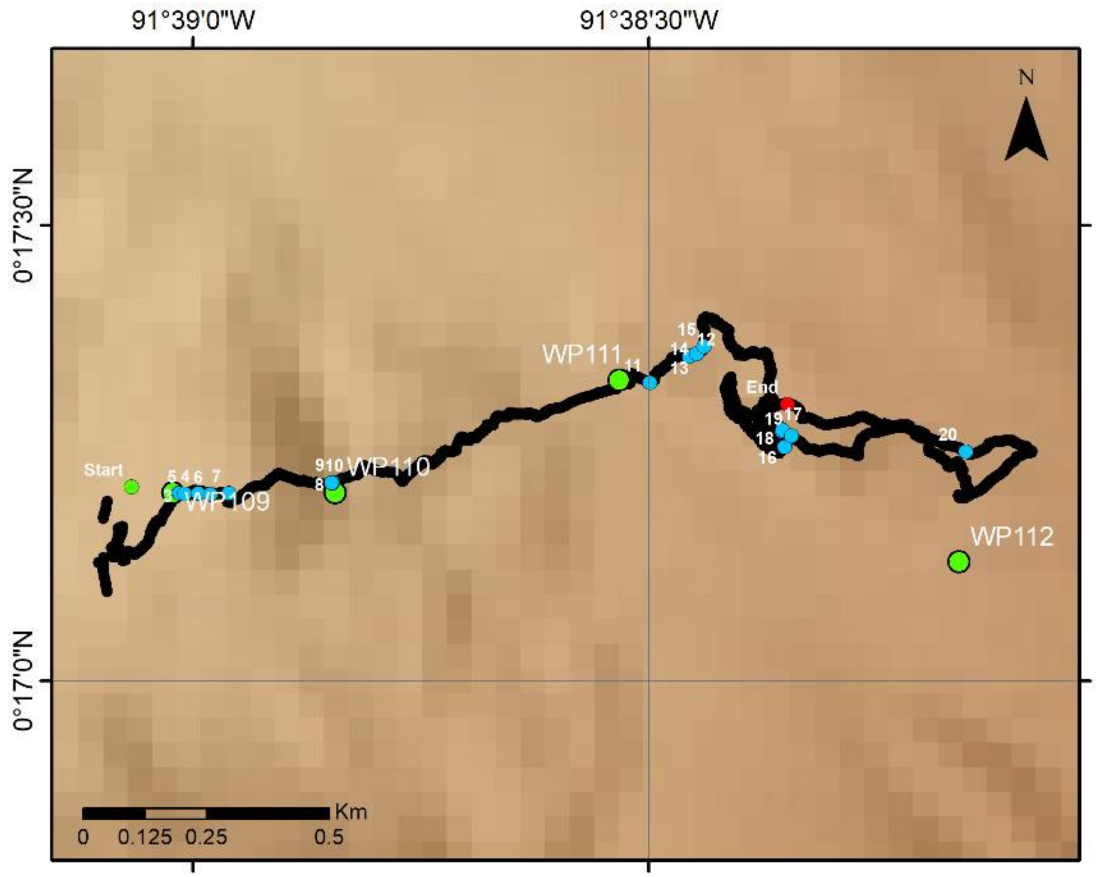
Dive S0586

BBC Filming Dive

Dive S0587

1. Dive Plan: Dive S0587 planned to explore a ridge feature along a depth gradient on the northern side of Roca Redonda. The aim is to collect benthic imagery, coral samples and lava samples in this area of high productivity on the NW side of the Galápagos Platform.

2. Dive Overview: The dive landed at 930 m depth and proceeded upslope to the NE to cover terrain that was found to be variably covered by mostly volcanic talus sediment with little carbonate. At the landing site there was a concentration of small shrimp and 'dandelion' colonial siphonophores on angular basalt talus. The dandelions are similar to those observed at the Galápagos Spreading Center at 86°W in 1977, and has been observed at other mid-ocean ridge hydrothermal sites. The traverse encountered abundant coral, sponge and other fauna which was expected given the high productivity in this western and northern portion of the archipelago. The base of the main scarp feature occurs at ~800 m depth and contained well-formed large pillows and other volcanic forms, including exposures of columnar jointed basalt suggesting that the scarp may be part of the feeder dike 'skeleton' framework of Roca Redonda, as displayed in the EM124 bathymetry. At ~650 m depth, on a bench in the scarp, abundant fossil corals were found at the base of the rock wall and sampled - the rock wall above this sample site contained abundant large living cup corals. The top of the scarp was found to be at ~570 m depth with abundant cup corals on the rock face with vase sponges and a wide diversity of soft and hard corals. The terrain above the top of the scarp was primarily carbonate and volcanic sediment and basalt rubble with less abundant biology but continued presence of stylasterid corals. The dive ended at ~468 m depth with a sample taken of madrepora coral from the reef area. That sample was stored in RNA-later.



3. Biological Sampling and Observations: This was a deep dive to basalt debris fields at over 900 m depth, with flytrap anemones, and many small shrimps on the rocks, plus benthic syphonophorans, sponges, some corals (*Anthomastus*, a gorgonian). At 860 m the density of shrimp declined moving out of the rubble field into the pillow lava. At 850 m density of the sponge *Conorete erectum* increased. Top of the ridge-like feature at 827 m covered by *C. erectum*, *Chrysogorgia* and some other octocorals. At 794 m there are less corals (*Acanthogorgia*) with hydroids, anemones and incrusting sponge with papillia, much more sedimentation on rocks. Section of columnar basalts at 792 m, with anemones and small sponges. Shear wall quickly became talus slope with pockets of sediment, sponges, chrysogorgids, rat tail fish. Corals and sponges at 737m on the wall. Colonies of stylasterids and white sponges increased in size while traversing up the wall. Substrate consisted of volcanic sand, with *Callogorgia* on rock. *Madrepora* colonies larger along with *Victorgorgia*, chrysogorgids, and stylasterids at the top of the wall. At 619 m, three species of black coral together: *Bathypathes,* *Parantipathes* and cladopathidae(?), along with *Chyrsogorgia*, yellow octocoral and *Desmophyllium*. Between 620 and 640 m on loose basalt blocks, high densities of cup corals were observed and collected. In shallower waters many multi-tubular sponges were observed. In the shallowest part of the dive between 410 and 390 m there were many colonies of *Madrepora*, live and dead, some covered with crinoids.

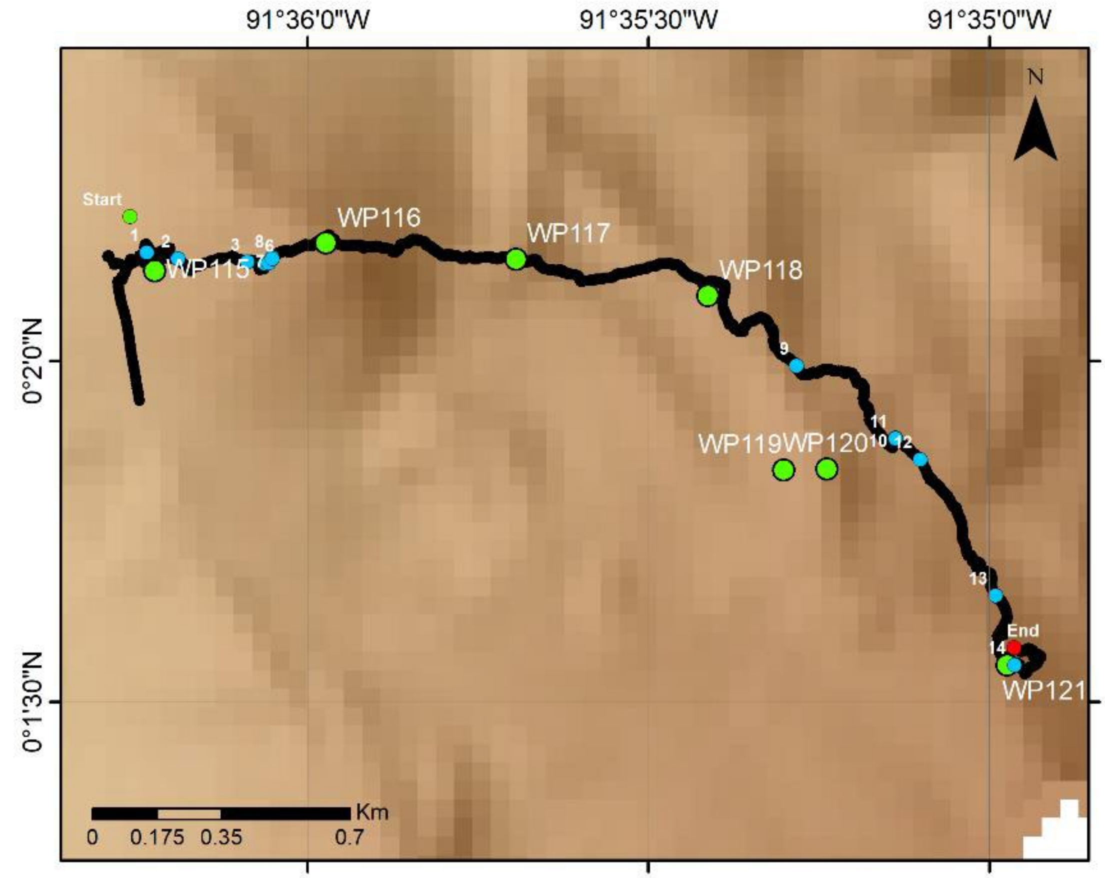
4. Rock Sampling and Observations: Four rocks were sampled, one event (Rock #30) was talus collected in a scoop net along with fossil corals and Rock#31 was collected in situ using a net along with live cup corals)

5. Fossil Coral Sampling and Observations: No collections of fossil corals were made for much of this dive, owing to a paucity of large fossil aggregations and the difficulty associated with sampling the rocky substrate using nets. When transiting the vertical wall which was mapped and imaged during this ROV dive, a large number of live corals – including extremely large Desmophyllum cup corals – were observed, and at one point during the video transect we observed an accumulation of dead cup corals on a small ledge on the wall. We therefore returned to this point, and sampled large (fist-sized) fossil cup corals using the grabber, before using the net to sample smaller individuals in greater numbers. This net also brought up a number of rocks. Finally, we sampled a rock which had a number of live Desmophyllum growing on it. 2 of these will be taken to Bristol for geochemical analysis, to provide a valuable modern tie point for temporal records. The remainder of these live specimens were given to the CDF.

Dive S0588

1. Dive Plan: Dive S0588 was planned to explore a small ridge as well as a few small scarps. The aim is to collect benthic imagery, coral and lava samples.

2. Biological Sampling and Observations: During the descent, squids and pelagic holothurians were observed; reached the bottom at 23:13:07, 760 m. Rocky outcrops with many stylasterids, *Chrysogorgia*, yellow octocorals and other soft corals, including a large *Paragorgia* with seastars and a *Victorgorgia*. A scree slope with urchin spines, *Acesta* shells and some corals fragments at 677m, with erosive characters was encountered with few organism. The few large boulders among the scree slope (650 m) had sponges and corals. At around 640 m the terrain changed and had Mn crust with *Madrepora*, anemones, *Acesta*, sponges, stylasterids, chrysogorgids, cup corals and urchins. At the top of the feature there seems to be a lower abundance of *Madrepora* and a higher abundance of yellow gorgonians with blue tips but moving down on the other side there was a strong current and more *Madrepora*. Area with pillow lavas and fallen coral rubble at 650 m, with the seafloor community composition similar to before. Ascending to 470 m and shollower, entering the Oxygen Minimum Zone (OMZ) large *Madropora* stands start to make an appearance and reaching the OMZ at 450 it became a *Madropora* dominated coral reef. At 370 m a most dead coral framework was encountered and ir was covered by uncountable numbers of brittle stars. At 311 m rocky outcrops had hundreds of sun seastars along with living *Madrepora*. There and shallower, many stylasterids were observed, together with a rich fauna, including nudibranchs, cup corals and ophiuroids, polychaete tubes and squat lobsters.



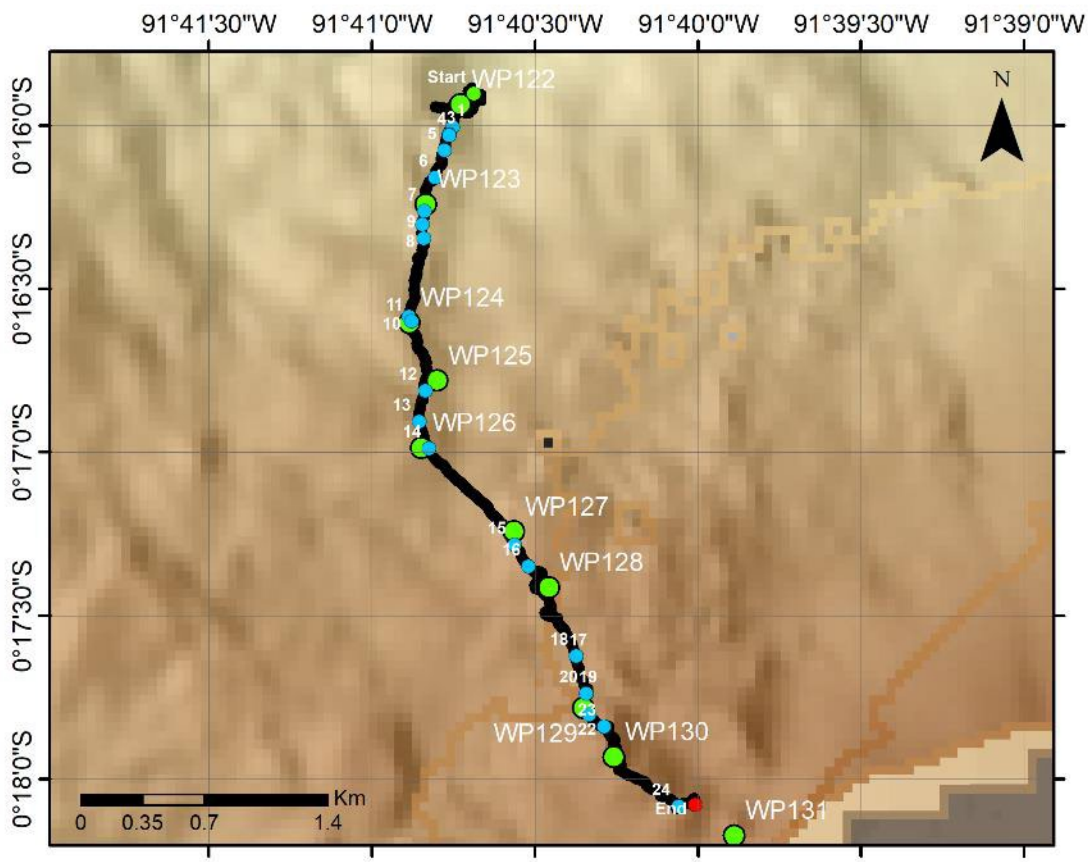
3. Rock Sampling and Observations: Four rocks representative rocks were collected at several depths along the traverse from 727 m to 297 m to characterize the lava outcrops along this northern section of the platform that had never been sampled previously and how the basalts relate to the subaerial lavas erupted from Volcans Ecuador and Wolf, the two northern volcanoes on Isabela.

4. Fossil Coral Sampling and Observations: No fossil corals were observed at the start of this dive, with the substrate dominantly characterised by rocky scree and/or pillow basalts. On ascending to shallower depths, dead coral framework was encountered, and a small net of samples was taken at ~ 534 m (event 9). As we continued to ascend, brittle stars covered the substrate, which included substantial quantities of dead coral framework, as well as dead solitary cup corals. No further fossil samples were taken. However, a large stylasterid fan was taken from ~ 300 m depth, growing attached to a rock (event 14). This fan has branches from 5 to 7 cm in length and could represent growth over 50 to 100 years.

Dive S0589

1. Dive Plan: The dive was planned to traverse the volcanic terrain on the northern flank of the NW submarine rift zone of Fernandina volcano between ~1690 m and 370 m depth. We plan tow cross specific volcanic constructional features and flow fronts that will provide exposures for in situ rock sampling and hopefully fossil coral deposits. The aim is to collect benthic imagery, coral and lava samples with abundant glassy crusts for geochemical analyses.

2. Dive Overview: The dive traversed a variety of flow types on the north flank of the submarine rift between ~1620-720 m depths. The dominant morphology was oblate and rounded pillows, but some areas of lobate and possible sheet flows were encountered and in one area there were prominent, deep (~5-8m?) collapse pits that may have been eruptive fissures as drainback was observed along the curved margins of the collapse (rocks #40 &41 were from that terrain). The slope is comprised of a series of volcanic constructs - mound features (constructional slopes on all sides), ~10-20 m high and in some cases hornitos or possible vents (rooted) were observed at the tops of pillow, and tubular pillow outcrops. There were variable amounts of sediment along the track, in some areas on the deeper section it was mostly intertwined lava morphologies, further up the slope more talus and volcanic sediment was encountered. At the base of vertical to overhanging constructional walls, extensive talus aprons were observed. Bamboo corals were observed on the bare basalt and a few were sampled. At ~620 m depth and continuing to ~420 m, more corals were observed and sampled to collect specimens from below and in the OMZ (Events 16-23). At ~350 m depth an expanse of live coral reef was observed and a small sample of madrepora was collected, but none of the fossil coral was recovered. The dive ended at the NW end of the ridge structure in the reef terrain.



3. Biological Sampling and Observations: Starting with a rocky substrate mainly basalt. The event 2 was the sampling of a pink *Swiftia* like coral cover by green/yellow zoanthids. Later a zone with the presence of bamboo coral. The event 4 was sampling a bamboo coral. Through the video transect there was a zone were the sea cucumber (*Elipinion sp.*) was present. At 420 we reached a dense Madrepora reef, which also hosts pockets of dendrophilia and lots of small lollypop shaped shapes and squat lobster. Current was very strong -it was very hard to pilot ROV in the desired direction. Reaching the top of the ridge at 380m the cold water coral reef is as dense as at Cacho de Coral site with lots of live desmophyllum.

4. Rock Sampling and Observations: 11 lava samples were collected, all in situ, between depths of ~1620-720 m along north flank of the NW submarine rift of Fernandina. NOTE: no rocks were cut from this dive to preserve the samples intact for processing at BSU and picking glass - all samples should have good glass, except perhaps the last one, #46... but there may be a bit on it too.

The dive traversed a variety of flow types on the north flank of the submarine rift between ~1620-720 m depths. The dominant morphology was oblate and rounded pillows, but some areas of lobate and possible sheet flows were encountered and in one area there were prominent, deep (~5-8m?) collapse pits that may have been eruptive fissures as drainback was observed along the curved margins of the collapse (rocks #40 &41 were from that terrain). The slope is comprised of a series of volcanic constructs - mound features (constructional slopes on all sides), ~10-20 m high and in some cases hornitos or possible vents (rooted) were observed at the tops of pillow, and tubular pillow outcrops. There were variable amounts of sediment along the track, in some areas on the deeper section it was mostly intertwined lava morphologies, further up the slope more talus and volcanic sediment was encountered. At the base of vertical to overhanging constructional walls, extensive talus aprons were observed.

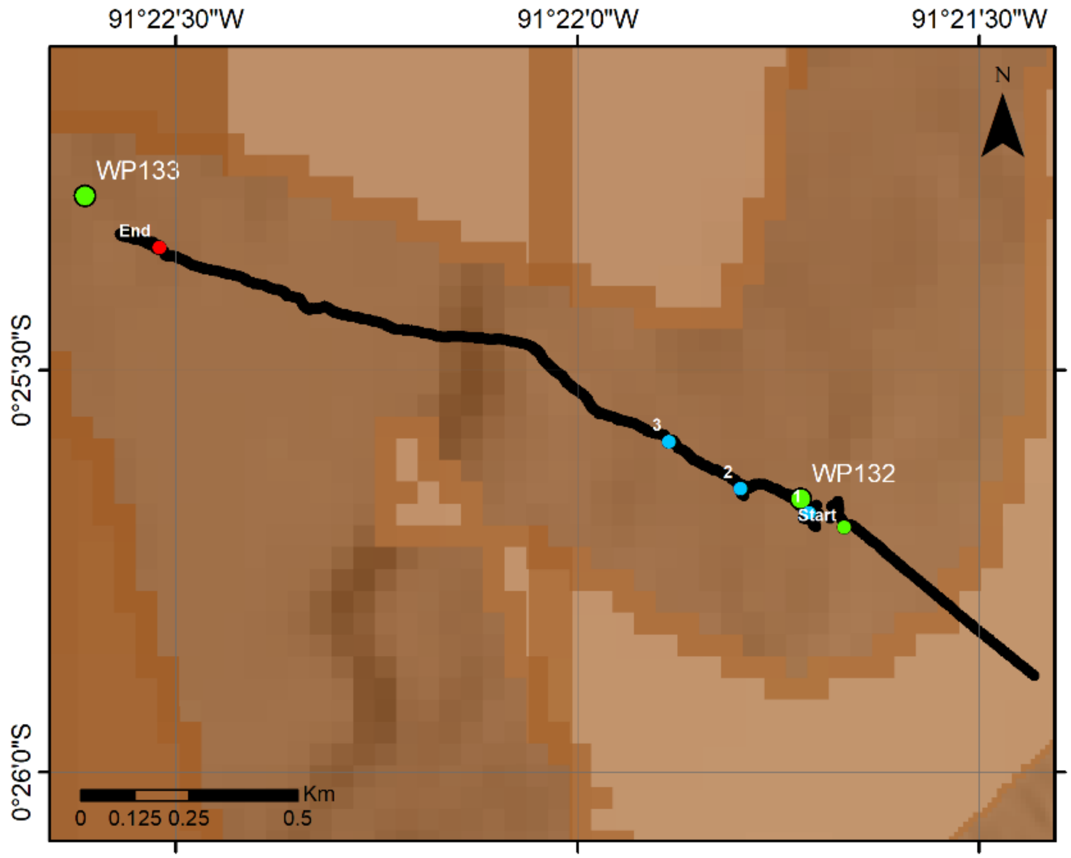
5. Fossil Coral Sampling and Observations: The primary aim of this dive from a fossil coral perspective was to explore the intermediate depths (~ 800 to 1500 m) on the west of the Platform and look for any aggregations of fossil corals. Unfortunately, no such aggregations were found at these depths. This is perhaps unsurprising, given the shallow aragonite saturation horizon in this region, and the absence of fossil corals here is still a valuable observation. However, thin bamboo corals of varying branch lengths (10 cm to > 2.5 m) were observed across these depths, and one bamboo coral (event 4, 1500 m) was sampled. This sample could provide valuable palaeoceanographic information at this depth, as well as providing a minimum age for the substrate it was growing on. At shallower depths, a substantial amount of reef framework was observed, which comprised dominantly dead *Madrepora*. No samples were taken.

Dive S0590

1. Dive Plan: The dive will occur within the Simón Bolívar channel to carry out benthic fauna video transects to characterize the mesophotic habitat around the sea cucumber fisheries near Punta Mangle.

2. Dive Overview: Dive S0590 was planned as a relatively short (1830m traverse) and shallow (230m – 120m depth) dive to help characterize the sedimented benthic mesophotic zone in the highly productive region of Canal Simon Bolivar (CSB), a shallow shelfed channel with graduated nearshore terraces separating the Islands of Fernandina and Isabela. INOCAR nautical charts were used to orientate the dive for pre-dive EM710 mapping over the area of interest.

The dive included both scientific and BBC filming objectives using a porta-lander, the latter being possible at the initial ROV landing site given favorable bottom conditions. ROV then began the 1800m upslope traverse to characterize habitat moving from the CSB channel at W132 towards the northern section of Punta Mangle (SE Fernandina) to the west at W133. Particular attention was given to holothurian distributions with specimen collection across the 240m – 100m depth range. There were three event collections (2 biology - holothurian / 1 geology - rock).



3. Biological Sampling and Observations: The main objective of this dive was to do a video transect of sea cucumber (*Holothuria*) assessment, and observations, 200-220 m in depth, close to a mangrove area. Two types of substrata were encountered, sand-limo type (muddy), where the sea cucumber, *Holothuria* cf. *sanctori* lives and clusters of rocks with variety of animals. Lava flows with stylsterids and sponges, and a few sea cucumbers in the soft sediments. Mangrove leaves were encountered at around 175 m. There was an alternation of sandy bottom, and a combination of sand and rocks, with several species of sponges and a single-branch octocoral between 140-130 m. Several species of fishes were observed between 130 and 120 m: a skate, *Beringraja binoculata*, many red lip batfish, *Ogcocephalus darwini* in sandy areas, scorpion fish, *Scorpaena*, and an eel, *Gymnothorax*. On the rocks, anemones, sponges and an arrow crabs were observed.

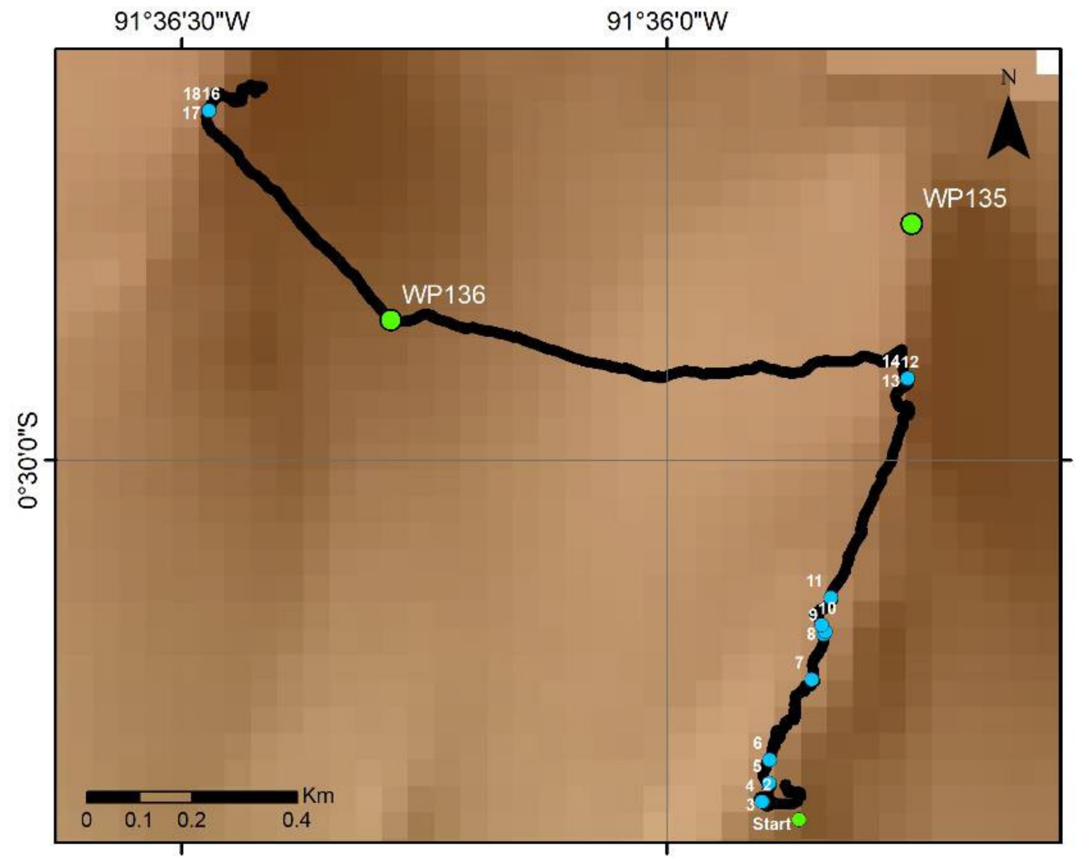
4. Rock Sampling and Observations: Along the traverse numerous outcrops of 'spiny' aa' aa' like lava were observed that were encrusted with biota. The outcrops were variable in areal extent and height, some reaching to ~7-10 m above the surrounding sedimented seafloor.

5. Fossil Coral Sampling and Observations: No fossil corals were observed or collected.

Dive S0591

1. Dive Plan: The dive was planned to explore two small ridges on the SW submarine rift of Fernandina that appear, from the bathymetry, to look like potential coral areas as observed during dive S0589 on the NW submarine rift of Fernandina. The aim is to focus on collecting biological and fossil samples little sampling has occurred on this expedition on the western side of the archipelago (except for the collections at Roca Redonda, further north on S0587). If a reef is observed, filming with the MISO 5.3k video camera on the 'selfie-stand' may be done.

2. Dive Overview: The sides of the ridges were mantled by extensive coarse volcanic sand and gravel and some larger blocks, with occasional outcrops. The western ridge appeared to be more covered in coarse sediment and talus than the eastern ridge. The lava forms, where intact and outcropping, were more aa'-aa' like suggesting they may be flows that entered the sea from a subaerial eruption or possibly more alkalic in composition. Extensive large fans with various associates were observed and some sampled. In several locations wide expanses of brittle stars and urchins were observed.



3. Biological Sampling and Observations: Descending, a large school of Chilean jack mackerel at around 400m was encountered. Arrived at a site where all the needed taxa for below the OMZ were present. Rocks with many species including a stolinifera octocoral, backet star and squat lobsters. Patchy but tall *Madrepora* reef structure observed. At 412m bottom turned to a gentle slope with sparse *Madrepora* and small stylasterids. As slope became more steep much more biomass was found. This wall gave way to seafloor with many colonies of madrepora, lots of small colonies live on the floor, mix of dead and alive. Terrain changed to more broken talus after going over smooth old sediment field with stylasterids, anthamastids, yellow sponges, sea stars and urchins at 325 m. This was followed by agglutinated breccia like rock with ledges and overhangs, hosting stylasterids. Moving onto sandy bottoms, massive numbers of brittle stars at 270m were observed. Between 190 and 260 m interesting species were encountered, including what might be a foraminiferan, single-branch octocoral and a sea robin. At 335 m a new field of ophioropids was encontered, followed by a massive amount of anemona carring hermit crabs at 278 m. Rocks at 440 m had a diverse community of organisms, including octocoral, anemones, mollusk eggs and sponges. In the sand at 470 m a red octocoral and at 480 m an octocoral with a diverse associated fauna. Between 380 and 400 m, fields of sea urchins were observed and at 275 m massive numbers of brittle stars. Towards the end of the dive, at 142 m the rocks were covered with organisms. A strange octocoral was seen together with some hard corals.

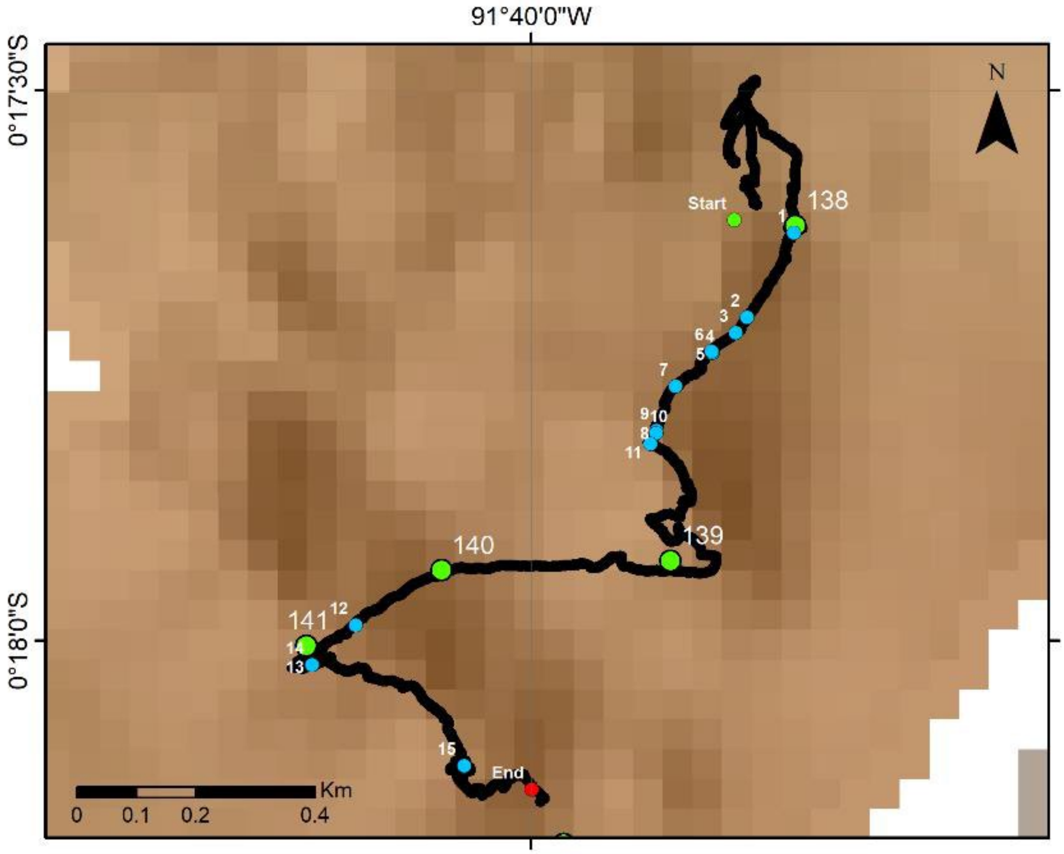
4. Rock Sampling and Observations: One rock was collected, a vesciular pillow fragment encrusted with sponges.

5. Fossil Coral Sampling and Observations: No fossil corals were observed or collected.

Dive S0592

1. Dive Plan: During this dive, we will explore the extent of the coral reef discovered during dive S0589 on the main NW rift zone of Fernandina. We will dive at 2 smaller ridge features to the NE of the main rift axis and explore their extent and then transit to the main rift axis to explore its width and shallow area closest to the coast. The aim is to focus on collecting biological and fossil samples as little fossil coral sampling occurred on the previous dive. Current may be very strong in this area.

2. Dive Overview: The dive began on the N flank of the smaller ridge and ascended a large coarse volcanic sand/rubble and sedimented slope with rocky pillow outcrops. The first event/rock sample was at 633 m and above that depth a wide variety of coral was encountered and sampled both in RNAlater and normally. At 452m depth a greater concentration of fossil coral, largely madrepora was encountered and a scoop was taken (Event 7). The top of the northern ridge was at 388 m with abundant coral communities. The dive proceeded to the southern ridge, that was partly observed during dive S0589 and at 388 m another fossil coral net was taken on that feature. Abundant live and dead coral was observed (similar to the end of dive S0589) and sampled confirming that the extent of the reef did go further upslope from the end of the dive S0589 track.



3. Biological Sampling and Observations: Sandy bottom next to rocks with sponges at 625 m. Candelabra coral and other species of octocorals were observed and collected at around 550 m. Almost at the summit of the feature, 389 m depth, extensive coral framework with living *Madrepora* colonies, no significant changes in community observed at 376 m. A large prickly shark spotted at 366 m. Flat reef structure with few live corals at 367 m, at 424 m *Madrepora* present only on outcrop rock, while more live and dead *Madrepora*, with high density of brittle stars and sponges at 349 m. Arriving at a flat area with coral framework (336 m) that was colonized by a sponge garden.

4. Rock Sampling and Observations: Four rock samples were collected from the NW-trending ridges on the shallow end of the north side of the Fernandina submarine rift. Note that Rock #51a is a talus sample collected with the fossil coral scoop at event site12, Rock#51b is a small piece of lava crust sampled at event 15 site (NB- sample 51a was found after we had already labelled rocks for the next dive).

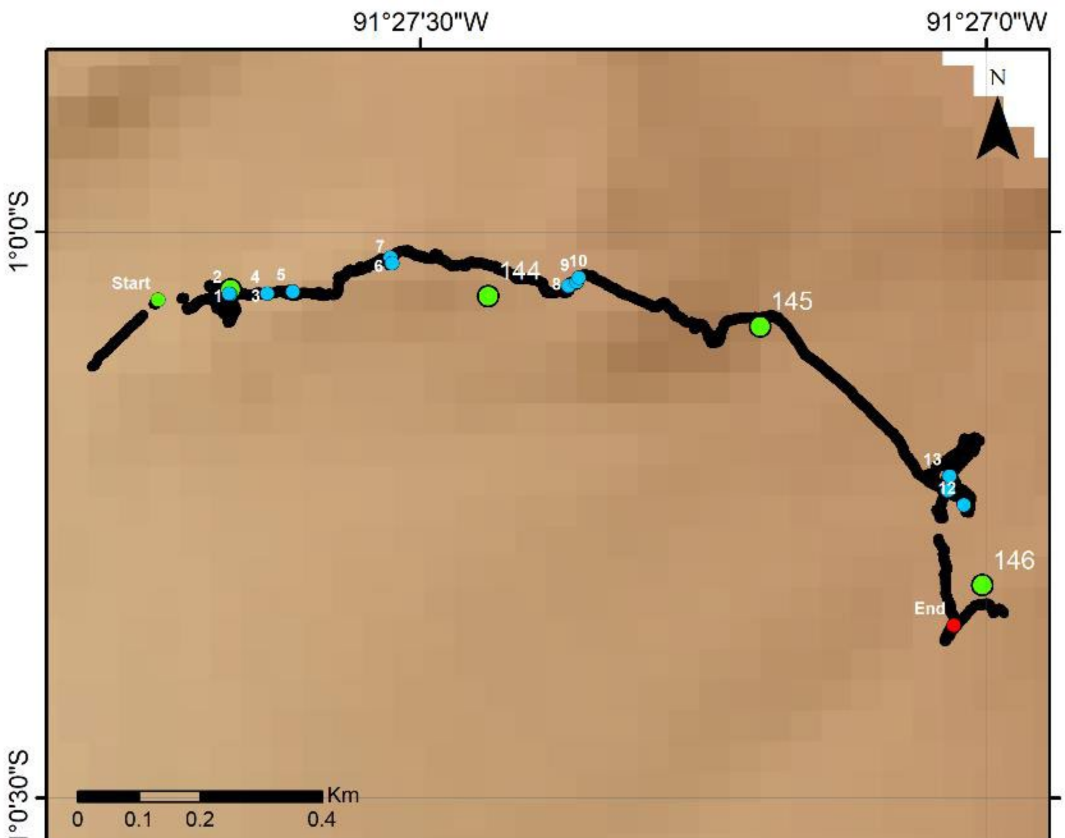
5. Fossil Coral Sampling and Observations: Targeted fossil coral sampling was carried out on this dive. On ascending the first feature, we found large chunks of Madrepora framework which were clearly derived from further upslope. Near the top of the feature, the cover of framework became almost complete, and a net sample was taken (event 7, 450 m). Some of this material may not have been in-situ, and could have come from the top of the feature around 50 m (vertical depth) higher. At the top of the mound, more samples of dead coral framework were taken, this time using the grabber (event 8, 390 m). After transiting southwards to the second feature, we encountered a similar situation, with chunks of Madrepora framework observed as we transited upslope. On this feature, dense framework coverage was encountered at shallower depths, with a net sample taken at 370 m (event 12).

Further grabs of in situ dead coral framework were taken on the south face of the feature (370 m, events 13 and 14).

Dive S0593

1. Dive Plan: Dive was offshore the SW cape of Isabela, Cerro Azul volcano to investigate the slope and scarps on the shallow portion of the submarine rift zone

2. Dive Overview: The dive began on a small ridge feature that trends approx. E-W at the base of the shelf slope off the west cape of Isabela, which is the flank of Cerro Azul volcano. On landing there were pillows and sediment and a low scarp or flow edge that trended ~070° with talus mixed in the sediment. As we began traversing east, there were extensive pillow basalts and tubular flows and apparent hornitos, small 5-8m constructs which may have been small vents or perhaps rootless vents that were being fed from further upslope. Rocks 52 and 53 were from an eggshell pillow at the base of one such structure. On ascending the slope headed generally east a wide array of corals were observed and sampled on mostly pillow outcrops with some areas that had more sediment and talus. At just above 600 m depth the slope steepened, and at 575 m depth more life/corals were observed. Extensive framework coral was observed around 488 m and sampled. The end of the dive from 460 m to 345 m where the dive ended had more sediment and less outcropping pillow flows. An ADCP line was carried out from 2300 UTC to the end of the dive just after midnight UTC.



3. Biological Sampling and Observations: The southwest of Isla Isabella is an area of very high productivity, here, the water looks green as opposed to the deep blue of other areas visited during this expedition. Bottom (736 m) consisted of pillow basalts with several species of octocorals and *Madrepora* at 692 m. At 667 m a large octocoral and its associates was observed, with cup corals at the base. Octocorals, cup coral, stylasterids and sponges cover the vertical walls at 650 m. A skate was found at 641 m. The lava rocks had stylasterids, *Acantogorgia*, cup corals usually near the octocorals, *Victorgorgia* with associated organisms at 590 m, and *Parantipathes* at 586 m. Large colonies of *Callogorgia* with associates where abundant at 587 m, with other octocorals and stylasterids. An important observation was of a *Xenoturbella* at 563 m. Venus' flower basket sponges (*Euplectella*) with black corals and *Callogorgia* were encountered on vertical walls at 558 m. The dive ended over sandy area where skates and other fishes were spotted.

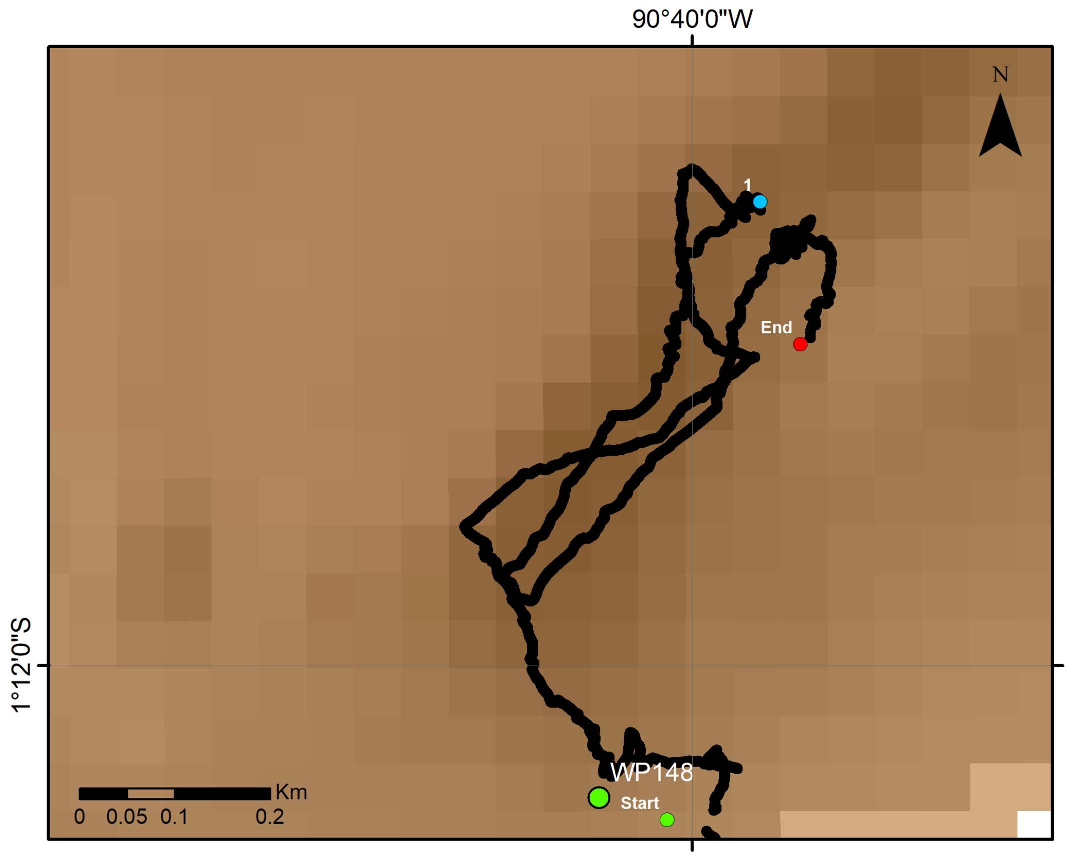
4. Rock Sampling and Observations: Three rocks were sampled in situ. Dive offshore the SW cape of Isabela, Cerro Azul volcano to investigate the slope/scarp on the shallow portion of the submarine rift zone.

5. Fossil Coral Sampling and Observations: Aggregations of fossil corals were encountered throughout this dive, either on sandy slopes (i.e. not in-situ) or surrounding the regular outcrops of rocks which were encountered. Generally, sampling in more rocky areas was difficult, as any dead corals tended not to aggregate in areas easily accessible by the net. Additionally, although a large number of live cup corals were observed on rocks, the dead coral rubble was dominanted by colonial scleractinians. Curiously, although live the colonial scleractinian biomass was dominated by *Madrepora*, the dead pieces of coral seemed to be dominated by *Dendrophyllia*, a finding confirmed on recovery of the one net taken during this dive (event 8, 500 m).

Dive S0594

1. Dive Plan: During S0594, we explored a vertical walls on the terraces south of Isabela. The aim was to look for high-resolution mapping targets and carry out vertical multibeam mapping.

2. Dive Overview: The start of this dive was on bioturbated seabed with off bedforms. As we moved up a steep slope, boulders become more abundant and some outcropping rocks appeared, dominated by black corals. The ROV got to the top of the slope without finding any vertical wall. The ROV moved downslope to the east where the terrain became rough again and large boulders appeared, covered with encrusting sponges, black corals and cup corals. At a depth of 570m, the ROV started ascending upslope to the west to the top of the hill at 503m. The sonar showed a flatter region with a high density of rocks. Two ROV mapping transects were carried out 1) 520m in depth, 140 deg beam angle, 20m from wall, heading 320; 2) 540m in depth, 140 deg beam angle, 20m from wall, heading 320.



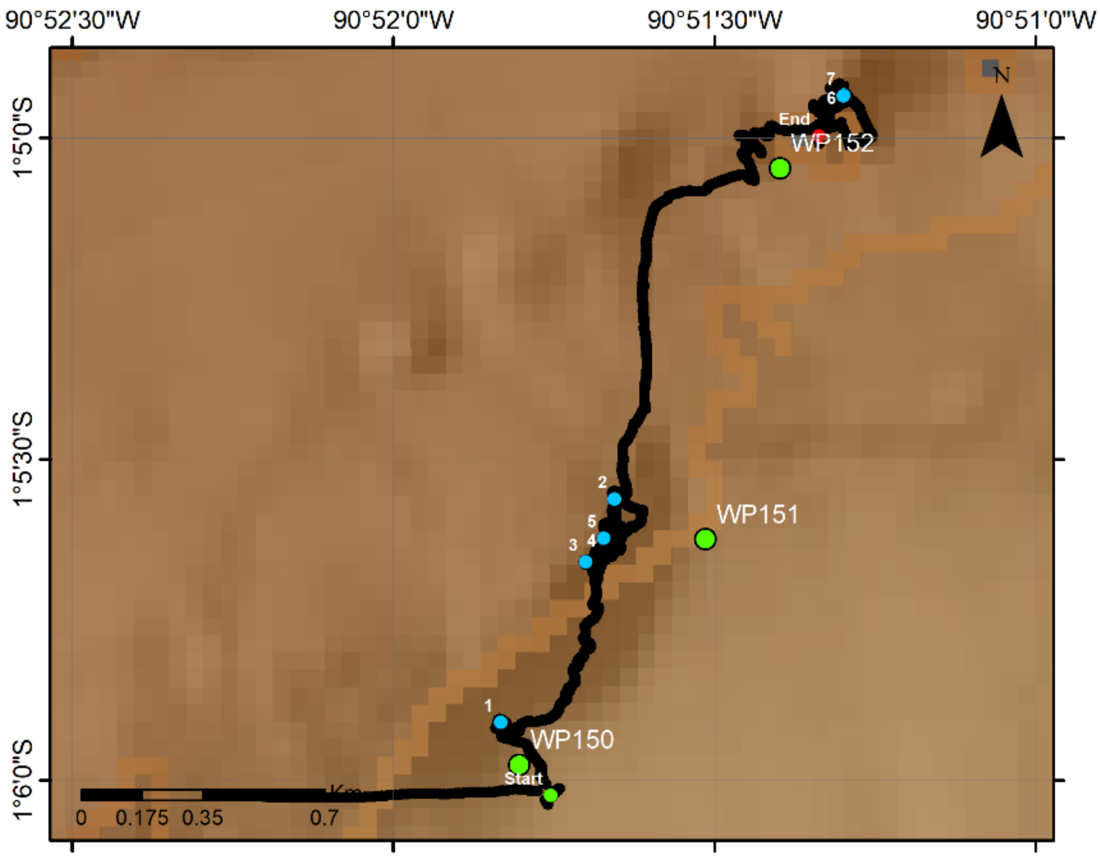
3. Biological Sampling and Observations: From ~520 m depth, we moved upwards to find the wall along soft sediment bottom with rocky outcrops colonized by several species of soft and hard corals: *Madrepora*, *Stichopathes*, *Chrisogorgia*, many crabs and sea urchins. A few large Primnoids were observed. Going up slope rocks were covered with *Acanthogorgia* and *Madrepora* were found. Near the base in the sandy areas with loose rocks at 539 m an octopus was spotted.

Dive S0595

1. Dive Plan: During dive S0595, we explored two vertical walls on the terraces south of Isabela. The aim was to look for high-resolution mapping targets and carry out vertical multibeam mapping at both walls.

2. Dive Overview: ROV started on sediment on arrival at bottom and moved toward a NE-SW trending wall. Continued to a massive wall full of sediment, with turbidity much higher than other dives. A cave was mapped with the MBES and giant *Acesta* clam were observed. Continued up the sedimented slope with lots of suspended sediments, confirming the low energy environment. A second wall was encountered and mapped at 540m in depth (120 deg beam angle, 10m away from wall, hdg 300) and video transects were acquired. The aubstratum was a mix of rocky outcrops with patches of loose sediment. Occasional octocoral fan, variety of encrusting sponges, a few *Desmophyllum* corals and small stylasterids. The ROV continued to travel upslope and reach a rock outcrop ledge flowing downwards with a few acanthagorgids and primnoids on it (450m in depth). *Madrepora* and *Dedrophyllia*. Observed while cimbing up a wall of broken pillow lava with a good layer of sediment. The OMZ was reached at the OMZ depth 410m where some

Dendrophyllia rubble and sponges occurred. At 363 meters a third MBES survey (heading 320, swath 120 degrees, at 10m from the wall) took place.

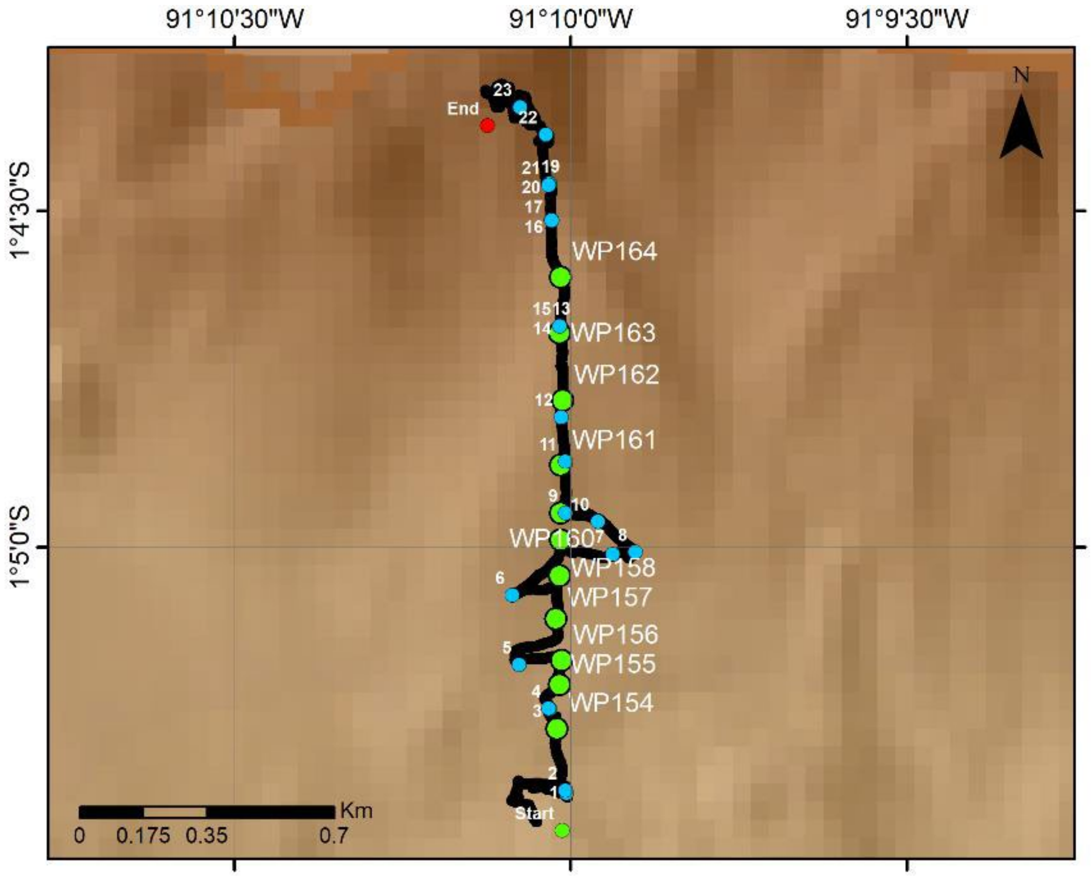


3. Fossil Coral Sampling and Observations: One sample of dead *Madrepora* was taken using the grabber to pick up large pieces (event 6, 360 m). This sample was taken from a particularly dense aggregation of bushy *Madrepora* encountered near a rocky outcrop.

Dive S0596

1. Dive Plan: The dive's objective is to visit an older lava flow on the south flank of Isabela, part of the large terrace structures and take geological samples. The ROV will travel along its length and investigate the types of lava morphologies and vent structures present as well as sample the flow in situ. If time allows, we will also image the shallower wall at the end of the dive and biological samples can be taken.

2. Dive Overview: We traversed the bottom of the flow and encountered mostly sediment, <u>suggesting that the sidescan was imaging the flow 'through' the sediment</u>, likely <~0.5m, so we traversed to the west and east edge of the flow (at various points along its length) as mapped by the sonar, and it matched very well with the E-W extent of the flow as imaged. Biology was sparse in the deeper portion of the dive, but above ~600 m there was a noticeable increase in fauna, both sessile and mobile and more extensive corals appeared as we ascended past ~540 m depth.



3. Biological Sampling and Observations: This dive was mainly for rock collection, but organisms were observed and recorded, and collections done. Going down a strawberry squid was encountered at 400m.
Started pillow lavas at 934 m, where rocks and some organisms were collected, and others were recorded, like the black coral *Bathypathes pseudoalternata*, xenophyophores. Skates were also seen.

4. Rock Sampling and Observations: We traversed the bottom of the flow and encountered mostly sediment, suggesting that the sidescan was imaging the flow 'through' the sediment, likely <~0.5m, so we traversed to the west and east edge of the flow as mapped by the sonar and it matched very well with the E-W extent of the flow as imaged. In the upper portion of the flow it appeared that there were likely large lava channels that transported the flow as we traversed along what was likely a channel margin with overhanging tube crusts. In the shallower part of the dive from ~500 m to 200 m, the 'shingled' texture in sidescan reflectivity is a steep slope with variable amounts of talus and sediment and areas of outcropping flow surface, pillows and tubular pillows.

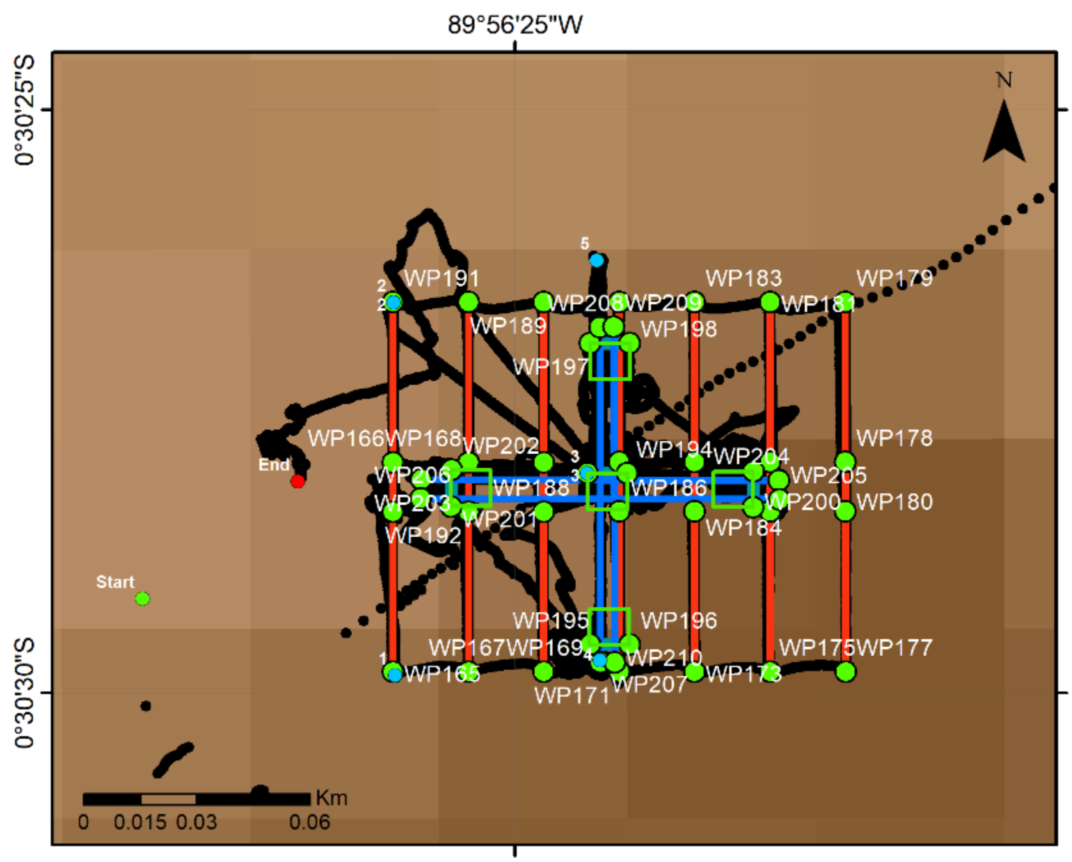
All samples were collected in situ, focusing on flow knobs, crusts and other exterior rinds so that we optimized chances for acquiring glass for geochemical analyses, including volatile analyses. The rocks were generally fresh-appearing but with some Mn coating and a few of the larger pillow fragments showe alteration halos on freshly broken faces. The surfaces of some of the crusts appeared to be irregular, almost like aa' aa' lava surfaces.

5. Fossil Coral Sampling and Observations: Very few significant outcrops of fossil corals were encountered during this dive, which started at intermediate depths and traversed significant amounts of sandy substrate. However, 2 live stylasterid fans were sampled early in this dive, which may represent good targets for studying coral growth rates and intermediate water mass evolution over the past century (event 4, 900 m). As we transited upslope, aggregations of dead *Madrepora* and *Dendrophyllia* became more abundant. One outcrop of *Madrepora* was sampled using the claw, pieces were extremely brittle (event 19, ~ 380 m). These samples were taken from the top of a small rocky mound/outcrop and were clearly in-situ. On inspection once back in the lab, these samples appear to be composed of some unaltered carbonate, meaning they may be useful as past ocean archives.

Dive S0597

1. Dive Plan: Dive S0597 aimed to map the main portion of the Cacho de Coral reef with the Norbit WMBS multibeam system, and select up to three locations to carry out Micro Insight laser scanner mapping. We finished with an ADCP survey over the reef.

2. Dive Overview: The dive started with a MBES survey at 400kHz over the Cacho de Coral reef with 33 lines getting collected. At 17:52:15 the laser mapping survey with the multibeam at 700kHz started and was completed at 23:24:56 following the acquisition of 75 lines across five boxes. 13 lines of ADCP were collected until 03:11:47 (10/11/2023), at which point Norbit testing took place.



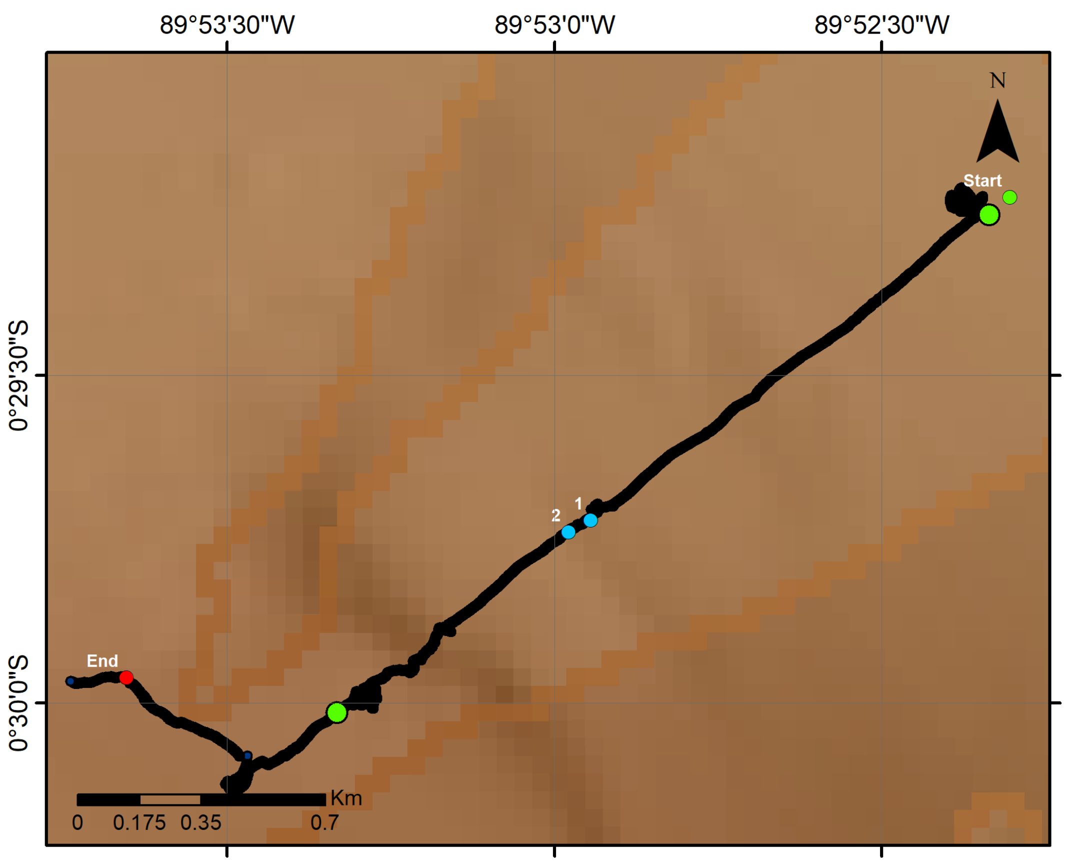
Dive S0598

BBC dive

Dive S0599

1. Dive Plan: This dive was back at the Cacho de Coral, but this time diving on the less steep northeast flank. The objective was to characterise the faunal community of this side through video analysis.

2. Dive Overview: The dive started at 12:10:51 and transited upslope. Three lines of multibeam mounted on the bumper bar were acquired on a steep wall near the summit of the seamount. The ROV was off bottom at 19:44:53.

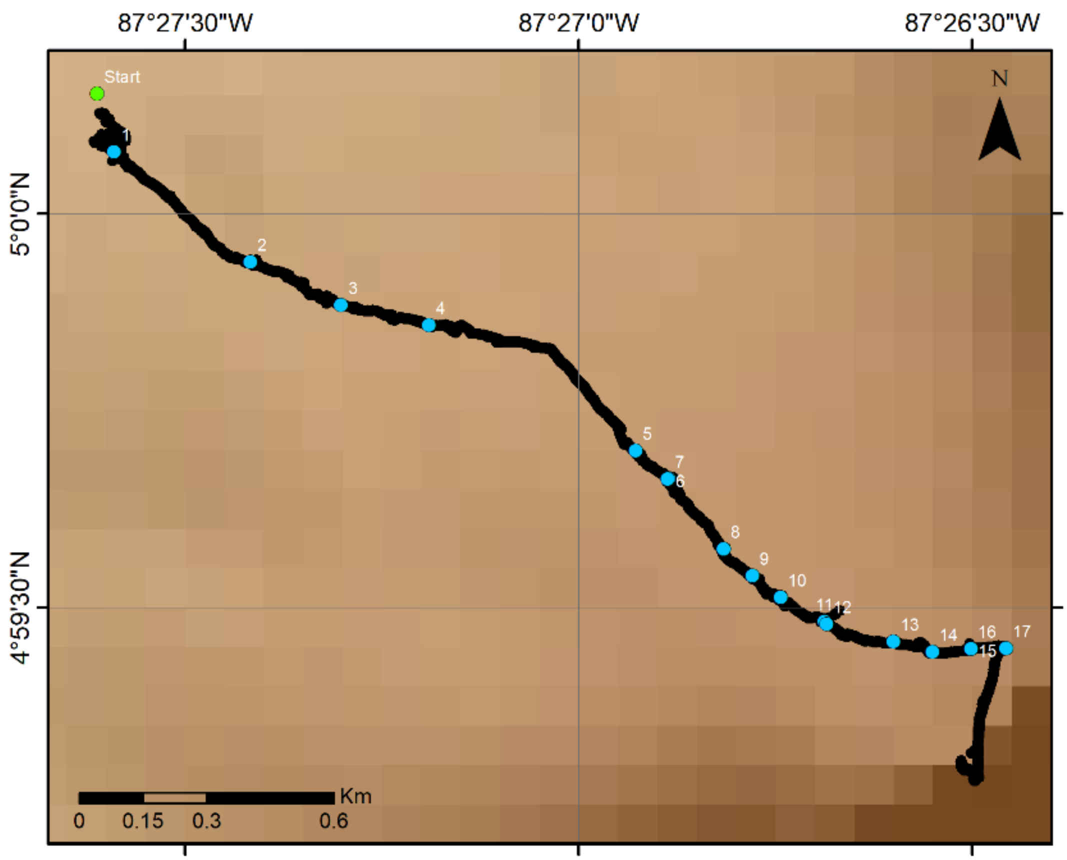


3. Biological Sampling and Observations: Descending gelatinous plankton was encountered. The bottom, at 453 m, was sandy with squat lobsters and crabs, a sea pen at 444 m, and a benthic siphonophore at 413 m. One of the species of octopus was spotted at 365 m. Moving over the sandy bottom, at 339 m an immense amount of sea urchins was encountered, and evidence of bioturbation observed in another section. Between 310 and 300 m, rocks were encountered some with ophiuroids and *Dendrophyllia*, and a diverse array of other phyla. On the sandy bottom at around 300 m, a huge number of hermit crabs, several species of seastars, and on the rocks within the sandy bottom, sponges and *Dendrophyllia* were observed. After that, flew over a low-density zone of ophiuroids, then a zone with medium density of sea urchins and ophiuroids. Encountered rocky zone at 185 m, covered by sponges, stylasterids, hydroids, ophiuroids, sea stars, and what seems to be a benthic foraminiferan. The first red calcareous algae were encountered at 152 m, while on the sand sea cucumbers were observed and were very abundant at around 135 m. Between 140 and 130 m the rocks were completely covered with calcareous algae and there were corals, and the sand nearby had variety of echinoderms, sea biscuit, a seastar and a very small sea cucumber.

Dive S0600

1. Dive Plan: The aim of this dive is to collect consistent benthic imagery up slope and collect coral samples to identify species distribution across OMZ.

2. Dive Overview: During this dive, we will traverse along 2.4 km on the north west of the Gemelas 1 Seamount between water depths of ~700m to 250m crossing the O_2 layer (following to CTD measures).

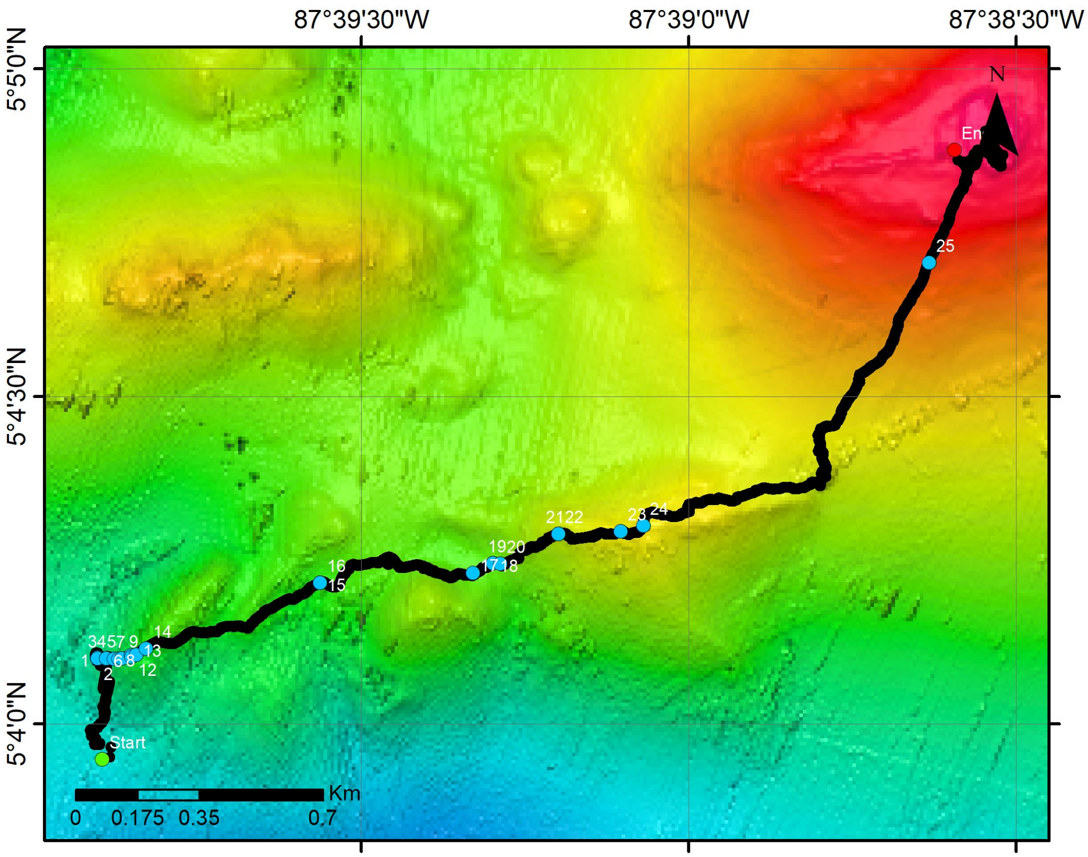


3. Biological Sampling and Observations: For the first ROV dive in Costa Rica, an oxygen sensor that measures in micromoles per litre, and percentage was available. Descending a Myctiforme fish and a medusae were encountered at 654 m. The bottom was at 688 m and sandy. At 682 m a fiddlehead sea pen was collected, at 621 m rocks covered with sand, and an *Anthomastus* were encountered. On the sand, which covered a very extensive area, caridean shrimps and crabs, another species of sea pen, and squat lobsters were spotted. Also, fish in sediment scours, a Dumbo octopus, and Quill worms. At 407 m we encountered the first yellow octocorals, and much more after 390 m. The sandy substrate was covered with living and dead bivalves. At 330 m a *Thesea* octocoral was collected and observations made of fish between 330 and 300 m. White morph *Aquaumbra* were encountered many times. At 302 m dead black corals with hydroids and many Rosy Jewelfish, *Anthias noeli* around 290 m and shallower. At that depth a nudibranch was observed on *Anthomastus*, and at 280 m a *Schizopathes* with eggs.

Dive S0601

1. Dive Plan: The aim of this dive is to collect consistent benthic imagery up slope and collect coral samples to identify species distribution across OMZ.

2. Dive Overview: During this dive, we will traverse along 2.8 km on the southwest of the Gemelas 2 Seamount between water depths of ~700m to 250m crossing the O_2 layer (following CTD measures).



3. Biological Sampling and Observations: Midwater observations included siphonophorans, medusae, fish and salps. Bottom at 612 m, rocky outcrop with several corals, including a muriceid; *Acanthogorgia*, 611 m; primnoid with crab, 609 m; crab, 591 m and orange octocoral, 572 m; a carnivorous sponge, 578 m; chiton and sponge, 572 m. At 563 m the rocky bottom had many *Stylaster* and sponges. One of the sponges had embedded zoanthids at 563 m, and a bamboo coral was found with eggs. A species of *Swiftia* at 536 m and a sea pen with eggs at 532 m were observed. A majestic prickly shark at 500 m, was followed for several minutes. On the rocks around 490 m, we saw a dense coverage of sponges some with crinoids. As we ascended more diverse assemblages were encountered on the rocks, and the octocorals with a diverse associated fauna at 497 m. At 388 m, in the Oxygen Minimum Zone (1.19 uM), the bottom was covered with an orange brittle star, and an anemone was observed with eggs. At 360 m gardens of a yellow octocoral on the rocks, and ophiuroids with polychaetes at the base were observed. When a rock at 204 m was studied in detail we saw nudibranchs, small octocorals and scorpion fish. Rock formation with sponges at 189 m, and at 162 m pink encrusting algae were observed. Near the top of the seamount at 162 m a *Mobula* ray was followed and the top was reached at 158 m.

APPENDIX 3 Faunal Samples

index no.	Region	Date	ROV Dive #	Unique ID	Parent ID	Event	ETOH 96 A	RNA B	ETOH 96 C	RNA D	LN2 E	ETOH 96 F	UCR ETOH 96 - LN G	Voucher CDF/UCR H	Splits no	# indiv	Description
1	Galápagos	18/09/2023	S0577	3		7	1					1		1	3	1	Black Coral - Schizopathidae
2	Galápagos	18/09/2023	S0577	5	3	7			1	1	1	1			4	4	Polychaeta
3	Galápagos	18/09/2023	S0577	7	9	8			1	1	1	1			4	7	Polychaeta
4	Galápagos	18/09/2023	S0577	6	9	8			1		1				2	1	Ophiuroid
5	Galápagos	18/09/2023	S0577	8	9	8			1		1				2	1	Polychaeta
6	Galápagos	18/09/2023	S0577	9		8	1					1		1	3	1	White soft coral
7	Galápagos	18/09/2023	S0577	10		6	1					1		1	3	1	Black Coral
8	Galápagos	18/09/2023	S0577	12	10	6			1						1	1	Baby shrimp
9	Galápagos	18/09/2023	S0577	11		10	1					1		1	4	1	Madrepora
10	Galápagos	18/09/2023	S0577	1		16			1					1	2	1	Rock
11	Galápagos	18/09/2023	S0577	2	1	16			1	1	1	1		1	5	1	Seastar
12	Galápagos	18/09/2023	S0577	13	11	10			1	1	1	2			5	1	Polychaeta
13	Galápagos	18/09/2023	S0577	14	11	10			1	1	1	1			4	3	Ophiuroids
14	Galápagos	18/09/2023	S0577	15	11	10	1					1			3	1	Cup coral
15	Galápagos	18/09/2023	S0577	16	11	10			1					1	2	2	Green Sponge
16	Galápagos	18/09/2023	S0577	17	16	10			1		1				2	2	Squat Lobster
17	Galápagos	18/09/2023	S0577	18	11	10			1	1	1	1		1	5	1	Eunice polychaeta
18	Galápagos	18/09/2023	S0577	19		15						2		1	3	1	Stylasteridae
19	Galápagos	18/09/2023	S0577	20		9	1					1		1	4	1	Madrepora
20	Galápagos	18/09/2023	S0577	21	20	9			1	1	1	1			4	2	Bivalves
21	Galápagos	18/09/2023	S0577	4	1	16			2	1	1	1		1	6	6	Ophiuroid
22	Galápagos	18/09/2023	S0577	22		4	1					1			3	1	Cup coral
23	Galápagos	18/09/2023	S0577	23	1	4	1					1			3	1	Cup coral
24	Galápagos	18/09/2023	S0577	24		4			1		1	1			3	1	Ophiuroids

25	Galápagos	18/09/2023	S0577	30	20	9		1						1		1	Ophiuroids
26	Galápagos	18/09/2023	S0577	31	20	9		2	1	1	1		1	6		4	Tube worm
27	Galápagos	18/09/2023	S0577	25		5		1	1	1	1		1	5		1	Squat Lobster
28	Galápagos	18/09/2023	S0577	26		4		1			1	1	1	5		2	Stylasteridae
29	Galápagos	18/09/2023	S0577	27	26	4		1		1				2		2	Polychaeta
30	Galápagos	18/09/2023	S0577	28		7		1		1			1	3		1	Squat Lobster
31	Galápagos	18/09/2023	S0577	29		11								1		1	ROCK
32	Galápagos	18/09/2023	S0577	32		2		1	1	1	1		1	5		1	Ophiuroid
33	Galápagos	18/09/2023	S0577	33		18								0	1		Rhodoliths
34	Galápagos	18/09/2023	S0577	34	29	11							1	1		1	Sponge
35	Galápagos	18/09/2023	S0577	35	34	11		1						1		1	Polychaeta
36	Galápagos	18/09/2023	S0577	36		16		1			1		1	3		2	Stylasteridae
37	Galápagos	18/09/2023	S0577	37	36	16		1		1				2		1	Ophiuroid
38	Galápagos	18/09/2023	S0577	38		1								1		1	ROCK
39	Galápagos	18/09/2023	S0577	39	38	1							1	1		1	Sponge
40	Galápagos	18/09/2023	S0577	40	39	1		1		1				2		1	Ophiuroid
41	Galápagos	18/09/2023	S0577	41	11	10		1		2				3		1	Polychaeta
42	Galápagos	22/09/2023	S0579	43		7	1				1		1	4		1	Dendrophyllia
43	Galápagos	22/09/2023	S0579	42	43	7		1	1	1	1		1	5		7	Ophiuroids
44	Galápagos	22/09/2023	S0579	63	43	7							1	2		1	Stylasteridae
45	Galápagos	22/09/2023	S0579	62	43	7		1						1		1	Squat Lobster
46	Galápagos	22/09/2023	S0579	61	61	7		1		1	1		1	4		1	Hydroids
47	Galápagos	22/09/2023	S0579	45		7		1	1	1	1			4		5	Polychaeta
48	Galápagos	22/09/2023	S0579	44		5	1				1			3		1	Madrepora
49	Galápagos	22/09/2023	S0579	147	44	5		1	1				1	3			Eunice polychaeta
50	Galápagos	22/09/2023	S0579	47	48	3	1				1		1	3		1	Chrysogorgia
51	Galápagos	22/09/2023	S0579	48		3								1			Fossil Dendrophyllia
52	Galápagos	22/09/2023	S0579	46	48	3		1	1	1	1		1	5		3	Bivalves
53	Galápagos	22/09/2023	S0579	58	63	7		1						1		1	Ophiuroids
54	Galápagos	22/09/2023	S0579	55	47	3		1	1	1	1			4		1	Ophiuroids
55	Galápagos	22/09/2023	S0579	60	47	3		1	1	1	1		1	5		1	Shrimp
56	Galápagos	22/09/2023	S0579	57	43	7							1	1		1	Stylasteridae
57	Galápagos	22/09/2023	S0579	52		26	2				2		1	6		1	Dendrophyllia

58	Galápagos	22/09/2023	S0579	50	52	15		1		1	1		3		2	Ophiuroids
59	Galápagos	22/09/2023	S0579	59	52	15		1	1	1	1		4		3	Polychaeta
60	Galápagos	22/09/2023	S0579	54		15	1				1	1	3		1	Anthomastus
61	Galápagos	22/09/2023	S0579	53	46	3					1		2		1	Cup coral
62	Galápagos	22/09/2023	S0579	51	46	3					1		2		1	Cup coral
63	Galápagos	22/09/2023	S0579	56	47	3		1	1	1	1	1	5		1	Squat Lobster
64	Galápagos	22/09/2023	S0579	69		25	1				1	1	4		1	Madrepora
65	Galápagos	22/09/2023	S0579	82	69	25		1		1			2		1	Polychaeta
66	Galápagos	22/09/2023	S0579	72	69	25		1	1	1	1	1	5		1	Eunice polychaeta
67	Galápagos	22/09/2023	S0579	83		28	1				1		3		1	Dendrophyllia thick
68	Galápagos	22/09/2023	S0579	84		13	1				1	1	3		1	Black coral
69	Galápagos	22/09/2023	S0579	79		28						1	1		1	Yellow sponge
70	Galápagos	22/09/2023	S0579	80	84	13		1	1	1			3		3	Squat Lobster
71	Galápagos	22/09/2023	S0579	81		18					1	2	3		2	Cup coral
72	Galápagos	22/09/2023	S0579	73		11	1				1	1	3		1	Parastenella pomponiae
73	Galápagos	22/09/2023	S0579	76	73	11		1	1	1	1	1	5		7	Ophiuroids
74	Galápagos	22/09/2023	S0579	74	48	3		1	1	1	1	1	5		2	Anemone
75	Galápagos	22/09/2023	S0579	75		24	1					1	2		1	Black coral
76	Galápagos	22/09/2023	S0579	77	73	11		1					1		1	Hermit crab
77	Galápagos	22/09/2023	S0579	78	75	24		1	1	1	1	1	5		3	Ophiuroids
78	Galápagos	22/09/2023	S0579	67	75	24		1	1	1	1	1	5	6+		Polychaeta
79	Galápagos	22/09/2023	S0579	70		22	1				1	1	3		1	Soft coral
80	Galápagos	22/09/2023	S0579	71		19	1					1	2		1	Paragorgia
81	Galápagos	22/09/2023	S0579	68	71	2		1	1	1		1	4		6	Ophiuroids
82	Galápagos	22/09/2023	S0579	86	73	11		1					1		1	Squat Lobster
83	Galápagos	22/09/2023	S0579	87		17	1				1	2	5		1	Madrepora
84	Galápagos	22/09/2023	S0579	88		20	1				1	1	3		1	Black coral
85	Galápagos	22/09/2023	S0579	89	88	20						1	1		1	Anemone
86	Galápagos	22/09/2023	S0579	90		16	1				1	1	3		2	Anthomastus yellow
87	Galápagos	22/09/2023	S0579	93	88	20		1	1	1	1		4		2	Polychaeta
88	Galápagos	22/09/2023	S0579	91	88	20		1	1	1	1		4		1	Ophiuroid
89	Galápagos	22/09/2023	S0579	92	88	20		1	1				2		2	Squat Lobster
90	Galápagos	22/09/2023	S0579	99	75	24		1	1	1			3		3	Shrimp

91	Galápagos	22/09/2023	S0579	97	98	4	1				1	2	4		1	Muriceides
92	Galápagos	22/09/2023	S0579	98		4							1		1	Fossil madrepora
93	Galápagos	22/09/2023	S0579	96	94	12	1				1	1	3		1	Black coral
94	Galápagos	22/09/2023	S0579	95		12		1	1	1	1		4		1	White pencill urchin
95	Galápagos	22/09/2023	S0579	94		12							1			Fossil madrepora
96	Galápagos	22/09/2023	S0579	103	96	12					1	1	2		1	Cup coral
97	Galápagos	22/09/2023	S0579	104	94	12	1				1		2		1	Gorgonia
98	Galápagos	22/09/2023	S0579	105	94	12						1	1		1	Bivalve
99	Galápagos	22/09/2023	S0579	100	94	12	1					1	2		1	Muriceides
100	Galápagos	22/09/2023	S0579	101	94	12	1				1	1	3		1	Gorgonia
101	Galápagos	22/09/2023	S0579	102	96	12		1	1	1	1	1	5	4+		Ophiuroids
102	Galápagos	22/09/2023	S0579	106	96	12		1	1	1	1		4		1	Squat Lobster
103	Galápagos	22/09/2023	S0579	107	94	12		1	1	1			3		1	Polychaeta
104	Galápagos	22/09/2023	S0579	108	95	12		1	1	1		1	4		1	Ophiuroids
105	Galápagos	22/09/2023	S0579	109	94	12	1				1		3		1	Madrepora
106	Galápagos	22/09/2023	S0579	110	96	12		1	1	1	1		4		3	Polychaeta
107	Galápagos	22/09/2023	S0579	111		8	1				2	1	5		1	Madrepora
108	Galápagos	22/09/2023	S0579	113	111	8		1	1	1	1	1	5	4+		Ophiuroids
109	Galápagos	22/09/2023	S0579	112	111	8						1	2		1	Stylasteridae
110	Galápagos	22/09/2023	S0579	114	111	8		1	1	1	1	1	5		4	Polychaeta
111	Galápagos	22/09/2023	S0579	115	111	8						1	1		1	Sponge
112	Galápagos	22/09/2023	S0579	116	111	8		1	1	1		1	4		1	Ophiuroid
113	Galápagos	22/09/2023	S0579	117	111	8						1	1		1	Sponge
114	Galápagos	22/09/2023	S0579	118	111	8						1	1		1	Cup coral
115	Galápagos	22/09/2023	S0579	119	111	8							1		1	Fossil cup coral
116	Galápagos	22/09/2023	S0579	126	111	8						1	2		1	Stylasteridae
117	Galápagos	22/09/2023	S0579	125		23	1				1		3		1	Dendrophyllia
118	Galápagos	22/09/2023	S0579	124	125	23		2	1	2	1	1	7			Tube worm
119	Galápagos	22/09/2023	S0579	123	125	23		1	1	1	1		4			Ophiuroids
120	Galápagos	22/09/2023	S0579	122	125	23		1	1	1	1		4			Ophiuroids
121	Galápagos	22/09/2023	S0579	121	125	23		1	1			1	3		1	Bivalves
122	Galápagos	22/09/2023	S0579	120	117	8		1	1	1	1		4	3+		Ophiuroids
123	Galápagos	22/09/2023	S0579	167	111	8		1	1	1	1	1	5		3	Eunice polychaeta

124	Galápagos	22/09/2023	S0579	155	111	8								0	1	Polychaeta
125	Galápagos	22/09/2023	S0579	131	111	8			1	1	1	1	1	5	2	Squat Lobster
126	Galápagos	22/09/2023	S0579	152	111	8							1	1	1	Sponge
127	Galápagos	22/09/2023	S0579	128	111	8			1	1	1	1		4	1	Polychaeta
128	Galápagos	22/09/2023	S0579	156	111	8			1	2	1	1		5	2	Tube worm
129	Galápagos	22/09/2023	S0579	132	90	16			1				1	2	1	Squat Lobster
130	Galápagos	22/09/2023	S0579	153	117	8			1					1	1	Spider crab
131	Galápagos	23/09/2023	S0580	129		13	1					2	1	4	1	Muriceides sp.
132	Galápagos	23/09/2023	S0580	150		8	1					1	1	3	1	Muriceides
133	Galápagos	23/09/2023	S0580	154	139	15							1	1	1	Cup coral
134	Galápagos	23/09/2023	S0580	130	151	17	1					1	1	3	1	Stolonifera
135	Galápagos	23/09/2023	S0580	151		17								1	1	Fossil madrepora
136	Galápagos	23/09/2023	S0580	127	152	17							1	1	1	Bryozoa
137	Galápagos	23/09/2023	S0580	148	129	13			1	1		1		3	2	Ophiuroids
138	Galápagos	23/09/2023	S0580	134	129	13			1	1		1		3	1	Ophiuroids
139	Galápagos	23/09/2023	S0580	137	130	15							1	1	3	Hidroids
140	Galápagos	23/09/2023	S0580	158	151	17			1	1		1	1	4	1	Squat Lobster
141	Galápagos	23/09/2023	S0580	134		13						1	2	3	2	Ophiuroids
142	Galápagos	23/09/2023	S0580	133		6	1	1				1	1	5	1	Yellow octocoral
143	Galápagos	23/09/2023	S0580	136		7	1	1				1	1	4	1	Black coral
144	Galápagos	23/09/2023.	S0580	157		11	1	1				1	1	4	1	Primnoid- Callogorgia
145	Galápagos	23/09/2023	S0580	135		10	1	1				1	1	4	1	Madrepora
146	Galápagos	23/09/2023	S0580	138		12	1	1					1	3	1	Dendrophyllia
147	Galápagos	23/09/2023	S0580	159		5			1	1		1	1	4	1	Cushion star
148	Galápagos	23/09/2023	S0580	143		2							1	1	1	Sea cucumber
149	Galápagos	23/09/2023	S0580	164		4			1	1		1	1	4	1	White cushion star
150	Galápagos	23/09/2023	S0580	140		18	1	1				1	1	4	1	Dendrophyllia
151	Galápagos	23/09/2023	S0580	161		19	1	1				1	1	4		Madrepora
152	Galápagos	23/09/2023	S0580	142		20	1	1				1	1	4	1	Acanthogorgia
153	Galápagos	23/09/2023	S0580	163	142	20			1	1		1		3	3	Ophiuroirds
154	Galápagos	23/09/2023	S0580	139		15								1	1	Rock
155	Galápagos	23/09/2023	S0580	160	139	15							1	1	2	White sponge
156	Galápagos	23/09/2023	S0580	144		16							1	1	5	Rock Asociates

157	Galápagos	23/09/2023	S0580	165		9							1	1	6	Rock Asociates
158	Galápagos	23/09/2023	S0580	141		14							1	1	1	Bivalve
159	Galápagos	23/09/2023	S0580	162	129	13						1		1	6	Crustacean
160	Galápagos	25/09/2023	S0581	146		12	1					1	1	3	1	Dendrophyllia
161	Galápagos	25/09/2023	S0581	145		10	1					1	1	3	1	Madrepora
162	Galápagos	25/09/2023	S0581	166		5	1					1	1	3	1	Madrepora
163	Galápagos	25/09/2023	S0581	202	166	5			1	1	1	1	1	5	1	Squat Lobster
164	Galápagos	25/09/2023	S0581	196		11	1					1	1	3	1	Paragorgia
165	Galápagos	25/09/2023	S0581	190	196	11			1	1	1	1	1	5	10	Ophiuroids
166	Galápagos	25/09/2023	S0581	178		4	1					1	2	4	1	Primnoid
167	Galápagos	25/09/2023	S0581	220	178	4			1	1	1	1	1	5	2	Ophiuroids
168	Galápagos	25/09/2023	S0581	188		7	1					1	1	3	1	Adelogorgia
169	Galápagos	25/09/2023	S0581	200	280	9	1					1	1	3	1	Thesea
170	Galápagos	25/09/2023	S0581	280		9								1	1	Fossil coral
171	Galápagos	25/09/2023	S0581	244	280	9							1	1	1	Ophiuroids
172	Galápagos	25/09/2023	S0581	226	280	9							1	1	1	Hydroid
173	Galápagos	25/09/2023	S0581	238	280	9						1	1	2	1	Gastropod
174	Galápagos	25/09/2023	S0581	184		19						1	1	2	1	Hydroid
175	Galápagos	25/09/2023	S0581	214		13							1	1	6	Rock11 - associates
176	Galápagos	25/09/2023	S0581	172		16							1	1	1	Rock 16 - associates
177	Galápagos	25/09/2023	S0581	208		2							1	1	4	Rock 8 - associates
178	Galápagos	25/09/2023	S0581	236		18							1	1	5	Rock 14- associates
179	Galápagos	27/09/2023	S0581	256		17							1	1		Ophiuroid
180	Galápagos	27/09/2023	S0581	210		17							1	1		Cup coral
181	Galápagos	27/09/2023	S0581	174		17							1	1		Fossil coral associates
182	Galápagos	27/09/2023	S0581	216		17							1	1		Ophiuroid
183	Galápagos	27/09/2023	S0582	300		22	1	1					3	6	1	Dendrophyllia
184	Galápagos	27/09/2023	S0582	298		23	1	1					2	4	1	Madrepora
185	Galápagos	27/09/2023	S0582	258	298	23				1	1		1	3	1	Eunice polychaeta
186	Galápagos	27/09/2023	S0582	260		30	1	1					2	4	1	Dendrophyllia
187	Galápagos	27/09/2023	S0582	296		29	1	1					2	4	1	Madrepora
188	Galápagos	27/09/2023	S0582	254		10	1					1	1	3	1	Muriceides
189	Galápagos	27/09/2023	S0582	306		27	1					1	1	3	1	Swiftia

190	Galápagos	27/09/2023	S0582	264	360	27		1	1		1	3	1	Ophiuroid
191	Galápagos	27/09/2023	S0582	304		12	1			1	1	3	1	Narella
192	Galápagos	27/09/2023	S0582	262		3	1			1	1	3	1	Anthotela
193	Galápagos	27/09/2023	S0582	266		2	1			1	1	3	1	Primnoid
194	Galápagos	27/09/2023	S0582	186		13	1			1	1	3	1	Primnoid
195	Galápagos	27/09/2023	S0582	222	186	13		1	1		1	3	6	Polychaete
196	Galápagos	27/09/2023	S0582	268		24	1			1	1	3	1	Thesea
197	Galápagos	27/09/2023	S0582	180	268	24		1	1		1	3	1	Shrimp
198	Galápagos	27/09/2023	S0582	182		26	1			1	1	3	1	Stolonifera? Clavularia?
199	Galápagos	27/09/2023	S0582	218		32				1	1	3		Pink Stylasterid
200	Galápagos	27/09/2023	S0582	176	218	32			1		1	2		Ophiuroid
201	Galápagos	27/09/2023	S0582	212	218	32					1	1		Polychaete
202	Galápagos	27/09/2023	S0582	170		4						1	5	Desmophyllum
203	Galápagos	27/09/2023	S0582	224	170	4					1	1	1	Anemone
204	Galápagos	27/09/2023	S0582	194		11			1		1	2	1	Bivalve
205	Galápagos	27/09/2023	S0582	230	18	14				1		1	1	Octocoral small
206	Galápagos	27/09/2023	S0582	206		14					1	1	5	Stylasterid + associate
207	Galápagos	27/09/2023	S0582	204		21			1		1	2	2	Ophiuroid
208	Galápagos	27/09/2023	S0582	270		10		1	1		1	3	1	Ophiuroid
209	Galápagos	27/09/2023	S0583	290		5	1			1	1	3	1	Madrepora
210	Galápagos	27/09/2023	S0583	242	290	5		1	1		1	3	1	Squat lobster
211	Galápagos	27/09/2023	S0583	284		6	1			1	1	3	1	Octocoral
212	Galápagos	27/09/2023	S0583	248		2	1			1	1	3	1	Isididae
213	Galápagos	27/09/2023	S0583	286		14	1			1	1	3	1	Chrysogorgia
214	Galápagos	27/09/2023	S0583	250	284	6		1	1		1	3	1	Worm
215	Galápagos	27/09/2023	S0583	292	286	14/15		1	1		1	3	1	Squat Lobster
216	Galápagos	27/09/2023	S0583	168		10	1			1	1	3	1	Acanthogorgia
217	Galápagos	27/09/2023	S0583	282		4	1			1	1	3	1	Black coral
218	Galápagos	27/09/2023	S0583	246		12					1	1	1	Stylasterid
219	Galápagos	27/09/2023	S0583	288	246	12		1	1		1	3	1	Ophiuroid
220	Galápagos	27/09/2023	S0583	252		9	1			1	1	3		Leopathes
221	Galápagos	27/09/2023	S0583	294	276	16			1		1	2		Shrimp

222	Galápagos	27/09/2023	S0583	274	168	10/ 11			1	1		1	3		Shrimp
223	Galápagos	27/09/2023	S0583	232		8	1				1	1	3		Muriceides
224	Galápagos	27/09/2023	S0583	192	286	14						1	1	2	Squat lobster
225	Galápagos	27/09/2023	S0583	228	246	12					1	1	2	1	Ophiuroid
226	Galápagos	27/09/2023	S0583	234		8					1		1	1	Desmophyllum
227	Galápagos	27/09/2023	S0583	198		8						1	1	1	Stylasterid + polychaete
228	Galápagos	27/09/2023	S0583	240		13	1				1	1	3	1	Pennatulacea- sea pen
229	Galápagos	27/09/2023	S0583	278	294	3						1	1	1	shrimp
230	Galápagos	27/09/2023	S0583	276		16	1				1	1	3		White octocoral
231	Galápagos	27/09/2023	S0583	294		3	1				1	1	3	1	Black coral
232	Galápagos	27/09/2023	S0583	272	276	16			1	1		1	3	1	Shrimp
233	Galápagos	2/10/2023	S0585	519		15	1				1		2	1	Swiftia
234	Galápagos	2/10/2023	S0585	478	519	15			1	1		1	3	1	Anemone
235	Galápagos	2/10/2023	S0585	476		16					1	1	2	1	Tubular sponge
236	Galápagos	2/10/2023	S0585	310		8	1	1				1	3	1	Placogorgia
237	Galápagos	2/10/2023	S0585	348	310	8						1	1	1	Ophiuriod
238	Galápagos	2/10/2023	S0585	318		11	1	1				1	4	1	Dendrophyllia
239	Galápagos	2/10/2023	S0585	330		16	1	1				1	3	1	Black coral
240	Galápagos	2/10/2023	S0585	324		12	1	1				1	4		Madrepora
241	Galápagos	2/10/2023	S0585	312		9	1	1				1	4		Dendrophyllia
242	Galápagos	2/10/2023	S0585	302		7	1	1				1	3	1	Primnoid
243	Galápagos	2/10/2023	S0585	308		6	1	1				1	3		Madrepora
244	Galápagos	2/10/2023	S0585	342		10			1	2		1	4	1	Squat Lobster
245	Galápagos	2/10/2023	S0585	336		14			1	1		1	3	1	Decorator crab
246	Galápagos	2/10/2023	S0585	480	318	11			1	1		1	3	1	Ophiuroid
247	Galápagos	2/10/2023	S0585	521	Rock24	3						1	1	1	Octocoral
248	Galápagos	2/10/2023	S0585	563	Rock24	3						1	1	1	Porifera
249	Galápagos	2/10/2023	S0585	438	Rock23	2						1	1	1	Stylasterid
250	Galápagos	2/10/2023	S0585	561	Rock23	2						1	1	7	Green Sponge
251	Galápagos	2/10/2023	S0585	354	Rock27	16						1	1	25	Sponge, hydroid, gostropod, stylasterid, bivalves,
252	Galápagos	2/10/2023	S0585	565	Net	13						1	1	16	Sponge, hydroid, ophiurids
253	Galápagos	2/10/2023	S0585	523	330	16			1				1	1	Polychaete
254	Galápagos	3/10/2023	S0587	603		2	1				1	1	3	1	Anthomastus

255	Galápagos	3/10/2023	S0587	607		3	1				1	1	3	1	Hidroid
256	Galápagos	3/10/2023	S0587	605		10	1				1	1	3	1	Crisogorgia
257	Galápagos	3/10/2023	S0587	647	605	10			1	1		1	3	1	Squat Lobster
258	Galápagos	3/10/2023	S0587	350		12	1	1				1	3	1	Madrepora
259	Galápagos	3/10/2023	S0587	392		13	1	1				1	3	1	Paranthipathes
260	Galápagos	3/10/2023	S0587	434		15	1	1				1	3	1	Callogorgia
261	Galápagos	3/10/2023	S0587	436		20	1	1				1	3	1	Madrepora
262	Galápagos	3/10/2023	S0587	394	434	15			1	1		1	3	1	Ophiuroid
263	Galápagos	3/10/2023	S0587	470		1			1	1		1	3	15	Shrimp
264	Galápagos	3/10/2023	S0587	396	583	8			1	1		1	3	1	Shrimp
265	Galápagos	3/10/2023	S0587	541	603	2			1	1		1	3	1	Shrimp
266	Galápagos	3/10/2023	S0587	555		6	1				1	1	3	1	Acanthogorgia
267	Galápagos	3/10/2023	S0587	513		4	1				1	1	3	1	Yellow swiftia
268	Galápagos	3/10/2023	S0587	448		5	1				1	1	3	1	Plumarella
269	Galápagos	3/10/2023	S0587	583		9	1				1	1	3	1	Plumarella
270	Galápagos	3/10/2023	S0587	499		14	1				1	1	3	1	Black coral
271	Galápagos	3/10/2023	S0587	645	499	14			1	1		1	3	6	Squat lobster
272	Galápagos	3/10/2023	S0587	533	499	14			1	1		1	3		Ophiurioids
273	Galápagos	3/10/2023	S0587	491	499	14			1	1		1	3	26	Polychaeta
274	Galápagos	3/10/2023	S0587	450	499	14						1	1	2	Shrimp
275	Galápagos	3/10/2023	S0587	649	Net	18						1	1	7	1 Spider crab, 2 crab, 2 polychaeta, 2 ophiurids
276	Galápagos	3/10/2023	S0587	446	Net	19						1	1	7	Desmophyllum
277	Galápagos	3/10/2023	S0587	456	Fossil	17						1	1	4	2 Hydroids, 1 white ophiuroid, 1 piece yellow coral
278	Galápagos	3/10/2023	S0587	497	Rock	7						1	1	4	3 hydroids, 1 bryozoa small, translucen. Bryozoa white
279	Galápagos	3/10/2023	S0587	352	Rock 31	19						1	1	4	2 anemonas, 2 sponges trasnparents in pieces.
280	Galápagos	4/10/2023	S0587	466	607	3						1	1	1	Jellyfish
281	Galápagos	4/10/2023	S0588	539		1	1				1	1	3	1	Paragorgia
282	Galápagos	4/10/2023	S0588	503	539	1			1	1		1	3	2	Ophiuroids
283	Galápagos	4/10/2023	S0588	462		10	1	1				1	4	1	Madrepora
284	Galápagos	4/10/2023	S0588	495		11	1	1				1	3	1	Acanthogorgia
285	Galápagos	4/10/2023	S0588	452		12	1	1				1	3	1	Dendrophyllia
286	Galápagos	4/10/2023	S0588	505		5	1	1				1	4	1	Madrepora
287	Galápagos	4/10/2023	S0588	454	505	5			1	1		1	3	1	Squat lobster

288	Galápagos	4/10/2023	S0588	531		6	1	1				1	3	1	Callogorgia
289	Galápagos	4/10/2023	S0588	537		7	1	1				1	3	1	Black coral
290	Galápagos	4/10/2023	S0588	545	537	7			1	1		1	3	2	Squat lobster
291	Galápagos	4/10/2023	S0588	547		8	1	1				1	3	1	Acanthogorgia
292	Galápagos	4/10/2023	S0588	553		13			1	1		1	3	8	Ophiuroids
293	Galápagos	4/10/2023	S0588	501	495	11			1	1		1	3	1	Ophiuroids
294	Galápagos	4/10/2023	S0588	551	Rock 33	3						1	1	4	3 hydroids, 1 hylaster
295	Galápagos	4/10/2023	S0588	509	Rock 34	4						1	1	12	2 cup coral(Javania), 3 squat, 2, anemones, 2 sponge, 2 chitones, 1 stylasteridae
296	Galápagos	4/10/2023	S0588	468	Yellow net	9						1	1	7	1 glass sponge, 1 polychaeta, 3 squat lobster, 2 ophiuroids
297	Galápagos	4/10/2023	S0588	511		13			1	1		1	3	5	Ophiuroids
298	Galápagos	4/10/2023	S0588	458		13						1	1	1	Polychaeta
299	Galápagos	4/10/2023	S0588	543	Rock 35	14						1	1	32	3 sponge, 9 tubeworms,10 stylaster, 7 ophiuroids, 1 crab, 1 red worm, 1 sea urchin, 1 cup coral, 2 hydroids
300	Galápagos	5/10/2023	S0589	374		19		1				1		1	Black coral
301	Galápagos	5/10/2023	S0589	320	374	19			1	1		1		1	Ophiuroids
302	Galápagos	5/10/2023	S0589	386		17		1				1		1	Acanthogorgia
303	Galápagos	5/10/2023	S0589	322	386	17			1	1		1		3	Ophiuroids
304	Galápagos	5/10/2023	S0589	380		18		1				1		1	Madrepora
305	Galápagos	5/10/2023	S0589	328		20		1				1		1	Primnoid
306	Galápagos	5/10/2023	S0589	326	328	20			1	1		1		1	Ophiuroid
307	Galápagos	5/10/2023	S0589	334		21		1				1		1	Dendrophyllia
308	Galápagos	5/10/2023	S0589	332		23		1				1		1	Madrepora
309	Galápagos	5/10/2023	S0589	340		22		1				1		1	Dendrophyllia
310	Galápagos	5/10/2023	S0589	338		2	1				1	1		1	Paragorgia
311	Galápagos	5/10/2023	S0589	346	338	2			1	1		1		1	Zoanthids
312	Galápagos	5/10/2023	S0589	344		16	1				1	1		1	Purple victogorgia
313	Galápagos	5/10/2023	S0589	432		11	1				1	1		1	Calliptrophora
314	Galápagos	5/10/2023	S0589	472		13					1	1		1	Hemicorallium
315	Galápagos	5/10/2023	S0589	493	472	13			1	1		1		1	Crinoid
316	Galápagos	5/10/2023	S0589	464		4	1				1	1		1	Bamboo coral
317	Galápagos	5/10/2023	S0589	474	472	13			1	1		1		2	Polychaeta
318	Galápagos	5/10/2023	S0589	422	Rock 38	5						1		2	Green sponge 1 ophiurids

319	Galápagos	5/10/2023	S0589	428	Rock 40	7						1	1	Hydroids
320	Galápagos	5/10/2023	S0590	460		1					1	1	1	Sea cucumber
321	Galápagos	5/10/2023	S0590	517		2					1	1	1	Sea cucumber
322	Galápagos	5/10/2023	S0590	507	Rock 47	3						1	1	Long fish
323	Galápagos	6/10/2023	S0591	515		3		1				1	1	Madrepora
324	Galápagos	6/10/2023	S0591	535		3		1				1	1	Primnoid
325	Galápagos	6/10/2023	S0591	549		1		1				1	1	Black coral
326	Galápagos	6/10/2023	S0591	559		5		1				1	1	Acanthogorgia
327	Galápagos	6/10/2023	S0591	575	559	5						1	1	Ophiuroid
328	Galápagos	6/10/2023	S0591	587		6		1				1	1	Dendrophyllia thin
329	Galápagos	6/10/2023	S0591	557		9		1				1	1	Madrepora
330	Galápagos	6/10/2023	S0591	573		10		1				1	1	Acanthogorgia
331	Galápagos	6/10/2023	S0591	589		10			1	1		1	5	Ophiuroid
332	Galápagos	6/10/2023	S0591	599		8		1				1	1	Dendrophyllia
333	Galápagos	6/10/2023	S0591	597		15	1				1	1	1	Yellow octocoral
334	Galápagos	6/10/2023	S0591	617		13	1					1	1	White octocoral - Thesea
335	Galápagos	6/10/2023	S0591	615		4	1					1	1	White octocoral
336	Galápagos	6/10/2023	S0591	639	615	4			1	1		1	2	Ophiuroids
337	Galápagos	6/10/2023	S0591	629	615	4			1	1		1	1	Shrimp
338	Galápagos	6/10/2023	S0591	631	615	4			1	1		1	5	Polychaetes
339	Galápagos	6/10/2023	S0591	410	Fossil	7	1						1	Swiftia
340	Galápagos	6/10/2023	S0591	368	Fossil	7	1					1	1	Tessea
341	Galápagos	6/10/2023	S0591	404		18	1					1	1	White octocoral branched
342	Galápagos	6/10/2023	S0591	362		17	1					1	1	White octocoral
343	Galápagos	6/10/2023	S0591	430		1	1					1	1	Paraminabea
344	Galápagos	6/10/2023	S0591	388	Rock 48	14						1	9	Organims on rock
345	Galápagos	6/10/2023	S0591	424	617	13			1	1		1	8	Amphipods
346	Galápagos	6/10/2023	S0591	370	Fossil	7	1					1	1	Yellow octocoral
347	Galápagos	6/10/2023	S0591	382	370	7			1	1		1	1	Ophiuroids
348	Galápagos	6/10/2023	S0591	418	Fossil	7						1	26	Fossil associates
349	Galápagos	6/10/2023	S0591	376	362	17			1			1	2	Shrimp
350	Galápagos	6/10/2023	S0591	412	Fossil	12						1	1	Fossil associates

351	Galápagos	6/10/2023	S0591	406	Fossil	11						1	1	Fossil associates
352	Galápagos	6/10/2023	S0592	364		4		1				1	1	Acanthogorgia
353	Galápagos	6/10/2023	S0592	643	364	4			2			1	5	Ophiuroids
354	Galápagos	6/10/2023	S0592	601		3		1				1	1	Black coral
355	Galápagos	6/10/2023	S0592	641		5		1				1	1	Madrepora
356	Galápagos	6/10/2023	S0592	400		2		1				1	1	White octocoral
357	Galápagos	6/10/2023	S0592	358		10		1				1	1	Acanthogorgia
358	Galápagos	6/10/2023	S0592	414	358	10			2			1	10	Ophiuroids
359	Galápagos	6/10/2023	S0592	372		9		1				1	1	Madrepora
360	Galápagos	6/10/2023	S0592	360		6	1	1			1	1	1	Bathypathes
361	Galápagos	6/10/2023	S0592	314		14						1		Fossil assocaites
362	Galápagos	6/10/2023	S0592	390		14	1				1		1	White octocoral
363	Galápagos	6/10/2023	S0592	525		13						1		Fossil assocaites
364	Galápagos	6/10/2023	S0592	426		13						1	1	Desmophyllum
365	Galápagos	6/10/2023	S0592	316	Fossil	12						1	1	Sea cucumber
366	Galápagos	6/10/2023	S0592	384	Fossil	12						1	1	Tessea/Swiftia fossil
367	Galápagos	7/10/2023	S0593	420		5	1				1	1		Paramuricea
368	Galápagos	7/10/2023	S0593	378		11		1				1		Madrepora
369	Galápagos	7/10/2023	S0593	483	420	5			1	1		1		Shrimp
370	Galápagos	7/10/2023	S0593	442	420	5			1	1		1		Squat lobster
371	Galápagos	7/10/2023	S0593	527		12		1				1		Dendrophyllia
372	Galápagos	7/10/2023	S0593	444		3		1				1		Acanthogorgia
373	Galápagos	7/10/2023	S0593	529		7		1				1		Primnoid
374	Galápagos	7/10/2023	S0593	487	529	7			1			1		Ophiuroid
375	Galápagos	7/10/2023	S0593	637	529	7			1			1		Squat lobster
376	Galápagos	7/10/2023	S0593	625		4		1				1		Madrepora
377	Galápagos	7/10/2023	S0593	595		9		1				1		Dendrophyllia
378	Galápagos	7/10/2023	S0593	633		6		1				1		Black coral
379	Galápagos	7/10/2023	S0593	591	633	6			1	1		1		Ophiuroid
380	Galápagos	7/10/2023	S0593	398	633	6			1	1		1		Squat lobster
381	Galápagos	7/10/2023	S0593	356		10						1		Carophyllia
382	Galápagos	7/10/2023	S0593	485								1		Squid
383	Galápagos	7/10/2023	S0593	585	Rock 54	10						1	1	Bivalve

384	Galápagos	9/10/2023	S0595	609		4	1				1	1	1	Whip coral
385	Galápagos	9/10/2023	S0595	569		5			1	1		1	1	Acesta
386	Galápagos	9/10/2023	S0595	611	613	6			1	1		1	1	Ophiura
387	Galápagos	9/10/2023	S0595	623	613	6			1	1		1	1	Ophiura
388	Galápagos	9/10/2023	S0595	581	613	6			1	1		1	1	Ophiura
389	Galápagos	9/10/2023	S0595	619	613	6			1	1		1	5	Ophiuras
390	Galápagos	9/10/2023	S0595	577	613	6			1				1	Polychaete
391	Galápagos	9/10/2023	S0595	621	613	6						1	1	Placophora
392	Galápagos	9/10/2023	S0595	579	613	6					1		1	Desmophyllum
393	Galápagos	9/10/2023	S0595	613		6								Fossil coral
394	Galápagos	9/10/2023	S0595	627	613	6			1	1		1	2	Sea urchins
395	Galápagos	9/10/2023	S0595	678								1	1	Squid
396	Galápagos	9/10/2023	S0596	733		14	1			1	1	2	1	Madrepora
397	Galápagos	9/10/2023	S0596	652	733	14			1	1		1	1	Squat lobster
398	Galápagos	9/10/2023	S0596	731	733	14			1	1		1	2	Ophiuroid
399	Galápagos	9/10/2023	S0596	729	733	14			1	1		1	1	Polychaete
400	Galápagos	9/10/2023	S0596	727		18	1	1			1	1	1	Madrepora
401	Galápagos	9/10/2023	S0596	726		21	1	1			1	1	1	Dendrophyllia
402	Galápagos	9/10/2023	S0596	724		17	1	1			1	1	1	Dendrophyllia
403	Galápagos	9/10/2023	S0596	723		13	1	1			1	1	1	Madrepora
404	Galápagos	9/10/2023	S0596	721	733	14			1	1		1	1	Squat lobster
405	Galápagos	9/10/2023	S0596	652	733	14			1	1		1	1	Squat lobster
406	Galápagos	9/10/2023	S0596	720		2	1				1	1	1	Black coral
407	Galápagos	9/10/2023	S0596	718		4						1	2	Stylasterid
408	Galápagos	9/10/2023	S0596	719	718	4			1	1		1	2	Ophiuroid - Eurelidae
409	Galápagos	9/10/2023	S0596	714	716	19			1	1		1	7	Chrinoids
410	Galápagos	9/10/2023	S0596	717	716	19			1	1		1	2	Polychaete
411	Galápagos	9/10/2023	S0596	715	716	19			1	1		1	1	Polychaete
412	Galápagos	9/10/2023	S0596	730	716	19						1	3	Desmophyllum
413	Galápagos	9/10/2023	S0596	713	716	19			1	1		1	1	Polychaete
414	Galápagos	9/10/2023	S0596	712	716	19			1	1		1	1	Ophiuroid
415	Galápagos	9/10/2023	S0596	711	716	19						1	1	Polychaete
416	Galápagos	9/10/2023	S0596	709	716	19			1	1		1	1	Polychaete

417	Galápagos	9/10/2023	S0596	716		19								1	Fossil coral with lots of associates
418	Galápagos	9/10/2023	S0596	710	716	19							1	1	Sponge
419	Galápagos	9/10/2023	S0596	708	716	19							1	1	Sponge
420	Galápagos	9/10/2023	S0596	707		15			1	1			1	1	Squat lobster
421	Galápagos	9/10/2023	S0596	706		15			1	1			1	1	Spoon worm
422	Galápagos	9/10/2023	S0596	702		6							1	1	Sponge
423	Galápagos	9/10/2023	S0596	701	713	19							1	1	Polychaete
424	Galápagos	9/10/2023	S0596	700		23	1				1		1	1	Acanthogorgia
425	Galápagos		S0596	722	?	?			1	1			1	1	Squat lobster
426	Galápagos	11/10/2023	S0599	705		1							1	1	Coronaster (posiblemente)
427	Galápagos	11/10/2023	S0599	698	699	2							1		Anemone
428	Galápagos	11/10/2023	S0599	699		2							1		Hemi crabs
429	Galápagos	11/10/2023	S0599	697		2							1		Conus
430	Isla del Coco	15/10/2023	S0600	675		1	1					1	1		Sea pen
431	Isla del Coco	15/10/2023	S0600	674		3	1					1	1		Sea pen, number in tube was corrected
432	Isla del Coco	15/10/2023	S0600	655		13	1					1	1		Schizopathes
433	Isla del Coco	15/10/2023	S0600	676		10	1					1	1		Thesea sp
434	Isla del Coco	15/10/2023	S0600	654	676	10							1		Hydroid
435	Isla del Coco	15/10/2023	S0600	653		7	1					1	1		Yellow octocoral
436	Isla del Coco	15/10/2023	S0600	686		11	1					1	1		White octocoral
437	Isla del Coco	15/10/2023	S0600	684		17	1					1	1		White octocoral
438	Isla del Coco	15/10/2023	S0600	683	684	17							1		nudibranch
439	Isla del Coco	15/10/2023	S0600	680		2							1		soft coral
440	Isla del Coco	15/10/2023	S0600	691		15							1		ophiuroid
441	Isla del Coco	15/10/2023	S0600	600	676	10							1		ophiuroid
442	Isla del Coco	15/10/2023	S0600	679		12	1					1	1		Dendrophyllia
443	Isla del Coco	15/10/2023	S0600	689		14	1					1	1		White octocoral
444	Isla del Coco	15/10/2023	S0600	682		5							1		bivalves
445	Isla del Coco	15/10/2023	S0600	687	686	11	1					1	1		hydroids
446	Isla del Coco	15/10/2023	S0600	665		6	1	1				1	1		Yellow octocoral
447	Isla del Coco	15/10/2023	S0600	664	686	11							1		Polychaete
448	Isla del Coco	15/10/2023	S0600	677		9						1	1		Pyrosome
449	Isla del Coco	15/10/2023	S0600	667		9							1		bivalve

450	Isla del Coco	15/10/2023	S0600	666		9				1		Ophiuroids
451	Isla del Coco	15/10/2023	S0600	681		16				1		Stylasterids
452	Isla del Coco	15/10/2023	S0600	650		16				1		Brachipod shells
453	Isla del Coco	15/10/2023	S0600	668		16				1		Bivalves
454	Isla del Coco	15/10/2023	S0600	673		16				1		Ophiuroids
455	Isla del Coco	15/10/2023	S0600	663		16				1		Polychaete
456	Isla del Coco	15/10/2023	S0600	672		16				1		Sponge
457	Isla del Coco	15/10/2023	S0600	671		16				1		White sponge
458	Isla del Coco	15/10/2023	S0600	685		8	1		1	1		Creamy yellow octocoral
459	Isla del Coco	15/10/2023	S0600	688		4				1		Quill worm
460	Isla del Coco	16/10/2023	S0601	693		24	1		1	1	1	Yellow octocoral
461	Isla del Coco	16/10/2023	S0601	694	693	24				1	1	Anemone associated
462	Isla del Coco	16/10/2023	S0601	725	693	24				1		Ophiurid
463	Isla del Coco	16/10/2023	S0601	692		20	1			1		Yellow octocoral with eggs
464	Isla del Coco	16/10/2023	S0601	732	692	20				1		Anemone
465	Isla del Coco	16/10/2023	S0601	659	692	20				1		Squat lobster
466	Isla del Coco	16/10/2023	S0601	658	693	24				1		Hydroid
467	Isla del Coco	16/10/2023	S0601	670		5	1		1	1		Black coral
468	Isla del Coco	16/10/2023	S0601	657	670	5				1		Squat lobster
469	Isla del Coco	16/10/2023	S0601	656		15	1		1	1		Sea pen with eggs
470	Isla del Coco	16/10/2023	S0601	669		2	1		1	1		Yellow octocoral
471	Isla del Coco	16/10/2023	S0601	661		1	1		1	1		Muricidae
472	Isla del Coco	16/10/2023	S0601	696		17	1		1	1		Yellow octocoral
473	Isla del Coco	16/10/2023	S0601	695		19	1		1	1		Callagorgia with eggs
474	Isla del Coco	16/10/2023	S0601	660		11	1		1	1		Bamboo coraL with eggs
475	Isla del Coco	16/10/2023	S0601	662		14	1		1	1		Yellow muricidae
476	Isla del Coco	16/10/2023	S0601	737		18		1				Callagorgia with eggs RNA
477	Isla del Coco	16/10/2023	S0601	758		9				1		White tube sponge
478	Isla del Coco	16/10/2023	S0601	762	758	9				1		Polychaeta
479	Isla del Coco	16/10/2023	S0601	741	758	9				1		Zoanthids
480	Isla del Coco	16/10/2023	S0601	740		6		1	1	1		Black coral RNA
481	Isla del Coco	16/10/2023	S0601	786		21		1	1	1		Yellow octocoral RNA
482	Isla del Coco	16/10/2023	S0601	742		25				1		nudibranch

483	Isla del Coco	16/10/2023	S0601	807	25				1		Little white sponge
484	Isla del Coco	16/10/2023	S0601	804	12	1		1	1		Pink Paragorgidae
485	Isla del Coco	16/10/2023	S0601	782	13	1		1	1		White Paragorgia
486	Isla del Coco	16/10/2023	S0601	743	8	1		1	1	1	Swiftia
487	Isla del Coco	16/10/2023	S0601	764	23				1	1	Bivalve
488	Isla del Coco	16/10/2023	S0601	785	22				1		Ophiuridae
489	Isla del Coco	16/10/2023	S0601	806	16				1	1	Unknow eggs
490	Isla del Coco	16/10/2023	S0601	745	10				1	1	Stylasterid
491	Isla del Coco	16/10/2023	S0601	766	7				1	1	Sponge quill
492	Isla del Coco	16/10/2023	S0601	803	23				1		Old coral stem, wood
493	Isla del Coco	16/10/2023	S0601	761	3	1		1	1	1	Primnoid
494	Isla del Coco	16/10/2023	S0601	765	4		1			1	Primnoid

APPENDIX 4 Rock Inventory

ROV Dive S0577 Sept. 18, 2023 - Cacho de Coral Seamount (Coral Crescent)
3 rocks sampled in bucket #1

Event 1 Rock 1 ~20#, in plastic bag in bucket #1
Event 11 Rock 2 ~ 5#, in plastic bag in bucket #1
Event 16 Rock 3 ~80#, broken up, 1 piece sawed and in plastic bag in bucket #1
2 tyvex bags with other pieces of the rock

ROV Dive S0578 Sept. 20, 2023 - Cacho de Coral Seamount (Coral Crescent)
mapping dive, no samples

ROV Dive S0579 Sept. 21-22, 2023- Cacho de Coral Seamount (Coral Crescent)
2 rocks sampled in bucket #2

Event 14 Rock 4 ~15# broken into 2 pieces, one sawed both in plastic bag, in bucket #2,
Event 27 Rock 5 ~60#, broken up into ~3 pieces, 1 piece sawed and in plastic bag in bucket #2, 1 tyvex bag with 2 other larger pieces

ROV Dive S0580 Sept. 22-23, 2023- Cacho de Coral Seamount (Coral Crescent)
1 rock sampled in bucket #2

Event 15 Rock 6 ~5#, sawed into several pieces, all in plastic bag, in bucket #2,

ROV Dive S0581 Sept. 25, 2023- seamount east of San Cristobal
8 rocks sampled (all in bucket #3, each in a plastic bag)

Event 1 Rock 7 0.25#, small piece of carbonate rock
Event 2 Rock 8 5#, carbonate slab
Event 3 Rock 9 4#, vesicular basalt
Event 6 Rock 10, 0.25#, small rock
Event 13 Rock 11 2#, vesicular basalt,Mn coated
Event 15 Rock 12 5#, basalt
Event 16 Rock 13 1# not cut, Mn coated basalt
Event 18 Rock 14 8#, dike rock, vesicular, fine grained basalt

ROV Dive S0582 Sept. 25, 2023- seamount east of San Cristobal
5 rocks sampled (all in bucket 4, each sample in a plastic bag)

Event 1 Rock 15 10# very weathered pillow tube, very vesicular, Mn coated
Event 8 Rock 16 3# sparsely vesicular basalt, weathered, angular, Mn coated
Event 11 Rock 17 8# weathered basalt, Mn coated
Event 14 Rock 18 2# vesicular basalt, minor Mn coating
Event 21 Rock 19 4# lobate crust, in situ, possible hyaloclastite?, Mn coated

ROV Dive S0583 Sept. 27, 2023 - seamount east of San Cristobal
2 rocks sampled (small pieces of each in bucket 5, large sample of each in a tyvex bag)

Event 1 Rock 20 60# large vesicular basalt w/Mn coating
Event 8 Rock 21 30# large vesicular basalt w/plagioclase phenocrysts, Mn coating

ROV Dive S0584 Sept. 28, 2023 - seamount east of San Cristobal
mapping dive, no samples

ROV Dive S0585 Sept. 30 - Oct. 1, 2023 - dive off NE cape of Santa Cruz Island
6 rocks sampled (Rocks 23&26 also have large pieces in 1 Tyvex bag, others are each in a plastic bag in bucket 5)

Event 1	Rock 22	1# vesicular plag rich basalt
Event 2	Rock 23	20# large basalt plag. glomerocrysts?
Event 3	Rock 24	3# hyaloclastite
Event 4	Rock 25	5# basalt w/sparse large plag. laths in fine grained matrix
Event 5	Rock 26	20# basalt w/large plag. glomercrysts? (similar texture to Rock 23)
Event 18	Rock 27	3# vesicular fine grained basalt

ROV Dive S0586 - BBC dive no rocks collected

ROV Dive S0587 Oct. 2-3, 2023 - dive on north flank of Roca Redonda
4 rocks sampled (Rock #30 is talus, all rock samples are each in a plastic bag in bucket 6)

Event 7	Rock 28	3# vesicular plag phyric basalt
Event 11	Rock 29	20# columnar basalt, in situ dense, some plag, small vesicles
Event 18	Rock 30	5# talus with fossil coral net scoop- not cut
Event 19	Rock 31	15# pillow fragment, in situ, vesicular plag. phyric with pipe vesicles - possible glass on outer rim?, in live coral net scoop

ROV Dive S0588 Oct. 3-4, 2023 - dive on north flank of Volcan Ecuador, north coast of Isabela
4 rocks sampled (not cut, each in a plastic bag in bucket 6)

Event 2	Rock32	0.25# small fragments of vesicular basalt, not cut
Event 3	Rock33	5# pillow fragment, vesicular, Mn coated, possible plag. phenoc.
Event 4	Rock34	2# lava crust fragments, Mn and Fe stained, vesicular, no phenoc.
Event 14	Rock35	2# lava crust, vesicular, no phenocrysts, had coral on it, that piece of the rock was cut and given to U. Bristol - James Kershaw

ROV Dive S0589 Oct. 3-4, 2023 - dive on north flank of NW submarine rift of Fernandina
11 rocks sampled

Event 1	Rock36	0.5# small lava nose, plag. phenocrysts also in glass
Event 3	Rock37	7# large lava nose w/plag. phenocrysts
Event 5	Rock38	30# large lava crust w/well developed drips and selvages and bubbles on interior surface of crust
Event 6	Rock39	10# lava nose - in 3 pcs (one given to Aaron) plag. phyric
Event 7	Rock40	5# lava crust with some drips, Mn coated, plag. phyric
Event 8	Rock41	4# lava crust, some Mn and weathered drip structures
Event 9	Rock42	4# lava nose, some plag.
Event 10	Rock43	15# large lava nose
Event 12	Rock44	7# lava crust, plag phyric, vesicular
Event 14	Rock45	20# large lava crust with big tube vesicles/closed channels on inside surface and drip selvages, vesicular, with plag. phencrysts
Event 15	Rock46	2# small lava crust, vesicular, plag phenocrysts

ROV Dive S0590 Oct. 5-6, 2023 - Dive in Canal Bolivar, shallow area between Isabela and Fernandina to assess commercial holothurian fishery

1 rock sampled from a lava flow

Event 3	Rock47	10# piece of fine-grained basalt from outcrop at 204 m depth in channel, some Mn coating and biology

ROV Dive S0591 Oct. 6, 2023 - Dive offshore the SE rift zone of Fernandina

1 rock sampled - likely talus

Event 14	Rock48	8# piece of vesicular basalt talus sampled near biology sampling site at 195 m depth some Mn coating and biology

ROV Dive S0592 Oct. 6-7, 2023 - Dive offshore the NW rift zone of Fernandina (N of D S0589)

4 rocks sampled - in situ except for #51a

Event 1	Rock49	15# large pillow fragment, vesicular, with plagioclase
Event 11	Rock50	5# large pillow fragment, vesicular, with plagioclase
Event 12	Rock51a	2# **TALUS** vesicular, sampled in coral scoop net
Event 15	Rock51b	0.1# small lava crust, vesicular

ROV Dive S0593 Oct. 7, 2023 - Dive offshore the SW cape of Isabela, Cerro Azul volcano to investigate the slope/scarp on the shallow portion of the submarine rift zone

3 rocks sampled

Event 1	Rock52	2# nose of lava tongue extruded from eggshell pillow sampled at this location, Rocks 52 and 53 from same feature, but 52 is the last pulse of lava that was extruded from the pillow when it cracked so may be more differentiated than the crust of the pillow sampled with Rock#53. **in situ**
Event 11	Rock53	4# pillow crust from eggshell pillow, originally formed 1st when pillow formed, then the small tube of lave extruded from the pillow when it broke open (the tip of that tube is what was sampled in Rock #52). **in situ**
Event 15	Rock54	2# vesicular crust- large vesicles

ROV Dive S0594 Oct. 7-8, 2023 - *no rock samples*

ROV Dive S0595 Oct. 8-9, 2023 - west cape of Isabela (Cerro Azul)

2 samples #55 & #56

Event5	Rock55 (Depth526 m)	5#	lava
Event7	Rock56 (Depth 360 m)	3#	lava

ROV Dive S0596 Oct. 9-10, 2023 - lava flow south coast of Isabela (Cerro Azul)
14 samples #57-#70

Event1	Rock57 (Depth 937 m)	5#	in situ lava crust
Event 3	Rock58 (Depth 900 m)	3#	in situ top of big bolster pillow
Event 5	Rock59 (Depth 879 m)	20#	in situ, large crust at west margin of flow
Event 6	Rock60 (Depth 835 m)	3#	in situ from west edge of flow
Event 7	Rock61 (Depth 809 m)	15#	in situ roundish pillow bud
Event 8	Rock62 (Depth 802 m)	5#	in situ pillow crust
Event 9	Rock63 (Depth 755 m)	2#	in situ tubular pillow crust
Event 10	Rock64 (Depth 768 m)	5#	in situ 3pcs of pillow crust
Event 11	Rock65 (Depth 689 m)	2#	in situ pieces of pillow crust in quiver2
Event 12	Rock66 (Depth 634 m)	20#	in situ large pillow fragment
Event 15	Rock67 (Depth 540 m)	3#	in situ crust from inflated pillow
Event 16	Rock68 (Depth 430 m)	40#	in situ large pillow fragment
Event 20	Rock69 (Depth 379 m)	10#	in situ pillow crust
Event 22	Rock70 (Depth 302 m)	3#	in situ pillow bud/crust

APPENDIX 5 Norbit multibeam surveys

Dive	Date	Configuration	Files	Surveys	Location
S0578	20/09/2023- 21/09/2023	45 degree forward facing, 700 kHz, 160° swath Equiangular Gain: -15dB Spreading: 40° Absorption: 80dB/km Pingrate: adaptive Sweep & bandwidth: auto Snippets No TSS1 input (goes to laser)	2023-09-20-15_07_20 2023-09-20-15_34_58 2023-09-20-18_15_22 2023-09-20-18_21_55 2023-09-20-18_30_55 2023-09-20-18_38_04 2023-09-20-18_46_21 2023-09-20-18_55_30 2023-09-20-18_57_10 2023-09-20-18_57_37 2023-09-20-19_09_30 2023-09-20-19_20_20 2023-09-20-19_29_03 2023-09-20-19_38_17 2023-09-20-19_48_02 2023-09-20-20_05_50 2023-09-20-20_24_09 2023-09-20-20_35_21 2023-09-20-20_44_31 2023-09-20-20_47_15 2023-09-20-20_59_12 2023-09-20-21_09_42 2023-09-20-21_18_58 2023-09-20-21_33_31 2023-09-20-21_37_43 2023-09-20-21_45_38 2023-09-20-21_53_46 2023-09-20-22_03_19 2023-09-20-22_13_30 2023-09-20-22_25_20 2023-09-20-22_36_00 2023-09-20-22_47_14 2023-09-20-22_56_48 2023-09-20-23_06_55 2023-09-20-23_16_21 2023-09-20-23_26_21 2023-09-20-23_37_17 2023-09-20-23_47_06 2023-09-20-23_55_15 2023-09-21-00_06_10 2023-09-21-00_17_42 2023-09-21-00_31_23 2023-09-21-00_44_54 2023-09-21-00_56_13 2023-09-21-01_05_47 2023-09-21-01_14_22 2023-09-21-01_23_07 2023-09-21-01_34_54 2023-09-21-01_42_59 2023-09-21-01_52_38 2023-09-21-02_04_30 2023-09-21-02_10_57 2023-09-21-02_14_13 2023-09-21-02_23_12 2023-09-21-02_29_10 2023-09-21-02_31_53 2023-09-21-02_39_42 2023-09-21-02_48_50 2023-09-21-02_57_22 2023-09-21-03_05_53 2023-09-21-03_18_28 2023-09-21-03_29_15 2023-09-21-03_37_24 2023-09-21-03_44_51 2023-09-21-03_52_34 2023-09-21-03_59_04 2023-09-21-04_03_35 2023-09-21-04_06_47 2023-09-21-04_14_47 2023-09-21-04_23_00 2023-09-21-04_29_36 2023-09-21-04_33_30	2	Cacho de Coral Calibration and plug ridge 483-460m

			2023-09-21-04_35_26 2023-09-21-04_40_48 2023-09-21-04_46_33 2023-09-21-04_52_19 2023-09-21-04_57_48		
S0582	25/09/2023- 26/09/2023	Side facing 400 kHz 120° swath Equiangular Other settings as above	2023-09-26-02_02_34 2023-09-26-02_20_40 2023-09-26-02_54_13 2023-09-26-03_12_29 2023-09-26-13_13_59 2023-09-26-13_22_11 2023-09-26-13_27_27 2023-09-26-20_55_03 2023-09-26-21_05_10 2023-09-26-21_40_32 2023-09-26-22_33_15	3	Fault on the western side of seamount site 4. 670-690m 545-580m 375-425m Nominal heading 175° 20m from wall
S0584	28/09/2023	75 degree forward facing 700kHz 120° swath Equiangular Other settings as above	2023-09-28-15_00_15 2023-09-28-15_08_39 2023-09-28-15_11_15 2023-09-28-15_14_14 2023-09-28-15_17_24 2023-09-28-15_20_05 2023-09-28-15_22_26 2023-09-28-15_22_28 2023-09-28-15_24_39 2023-09-28-15_30_06 2023-09-28-15_33_52 2023-09-28-15_35_51 2023-09-28-15_37_59 2023-09-28-15_40_19 2023-09-28-15_48_16 2023-09-28-15_49_20 2023-09-28-15_51_25 2023-09-28-15_53_25 2023-09-28-15_55_44 2023-09-28-15_57_15 2023-09-28-15_58_55 2023-09-28-16_01_55 2023-09-28-16_04_27 2023-09-28-16_06_35 2023-09-28-16_08_21 2023-09-28-16_10_35 2023-09-28-16_13_09 2023-09-28-16_15_30 2023-09-28-16_18_21 2023-09-28-16_21_19 2023-09-28-16_24_00 2023-09-28-16_27_27 2023-09-28-16_30_31 2023-09-28-16_34_47 2023-09-28-16_38_02 2023-09-28-16_40_31 2023-09-28-16_43_50 2023-09-28-16_47_18 2023-09-28-16_51_00 2023-09-28-16_53_55 2023-09-28-16_58_05 2023-09-28-17_01_18 2023-09-28-17_04_27 2023-09-28-17_08_38 2023-09-28-17_11_34 2023-09-28-17_14_29 2023-09-28-17_17_40 2023-09-28-17_20_40 2023-09-28-17_25_32 2023-09-28-17_29_07 2023-09-28-17_31_58 2023-09-28-17_34_47 2023-09-28-17_37_38 2023-09-28-17_40_15 2023-09-28-17_43_23 2023-09-28-17_46_14 2023-09-28-17_49_28 2023-09-28-17_52_32 2023-09-28-17_55_35 2023-09-28-18_04_41 2023-09-28-18_08_24	1	Laser and MBES Seamount- Site 4, ridge to north 412-390m

			2023-09-28-18_13_25 2023-09-28-18_17_30 2023-09-28-18_24_21 2023-09-28-18_30_18 2023-09-28-18_37_39 2023-09-28-18_46_01 2023-09-28-18_53_20 2023-09-28-19_00_39 2023-09-28-19_08_14 2023-09-28-19_15_49 2023-09-28-19_23_52 2023-09-28-19_31_08 2023-09-28-19_38_08 2023-09-28-19_44_34 2023-09-28-19_51_44 2023-09-28-19_59_11 2023-09-28-20_05_20 2023-09-28-20_11_00 2023-09-28-20_16_30 2023-09-28-20_22_38		
S0587	02/10/2023- 03/10/2023	Side facing 400 kHz 120° swath Equiangular	20231003_091403.s7k 20231003_094435.s7k	1	Vertical wall Redonda Rock 640m Nominal heading: 45° 20m from wall
S0594	08/10/2023	Side facing 400 kHz 140° swath Equiangular	20231008_110316.s7k 20231008_114430.s7k	1	Deeper vertical wall exploration on terraces south of Isabela. 20 m away from wall, Nominal Heading: 320, Depth 520-540 m
S0595	08/10/2023- 09/10/2023	Side facing 400 kHz 120° swath Equidistant	20231008_205116.s7k 20231008_210403.s7k 20231008_211101.s7k 20231008_233741.s7k 20231009_000401.s7k 20231009_002708.s7k 20231009_064412.s7k 20231009_065655.s7k 20231009_071020.s7k 20231009_071320.s7k	3	Two vertical walls on the terraces south of Isabela Nominal Heading: Survey 1 (cave): Line 1: heading 35 Line 2: heading 345 Line 3: heading 270 Survey 2: heading 300 Survey 3: heading 320
S0597	10/10/2023	45 degree forward facing 400kHz 120° swath Equidistant Other settings as above -dedicated MBES Survey 700kHz collected during laser survey, other settings as above.	400kHz 20231010_153347.s7k 20231010_153839.s7k 20231010_154333.s7k 20231010_154647.s7k 20231010_154811.s7k 20231010_155247.s7k 20231010_155536.s7k 20231010_155659.s7k 20231010_160252.s7k 20231010_160617.s7k 20231010_160723.s7k 20231010_161218.s7k 20231010_161558.s7k 20231010_161642.s7k 20231010_162329.s7k 20231010_162635.s7k 20231010_162659.s7k 20231010_163152.s7k 20231010_163836.s7k 20231010_164116.s7k 20231010_164643.s7k 20231010_165000.s7k 20231010_165038.s7k 20231010_165500.s7k 20231010_165744.s7k 20231010_165805.s7k 20231010_170158.s7k 20231010_170515.s7k 20231010_170931.s7k 20231010_171255.s7k 20231010_171653.s7k 20231010_172021.s7k 20231010_172428.s7k 20231010_172732.s7k	2	Cacho de Coral Mound 400kHz 390-446m 15m from mound, varied due to uneven terrain Lines run N-S/S-N 700kHz 370-430m 2-4m from mound Lines run in direction of slope across 4 10 x 10m boxes 370-430m

S0599	11/10/2023	Side facing 400 kHz 120° swath Equidistant	400kHz 20231011_174936.s7k 20231011_181207.s7k	1	Cacho de Coral dark side 10m from overhangs 140m depth Line 1: hdg 235 Line 2: hdg 120
		700kHz Same settings as above	700kHz 20231011_181818.s7k		700kHz, 3m from overhangs Line 3: hdg 120

APPENDIX 6 ADCP surveys

Station No	Gear No	Event No	Event Gear No	Line No	Start Date	Start Time UTC	Start Lat	Start Long	Equipment Depth	START/ END
16	ROV578	4	DVL01	1	9/21/2023	6:22:42	-0.5182	-89.9133	436.11	START
16	ROV578	4	DVL01	1	9/21/2023	6:29:55	-0.518686	-89.91401	436.12	END
16	ROV578	4	DVL01	2	9/21/2023	6:30:39	-0.518657	-89.91401	436.09	START
16	ROV578	4	DVL01	2	9/21/2023	6:32:26	-0.518445	-89.91409	436.05	END
16	ROV578	4	DVL01	3	9/21/2023	6:32:45	-0.518425	-89.9141	436.07	START
16	ROV578	4	DVL01	3	9/21/2023	6:41:12	-0.518034	-89.91347	436.01	END
16	ROV578	4	DVL01	4	9/21/2023	6:43:14	-0.518087	-89.91343	436.03	START
16	ROV578	4	DVL01	4	9/21/2023	6:49:46	-0.518575	-89.91403	436.1	END
16	ROV578	4	DVL01	5	9/21/2023	6:52:05	-0.518686	-89.91402	436.07	START
16	ROV578	4	DVL01	5	9/21/2023	7:01:15	-0.518207	-89.91331	436.04	END
16	ROV578	4	DVL01	6	9/21/2023	7:03:36	-0.518286	-89.91324	436.08	START
16	ROV578	4	DVL01	6	9/21/2023	7:17:58	-0.518795	-89.91396	436.1	END
16	ROV578	4	DVL01	7	9/21/2023	7:20:03	-0.518841	-89.91384	436.1	START
16	ROV578	4	DVL01	7	9/21/2023	7:29:10	-0.518384	-89.91319	436.14	END
16	ROV578	4	DVL01	8	9/21/2023	7:31:01	-0.518482	-89.91313	436.12	START
16	ROV578	4	DVL01	8	9/21/2023	7:42:07	-0.51895	-89.91376	436.15	END
16	ROV578	4	DVL01	9	9/21/2023	7:42:45	-0.518939	-89.91376	436.24	START
16	ROV578	4	DVL01	9	9/21/2023	7:49:23	-0.518457	-89.91427	436.2	END
16	ROV578	4	DVL01	10	9/21/2023	7:51:55	-0.518272	-89.91416	436.13	START
16	ROV578	4	DVL01	10	9/21/2023	8:03:52	-0.518947	-89.91371	436.17	END
16	ROV578	4	DVL01	11	9/21/2023	8:05:35	-0.518838	-89.91359	436.14	START
16	ROV578	4	DVL01	11	9/21/2023	8:16:27	-0.518264	-89.91406	436.18	END
16	ROV578	4	DVL01	12	9/21/2023	8:17:28	-0.51822	-89.91395	436.15	START
16	ROV578	4	DVL01	12	9/21/2023	8:31:51	-0.518832	-89.91349	436.2	END
16	ROV578	4	DVL01	13	9/21/2023	8:33:16	-0.51875	-89.91337	436.28	START
16	ROV578	4	DVL01	13	9/21/2023	8:42:17	-0.518142	-89.91387	436.22	END
16	ROV578	4	DVL01	14	9/21/2023	8:43:26	-0.518069	-89.91375	436.24	START
16	ROV578	4	DVL01	14	9/21/2023	8:56:38	-0.518701	-89.91331	436.43	END
16	ROV578	4	DVL01	15	9/21/2023	8:58:32	-0.518572	-89.91325	436.44	START
16	ROV578	4	DVL01	15	9/21/2023	9:04:57	-0.518001	-89.91371	436.41	END
16	ROV578	4	DVL01	16	9/21/2023	9:06:01	-0.517945	-89.9136	436.44	START
16	ROV578	4	DVL01	16	9/21/2023	9:14:06	-0.518538	-89.91312	436.48	END
35	ROV582	7	DVL01	1	9/26/2023	3:44:20	-0.974631	-88.92413	685.47	START
35	ROV582	20	DVL02	1	9/26/2023	13:42:46	-0.97256	-88.93988	547.11	START
35	ROV582	7	DVL01	1	9/26/2023	3:47:50	-0.9748	-88.92407	685.16	END
35	ROV582	20	DVL02	1	9/26/2023	13:46:14	-0.972967	-88.94002	547.02	END
35	ROV582	7	DVL01	2	9/26/2023	3:53:22	-0.974576	-88.92416	685.14	START
35	ROV582	20	DVL02	2	9/26/2023	13:49:25	-0.972505	-88.94018	546.91	START
35	ROV582	7	DVL01	2	9/26/2023	3:58:30	-0.974799	-88.92416	685.13	END
35	ROV582	20	DVL02	2	9/26/2023	13:51:10	-0.97284	-88.94032	547.05	END
35	ROV582	7	DVL01	3	9/26/2023	4:04:10	-0.974604	-88.92425	685.12	START
35	ROV582	20	DVL02	3	9/26/2023	13:54:23	-0.972441	-88.94042	546.97	START
35	ROV582	7	DVL01	3	9/26/2023	4:08:05	-0.974813	-88.92424	685.11	END
35	ROV582	20	DVL02	3	9/26/2023	13:56:31	-0.972825	-88.94059	547.02	END
35	ROV582	7	DVL01	4	9/26/2023	4:11:31	-0.974605	-88.92434	685.12	START
35	ROV582	7	DVL01	4	9/26/2023	4:16:12	-0.974828	-88.92434	685.11	END
35	ROV582	7	DVL01	5	9/26/2023	4:22:49	-0.974302	-88.92443	685.09	START
35	ROV582	7	DVL01	5	9/26/2023	4:31:12	-0.974846	-88.92443	685.09	END
35	ROV582	7	DVL01	6	9/26/2023	4:36:46	-0.974359	-88.92453	685.11	START
35	ROV582	7	DVL01	6	9/26/2023	4:44:08	-0.974863	-88.92452	685.07	END
46	ROV584	3	DVL01	1	9/28/2023	20:56:50	-0.971566	-88.95194	389.48	START
46	ROV584	3	DVL01	1	9/28/2023	21:07:56	-0.970755	-88.95207	389.57	END
46	ROV584	3	DVL01	2	9/28/2023	21:09:03	-0.970982	-88.95204	389.6	START
46	ROV584	3	DVL01	2	9/28/2023	21:11:04	-0.971536	-88.95198	389.61	END
46	ROV584	3	DVL01	3	9/28/2023	21:14:15	-0.971569	-88.952	379.95	START
46	ROV584	3	DVL01	3	9/28/2023	21:24:29	-0.970785	-88.95215	379.93	END
46	ROV584	3	DVL01	4	9/28/2023	21:36:27	-0.971601	-88.9521	379.94	START
46	ROV584	3	DVL01	4	9/28/2023	21:38:16	-0.971558	-88.95207	379.9	END
46	ROV584	3	DVL01	5	9/28/2023	21:40:17	-0.971496	-88.95212	379.89	START
46	ROV584	3	DVL01	5	9/28/2023	22:00:10	-0.970887	-88.9524	379.88	END
46	ROV584	3	DVL01	6	9/28/2023	22:01:29	-0.971151	-88.95236	379.91	START
46	ROV584	3	DVL01	6	9/28/2023	22:03:52	-0.971592	-88.95229	379.99	END
46	ROV584	3	DVL01	7	9/28/2023	22:05:49	-0.971576	-88.95221	379.92	START
46	ROV584	3	DVL01	7	9/28/2023	22:07:14	-0.971517	-88.95214	379.91	END
46	ROV584	3	DVL01	8	9/28/2023	22:09:34	-0.971581	-88.9522	379.91	START
46	ROV584	3	DVL01	8	9/28/2023	22:11:07	-0.971577	-88.95219	379.9	END
46	ROV584	3	DVL01	9	9/28/2023	22:12:20	-0.971538	-88.9522	379.89	START

46	ROV584	3	DVL01	9	9/28/2023	22:27:37	-0.970774	-88.95231	379.91	END
46	ROV584	3	DVL01	10	9/28/2023	22:30:08	-0.971111	-88.95227	376.57	START
46	ROV584	3	DVL01	10	9/28/2023	22:32:40	-0.971593	-88.95229	370.25	END
46	ROV584	3	DVL01	11	9/28/2023	22:33:41	-0.971579	-88.95227	370.22	START
46	ROV584	3	DVL01	11	9/28/2023	22:34:44	-0.971548	-88.95221	370.21	END
46	ROV584	3	DVL01	12	9/28/2023	22:36:48	-0.971563	-88.95226	370.23	START
46	ROV584	3	DVL01	12	9/28/2023	22:51:55	-0.970806	-88.95241	370.21	END
46	ROV584	3	DVL01	13	9/28/2023	22:53:31	-0.970816	-88.95242	370.24	START
46	ROV584	3	DVL01	13	9/28/2023	22:54:50	-0.97089	-88.95249	370.19	END
46	ROV584	3	DVL01	14	9/28/2023	22:56:07	-0.970914	-88.95249	370.23	START
46	ROV584	3	DVL01	14	9/28/2023	23:03:41	-0.971603	-88.95238	370.27	END
46	ROV584	3	DVL01	15	9/28/2023	23:05:31	-0.971592	-88.95238	370.26	START
46	ROV584	3	DVL01	15	9/28/2023	23:07:20	-0.971589	-88.95237	370.25	END
46	ROV584	3	DVL01	16	9/28/2023	23:08:57	-0.97159	-88.95238	370.18	START
46	ROV584	3	DVL01	16	9/28/2023	23:24:07	-0.970828	-88.95251	370.19	END
46	ROV584	3	DVL01	17	9/28/2023	23:25:49	-0.970879	-88.95259	370.22	START
46	ROV584	3	DVL01	17	9/28/2023	23:33:06	-0.971614	-88.95247	370.2	END
46	ROV584	3	DVL01	18	9/28/2023	23:35:55	-0.97161	-88.95245	360.04	START
46	ROV584	3	DVL01	18	9/28/2023	23:36:28	-0.971602	-88.95244	360.03	END
46	ROV584	3	DVL01	19	9/28/2023	23:37:40	-0.971594	-88.95247	360.12	START
46	ROV584	3	DVL01	19	9/28/2023	23:52:22	-0.970843	-88.95259	360.09	END
46	ROV584	3	DVL01	20	9/28/2023	23:53:50	-0.970884	-88.95268	360.11	START
46	ROV584	3	DVL01	20	9/29/2023	0:01:44	-0.971625	-88.95256	360.1	END
46	ROV584	3	DVL01	21	9/29/2023	0:05:18	-0.971596	-88.95255	360.09	START
46	ROV584	3	DVL01	21	9/29/2023	0:20:14	-0.970853	-88.95268	360.09	END
46	ROV584	3	DVL01	22	9/29/2023	0:23:01	-0.970859	-88.95277	360.14	START
46	ROV584	3	DVL01	22	9/29/2023	0:30:47	-0.971642	-88.95265	360.12	END
46	ROV584	3	DVL01	23	9/29/2023	0:31:21	-0.971639	-88.95265	360.14	START
46	ROV584	3	DVL01	23	9/29/2023	0:36:43	-0.971347	-88.95264	360.14	END
46	ROV584	3	DVL01	24	9/29/2023	0:41:15	-0.971635	-88.95265	360.16	START
46	ROV584	3	DVL01	24	9/29/2023	0:56:26	-0.970858	-88.95277	360.11	END
46	ROV584	3	DVL01	25	9/29/2023	0:59:52	-0.970842	-88.95277	360.2	START
46	ROV584	3	DVL01	25	9/29/2023	1:03:39	-0.970814	-88.95262	360.14	END
46	ROV584	3	DVL01	26	9/29/2023	1:13:33	-0.970864	-88.95276	360.15	START
46	ROV584	3	DVL01	26	9/29/2023	1:41:51	-0.970754	-88.95206	360.06	END
46	ROV584	3	DVL01	27	9/29/2023	1:48:45	-0.971011	-88.95199	360.11	START
46	ROV584	3	DVL01	27	9/29/2023	2:03:38	-0.971172	-88.95274	360.09	END
46	ROV584	3	DVL01	28	9/29/2023	2:15:49	-0.971456	-88.9526	370.34	START
46	ROV584	3	DVL01	28	9/29/2023	2:27:12	-0.971363	-88.95205	370.35	END
46	ROV584	3	DVL01	29	9/29/2023	2:28:14	-0.971204	-88.95202	370.36	START
46	ROV584	3	DVL01	29	9/29/2023	2:32:51	-0.970828	-88.9523	370.31	END
46	ROV584	3	DVL01	30	9/29/2023	2:44:29	-0.970796	-88.95224	410.05	START
46	ROV584	3	DVL01	30	9/29/2023	2:56:40	-0.971411	-88.95215	404.24	END
46	ROV584	3	DVL01	31	9/29/2023	3:00:56	-0.971343	-88.95215	394.01	START
46	ROV584	3	DVL01	31	9/29/2023	3:02:25	-0.971299	-88.95211	394.05	END
46	ROV584	3	DVL01	32	9/29/2023	3:04:09	-0.971295	-88.95216	389.26	START
46	ROV584	3	DVL01	32	9/29/2023	3:14:54	-0.970779	-88.95223	389.26	END
80	ROV589	13	DVL01	1	10/5/2023	9:40:43	-0.301399	-91.66766	338.79	START
80	ROV589	13	DVL01	1	10/5/2023	9:46:03	-0.3014	-91.66766	299.7	END
80	ROV589	13	DVL02	2	10/5/2023	9:47:09	-0.3014	-91.66766	299.81	START
80	ROV589	13	DVL02	2	10/5/2023	9:52:18	-0.301399	-91.66766	299.78	END
97	ROV593	24	DVL01	1	10/7/2023	23:27:00	-1.003196	-91.45019	354.93	START
97	ROV593	24	DVL01	1	10/7/2023	23:26:06	-1.003194	-91.4502	354.93	END
97	ROV593	24	DVL02	2	10/7/2023	23:28:09	-1.003206	-91.45021	354.97	START
97	ROV593	24	DVL02	2	10/7/2023	23:27:37	-1.003229	-91.45018	354.93	END
97	ROV593	13	DVL03	3	10/7/2023	23:43:58	-1.003604	-91.45058	344.95	START
97	ROV593	13	DVL03	3	10/7/2023	23:42:27	-1.003612	-91.45058	354.92	END
97	ROV593	13	DVL04	4	10/7/2023	23:10:00	-1.003594	-91.45054	354.97	START
97	ROV593	13	DVL04	4	10/8/2023	0:03:52	-1.003195	-91.45019	344.95	END
110	ROV597	4	MBS01	1	10/10/2023	23:51:07	-0.508256	-89.94008	390.01	START
110	ROV597	4	MBS01	1	10/11/2023	0:30:05	-0.507331	-89.94008	389.98	END
110	ROV597	4	MBS01	2	10/11/2023	0:38:33	-0.507334	-89.94008	380.23	START
110	ROV597	4	MBS01	2	10/11/2023	0:42:53	-0.507445	-89.94008	380.2	END
110	ROV597	4	MBS01	3	10/11/2023	0:43:09	-0.507445	-89.94008	380.19	START
110	ROV597	4	MBS01	3	10/11/2023	0:48:40	-0.50743	-89.94007	380.24	END
110	ROV597	4	MBS01	4	10/11/2023	1:03:38	-0.507441	-89.94008	380.25	START
110	ROV597	4	MBS01	4	10/11/2023	1:35:25	-0.508261	-89.94008	380.22	END
110	ROV597	4	MBS01	5	10/11/2023	1:43:16	-0.508254	-89.94008	389.88	START
110	ROV597	4	MBS01	5	10/11/2023	2:08:46	-0.507821	-89.94051	389.87	END
110	ROV597	4	MBS01	6	10/11/2023	2:10:45	-0.507816	-89.94053	389.9	START
110	ROV597	4	MBS01	6	10/11/2023	2:11:20	-0.507823	-89.94043	389.86	END
110	ROV597	4	MBS01	7	10/11/2023	2:12:15	-0.507799	-89.94053	389.89	START
110	ROV597	4	MBS01	7	10/11/2023	2:14:40	-0.507792	-89.94039	389.9	END

110	ROV597	4	MBS01	8	10/11/2023	2:21:29	-0.507787	-89.94045	390.39	START
110	ROV597	4	MBS01	8	10/11/2023	2:29:18	-0.507802	-89.94007	390.39	END
110	ROV597	4	MBS01	9	10/11/2023	2:30:51	-0.5078	-89.94006	401.57	START
110	ROV597	4	MBS01	9	10/11/2023	2:34:50	-0.50781	-89.93989	407.03	END
110	ROV597	4	MBS01	10	10/11/2023	2:34:57	-0.507811	-89.93989	406.94	START
110	ROV597	4	MBS01	10	10/11/2023	2:39:49	-0.507821	-89.93965	406.92	END
110	ROV597	4	MBS01	11	10/11/2023	2:43:06	-0.507759	-89.93971	402.17	START
110	ROV597	4	MBS01	11	10/11/2023	2:54:12	-0.507803	-89.94008	402.12	END
110	ROV597	4	MBS01	12	10/11/2023	2:55:20	-0.507791	-89.94008	402.15	START
110	ROV597	4	MBS01	12	10/11/2023	3:05:03	-0.507301	-89.94007	402.09	END
110	ROV597	4	MBS01	13	10/11/2023	3:05:54	-0.507307	-89.94007	404.7	START
110	ROV597	4	MBS01	13	10/11/2023	3:11:47	-0.507303	-89.94008	432.19	END