



RESEARCH EXPEDITION REPORT

RRS James Cook Cruise 278

30th May – 23rd June 2025

Multidecadal Research at the Porcupine
Abyssal Plain Sustained Observatory

Andrew R Gates, Socratis Loucaides, Jennifer Durden &
Susan Hartman

2025 REPORT NO. 86

© National Oceanography Centre, 2025

NOC.AC.UK

Document Data Sheet

<p>Author Andrew R Gates, Socratis Loucaides, Jennifer Durden & Susan Hartman</p>	<p>Publication Date 2025</p>
<p>Title</p> <p>RRS James Cook Cruise 278: Multidecadal research at the Porcupine Abyssal Plain Sustained Observatory / 30th May – 23rd June 2024 / United Kingdom</p>	
<p>Reference</p> <p>Southampton, UK: National Oceanography Centre, Southampton, 199pp. (National Oceanography Centre Research Expedition Report, No. 83)</p>	
<p>Abstract</p> <p>The primary aim of RRS James Cook Cruise 278 (JC278) was to study multidecadal change in the NE Atlantic by continuing long-term observations at the Porcupine Abyssal Plain Sustained Observatory (PAP-SO) and Whittard Canyon. Both sites are part of the Natural Environment Research Council's "AtlantiS" National Capability project that is managed by the National Oceanography Centre (NOC). The cruise also aimed to demonstrate a range of innovative sensors and platforms to observe carbonate chemistry through the water column to the seabed as part of the Next Generation Multiplatform Ocean Observing Technologies for Research Infrastructures (GEORGE) Project. Additional aims included deployment of moorings in the Canyons MCZ ahead of other research cruises later in 2025 for the Processes driving Submarine Canyon fluxES (PISCES) project and in situ plankton imaging and passive acoustics monitoring for two internal NOC RISC projects.</p> <p>RRS James Cook departed Southampton 30th May 2025 on JC278 to Porcupine Abyssal Plain Sustained Observatory via the Canyons MCZ and Whittard Canyon Eastern Branch. The first stop was a shallow test CTD in the Channel. On arrival at the Canyons MCZ on 01/06/2025 a CTD and camera survey were carried out on the interfluve, before two physical oceanography moorings and a hydrophone lander were deployed. Two further camera surveys were completed overnight before moving to the Eastern Branch of Whittard Canyon in the Irish EEZ for a CTD and turnaround of a long-running mooring. Work in the Whittard Canyon area was completed on 3rd June. On arrival at PAP-SO a programme of operations started with a Megacore deployment (05/06/2025). A schedule of moorings operations, CTDs and glider deployments by day and core sampling at night continued until a transit to Falmouth was required. On arrival back at PAP-SO (11/06/2025) the weather was perfect for deployment of the large Met Office ODAS buoy. The schedule returned to CTD's moorings and glider work during day shifts and photographic seabed survey work at night until the end of scientific operations at midnight 20/06/2025. Transit back to Southampton was direct, arriving back alongside the National Oceanography Centre at 08:30 23/06/2025.</p>	

This cruise was a contribution to the Atlantic Climate and Environment Strategic Science (AtlantiS) project supported by the UK Natural Environment Research Council (grant number NE/Y005589/1).

Keywords Porcupine Abyssal Plain, Whittard Canyon, Ocean Observations, Integrated Carbon Observing System (ICOS), Met Office, GEORGE, Biogeochemistry, Time Series, Argo, Benthic Ecology,

Issuing Organisation

National Oceanography Centre
European Way
Southampton
SO14 3ZH, UK

Email: publications@noc.ac.uk

A pdf of this report is available for download at: (NORA link)

Contents

1. PERSONNEL	7
2. ITINERARY	8
3. CRUISE BACKGROUND AND AIMS.....	9
4. OBJECTIVES.....	10
5. NARRATIVE.....	11
6. NMF TECHNICAL REPORT	17
6.1 MOORING OPERATIONS.....	17
6.2 INSTRUMENTATION REPORT.....	30
6.3 CTD OPERATIONS	47
6.4 HYBIS REPORT.....	58
6.5 SHIP SCIENTIFIC SYSTEMS	79
7. PAP1 RECOVERED – SCIENTIFIC REPORT	93
7.1 MOORING LOSS.....	93
7.2 ATTEMPTS AT FRAME / ROPE RECOVERY	97
7.3 SCIENTIFIC DATA RECOVERED.....	98
8. PAP1 DEPLOYED – SCIENTIFIC REPORT.....	102
9. CTD CASTS AND WATER SAMPLING	111
9.1 CTD OPERATIONS.....	111
9.2 CTD PROCESSING	120
9.2 DISSOLVED OXYGEN SAMPLING.....	123
9.3 CARBONATE CHEMISTRY SAMPLING.....	132
9.4 DISSOLVED NUTRIENT SAMPLING	132
9.5 CHLOROPHYLL, HPLC PIGMENT, LUGOL’S TAXONOMY AND PARTICULATE SAMPLING	132
9.6 SATELLITE DATA.....	137
9.8 CTD DECK SAMPLING LOG SHEETS.....	139
10. UNDERWAY SENSORS AND SAMPLING.....	149
10.1 UNDERWAY XCO ₂	149
10.2 UNDERWAY LAB-ON-A-CHIP SENSORS	155
10.3 DISCRETE BIOLOGICAL SAMPLING FROM UNDERWAY.....	157
10.4 UNDERWAY CHLOROPHYLL A FLUORESCENCE AND CALIBRATION	157
10.5. UNDERWAY SAMPLING EVENT LOG	159
11. PHYTOPLANKTON COMMUNITY SURVEY FROM UNDERWAY IMAGING FLOW CYTOMETRY	172
11.1 OBJECTIVE.....	172
11.2 APPROACH	173
11.3 IMPRESSIONS AND INITIAL RESULTS.....	175
11.4 LESSONS LEARNED.....	178
12. BIOGEOCHEMISTRY ARGO	180
12.1 DATA.....	181
12.2 PROCEDURE.....	184
13. PAP3 - SEDIMENT TRAPS.....	187
13.1 RATIONALE AND APPROACH.....	187
13.2 RECOVERED TRAPS	187

13.3 DEPLOYED TRAPS.....	193
14. BENTHIC SYSTEMS AND SAMPLING.....	197
14.1 AIMS AND OBJECTIVES.....	197
14.2 NARRATIVE OF BENTHIC ACTIVITIES	197
14.3 SEDIMENT CORING	201
14.4 AMPHIPOD TRAP	205
14.5 TIME-LAPSE PHOTOGRAPHY WITH BATHYSNAP	209
14.6 SEABED PHOTOGRAPHY WITH HYBIS.....	214
14.7 ACOUSTIC MAPPING	226
15. BENTHIC CHAMBER LANDER	228
15.1 OVERVIEW AND GOALS.....	228
15.2 SETUP DETAILS	229
15.3 DEPLOYMENTS	233
15.4 RECOMMENDATIONS FOR FUTURE USE	236
16 GEORGE PROJECT CRUISE REPORT	237
16.1 THE GEORGE PROJECT INFORMATION.....	237
16.2 GLIDER MISSIONS	239
16.3. PROFILING FLOAT	247
16.4 EGIM LANDER	250
16.5 GAS TIGHT SAMPLER	263
17. PASSIVE ACOUSTIC MONITORING OF SOUNDSCAPES OF PAP AND WHITTARD CANYON	275
17.1 INTRODUCTION	275
17.2 WHITTARD CANYON AREA.....	278
17.3 PORCUPINE ABYSSAL PLAIN	284
18 WHITTARD CANYON MOORING	295
19 OUTREACH AND ENGAGEMENT	298
20 STATION LIST	311

1. Personnel

Ship's Personnel

GWINNELL	JAMES MARCUS	Master
CLAYTON	OLIVER DAVID	C/O
MORROW	DECLAN DANIEL ANDERSON	2/O
HOPKINS	LEWIS MICHAEL	3/O
WEIR	ROSS ALISTAIR	C/E
MURRAY	MICHAEL	2/E
SILAJDZIC	EDIN	3/E
SLATER	GARY	3/E
HAWKSWORTH	DAVID RONALD	ETO
LUCAS	PAUL DERRICK	PCO
FRASER	GRANT FORBES	CPOS
MACLEAN	ANDREW	CPOD
FORBES	IAIN	POS
ALLEN	JOHN MICHAEL	POD
BURTON	BRIAN JAMES	SG1A
LEECH	ROBERT ROY	SG1A
MARSHALL	PAUL DAVID	SG1A
ANGUS	SEAN PAUL	ERPO
KEIGHLEY	CHRISTOPHER	Head Chef
CRAIG	STEPHEN	Chef
BRADBURY	JANE	Stwd
MENTHA	REBECCA LOIS	A/Stwd

Scientific Personnel

GATES	ANDREW RUSSELL	PSO	NOC
HARTMAN	SUSAN ELIZABETH	Watch leader	NOC
DURDEN	JENNIFER MARY	Watch leader	NOC
LOUCAIDES	SOCRATIS	GEORGE Lead	NOC
BHUIYAN	WAHIDA TASKIN	Sci	NOC
CASTLE	SAMUEL TIMOTHY	Sci	NOC
CHAUVET	ADRIEN CHARLES YVES	Sci	IFREMER
CLAYTON	SOPHIE ANNE	Sci	NOC
FARRELL	DARA MARY	Sci	NOC
FELTHAM	CHRISTOPHER NIGEL	Sci	NOC
VILAKKUMADATHIL RAVI	DIPIN GHOSH	Sci	NOC
HARTMAN	SUSAN ELIZABETH	Sci	NOC
HASTINGS RAFFERTY	VICTORIA ISOBEL	Obs	University of Cork
LE PIVER	DAVID	Sci	IFREMER
PIZARRO BRAVO PEREIRA MENDES	MARIA LEONOR	Student	CIIMAR
READING	JETHRO GEORGE JACK	Student	University of Southampton
SCHAAP	ALLISON MARIE	Sci	NOC
SKEIN	LISA	Sci	NOC
SLAVIK	PETR	Sci	Whale Wise
STIL	PACO	Sci	Sorbonne Université
WALKER	BEN	Student	University of Southampton
POWELL	TIMOTHY DAVID	Lead Tech	NOC
WARD	JUAN	SST	NOC
DRAWIL	BASEM ATIG ARBI	SST	NOC
BALLINGER	THOMAS JOSEPH	Tech	NOC
COMBEN	DANIEL HOWARD	Tech	NOC
CROWE	CHRISTIAN LEE	Tech	NOC
DOWNER	ALEXANDER	Tech	NOC
GARNER	JADE ELIZABETH	Tech	NOC
KING	HOWARD STANLEY	Tech	NOC
MUTLU	EMRE	Tech	NOC
YEOMANS	MARTIN RICHARD	Tech	NOC

2. Itinerary

Mobilisation began at NOC, Southampton on the Bank Holiday Monday 26th May. Scientists and technicians joined 29th May 2025 before RRS James Cook departed Southampton 30th May 2025 on JC278 to Porcupine Abyssal Plain Sustained Observatory via the Canyons MCZ and Whittard Canyon Eastern Branch. The first stop was a shallow test CTD in the Channel. On arrival at the Canyons MCZ on 01/06/2025 a CTD and camera survey were carried out on the interfluve, before two physical oceanography moorings and a hydrophone lander were deployed. Two further camera survey were completed overnight before moving to the Eastern Branch of Whittard Canyon in the Irish EEZ for a CTD and turnaround of a long-running mooring. Work in the Whittard Canyon area was completed on 3rd June. On arrival at PAP-SO a programme of operations started with a Megacore deployment (05/06/2025). A schedule of moorings operations, CTDs and glider deployments by day and core sampling at night continued until a transit to Falmouth was required. On arrival back at PAP-SO (11/06/2025) the weather was perfect for deployment of the large Met Office ODAS buoy. The schedule returned to CTD's moorings and glider work during day shifts and photographic seabed survey and coring over night until the end of scientific operations at midnight 20/06/2025. Transit back to Southampton was direct, arrive back alongside the National Oceanography Centre at 10:30 23/06/2025.

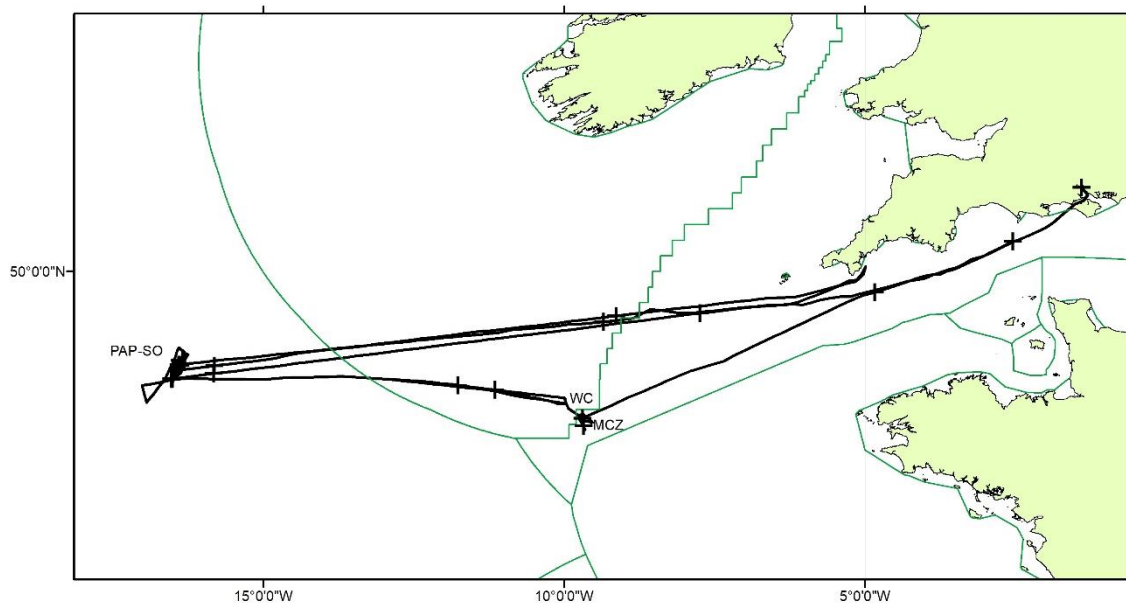


Figure 2.1: JC278 Cruise track 30 May – 23 June 2025. PAP-SO: Porcupine Abyssal Plain Sustained Observatory, WC: Whittard Canyon (Eastern Branch), MCZ: The Canyons Marine Conservation Zone. +: midnight positions.

3. Cruise background and aims

Research at PAP-SO aims to use time-series data on different temporal scales (hours to years) to observe biogeochemical and ecological change at the site. Scientists have been visiting PAP-SO since 1985 to make observations, and the nature of the science has evolved over that time period.

The primary aim of RRS James Cook Cruise 278 (JC278) was to study multidecadal change in the NE Atlantic by continuing long-term observations at the Porcupine Abyssal Plain Sustained Observatory (PAP-SO) and Whittard Canyon. Both sites are part of the Natural Environment Research Council's "AtlantiS" National Capability project that is managed by the National Oceanography Centre (NOC) - <https://noc.ac.uk/projects/atlantic-climate-environment-strategic-science>. The cruise also aimed to demonstrate a range of innovative sensors and platforms to observe carbonate chemistry through the water column to the seabed as part of the Next Generation Multiplatform Ocean Observing Technologies for Research Infrastructures (GEORGE) Project. Additional aims included deployment of moorings in the Canyons MCZ ahead of other research cruises later in 2025 Processes driving Submarine Canyon fluxES (PISCES).

4. Objectives

Specific objectives of JC278 were:

Canyons MCZ:

- Deployment of PISCES 1 and PISCES 2 moorings (and associated CTDs)
- Deployment of Hydrophone lander
- Hybis camera surveys on interfluve
- CTD on interfluve

Whittard Canyon Eastern Branch:

- Mooring turnaround
- Operational CTDs

PAP-SO

- Met Office / NOC atmospheric and upper ocean autonomous mooring turnaround (“PAP1”)
- CTD profiles and sampling
- Argo deployment x 2
- Glider deployments and validation with
- EGIM deployment
- PAP sediment trap mooring turnaround (“PAP3”)
- Benthic sampling and ex situ experiments (Megacorer)
- Time series benthic imaging survey (HyBIS)
- Seabed time-lapse photography (Bathysnap)
- Baited trap sample collection
- Trials of benthic chamber lander

Underway measurements for duration of cruise

- Underway data collection including addition of IFCB instrument

5. Narrative

Thursday 29th May 2025 Mobilisation continued with the loading of the Met Office rope. The morning was spent with BBC South visiting the ship to do interviews with Andrew Gates, Dara Farrell and Ben Walker about the departure of the expedition and the long-term nature of observations at PAP-SO, for broadcast the following day. Mike Thurston also visited the ship. Mike was PSO on the first benthic sampling cruise that visited the area we now call PAP-SO. The full scientific party arrived through the morning ahead of the induction and signing on to the ship in the afternoon. This followed by an IT induction. The rest of the day was spent setting up labs and settling in to life aboard. The science party stayed aboard ahead of planned early departure in the morning.

Friday 30th May 2025 An early start with a 07:05 interview on the Radio Solent Lucy Ambache Breakfast Show. Preparations continued through the morning before a slightly delayed departure at 11:00, to allow the final stages of mobilisation, after loading the Met Office rope took longer than expected. A small group had gathered on the quayside and executive balcony to wave us off. The science team enjoy a pleasant departure through the Solent, among many yachts enjoying sunny weather and a good breeze. We have an all crew science briefing at 13:00 before a boat drill. Overnight the clocks change to UTC.

Saturday 31st May 2025 During the transit we stop at 0900 for a test CTD cast in 125 m depth off the SW of Cornwall (JC278-001). This test of the CTD equipment is a good opportunity for the CTD scientific team to get some practice before the science CTDs begin. In transit the teams continue their preparations for the weeks ahead. On arrival at the Canyons MCZ interfluvium between Explorer Canyon and Dangaard Canyon, we do a CTD cast for a sound velocity profile for HyBIS ahead of planned overnight dives for environmental characterisation of the interfluvium areas where 'mini-mounds' are found that previously supported *Desmophyllym pertusum* reefs and are a target for restoration activities in the REDRESS project (JC278-002). The first HyBIS dive on the interfluvium between Explorer and Dangaard Canyon followed, repeating observations made during CLASS cruise (JC166), providing new data for AtlantiS Theme 1 and background information for the REDRESS project ahead of the DY200 cruise planned for September / October 2025.

Sunday 1st June 2025 A successful HyBIS dive (JC278-003) revealed limited, if any, evidence for live cold-water coral, but areas of rubble were observed on the coral mini-mounds. The epibenthic faunal assemblage appeared typical for this area with occasional holothurians (*Parastichopus*), asteroids (*Porania*) and many hormathiid anemones seemingly always facing into the current. On completion of HyBIS we moved into deeper water of the Explorer Canyon. Following a release test CTD (JC278-004) at 1304 m depth we move into the first mooring operations of the research cruise. Starting with the PISCES-2 (JC278-005) mooring, which is deployed without incident, in Explorer Canyon we start data collection for both the Processes driving Submarine Canyon fluxES (PISCES) project and the NOC "Soundscapes of Whittard Canyon and PAP". The PISCES-1 mooring is then deployed in Dangaard Canyon (JC278-006) before putting a Hydrophone lander (JC278-007) on the interfluvium between the two canyons. After a busy day on deck for the moorings team we re-locate to do a HyBIS dive on the interfluvium south of Dangaard Canyon (JC278-008). Many of the ship's company are enthralled by the high abundance of krill in the water column and dense aggregations of comatulid crinoids (feather stars) on the seabed, a stark contrast to the previous night.

Monday 2nd June 2025 A second HyBIS of the night (JC278-009) is completed at the Explorer/Dangaard interfluvium, again revealing lower abundance of fauna, as previously. At 0600 we move into deeper water (2000 m) do a CTD cast (JC278-010) to test the releases for the Whittard Canyon Mooring

(WCM(A)). We then attempt to recover the existing WCM mooring (JC263-007). The comms with the releases were good, and release command appeared to work but it failed to surface, remaining stubbornly at the seabed. Discussion of options for recovery find little we can try other than waiting. Dragging is not a suitable option in a sensitive area, while there are a plethora of risks to the vehicle in the event of an attempted HyBIS recovery. We decide to deploy the replacement mooring (JC278-011) to allow as much time as possible for the missing mooring to surface. This means we have to move it 1km from the planned position to avoid the two moorings coming in contact (this is approved after consultation with the project PI). Once successfully deployed, we make one final attempt to communicate with the releases of JC263-007 but it still hasn't moved so we have no other options but to continue to PAP.

Tuesday 3rd June 2025 Overnight the wind and seas increased, slowing our progress towards PAP to 7.5 knots. The iridium beacon from JC263-007 had sent some position updates indicating that it had surfaced during the night. We decide to return to the site to recover the mooring as it poses a hazard, contains highly valuable scientific data and has financial value. We immediately turn around and plot a course for the beacon position. Progress is good with a following wind and seas.

The mooring had drifted about 5 nautical miles from its deployed location. The recovery was not straight forward. The mooring components had become tangled into a single clump. Initially it was quickly grappled and brought astern but part of the mooring parted and had to be grappled again. This time it was successfully retrieved but came up in a tangle. The sediment trap was upside down, probably affecting the quality of the sample. On inspection the releases were entangled in fishing line, likely explaining the reluctance of the mooring to surface. Once the mooring was on deck and all equipment secured, at around 19:00 we continued our journey to PAP.

Wednesday 4th June 2025 Progress has been steady, if a little bumpy, overnight. The ETA at PAP is around 22:00. The transit day is spent planning the upcoming deployments, in particular the GEORGE project glider deployments. On arrival at PAP central at 21:30, we prepare to launch the megacorer. Once in the water there is a short delay owing to an issue with the forward thruster.

Thursday 5th June 2025 The corer reached the seabed shortly after midnight and recovered 7 macrofauna samples (JC278-012). A transit to the CTD station followed for a deep CTD (JC278-013) to test 6 releases, pre-calibration dips for the MicroCATs for PAP-3 and a near bottom water sample for Leonor Pizzaro's incubation experiments.

After the deep CTD was completed a short move was made toward the last year's long-term Bathysnap (JC263-072). At that location we did a 1000 m CTD cast with the two GEORGE gliders attached to the rosette frame, as a glider calibration cast (JC278-014). With long stops at 3 depths to calibrate the LOC sensors this CTD took about 4 hours.

The long-term bathysnap was released and recovered by 16:15. On the transit to the core site the first of the GEORGE project CTS-5 Argo floats was deployed (JC278-015). The first core of the night reached the bottom at 20:30 (JC278-016).

Friday 6th June 2025 After completion of a second core of the night (JC278-017), the day started a little later with a plan for glider deployment at 06:00. The launch directly from the ship was not going to plan as the tether rope was wrapping around the glider antenna. Eventually it is decided that the rescue boat can be used to deploy the gliders. Each one needs to do a tethered dive to check the ballast before being released. One glider requires the addition of extra syntactic foam in the nose cone, which is completed before allowing the gliders to dive and begin their survey (JC278-018 and JC278-019). On completion of the glider survey we move into position to deploy PAP-3 sediment trap

mooring (JC278-020), a first triangulation point is measured but time does not allow completion of the triangulation, which is finished later in the cruise.

Saturday 7th June 2025 Overnight 2 good cores had been collected (JC278-021 and JC278-022). At 04:00 we do a deep CTD (JC278-023). This is followed by a validation for of the two underwater gliders. To do this the ship moves into location close to the gliders and carries out an underway data collection while the gliders drift (JC278-024). We then deploy a short-term Bathysnap (JC278-025) intended for the duration of the cruise and then move to PAP Central. After the first of two planned megacores of the night shift (JC278-026), we make the decision to return to Falmouth for a medivac, a situation we had been monitoring for a few days. As this is a medivac we are permitted to use the third engine to increase our speed back to Falmouth.

Sunday 8th June 2025 Despite a rather subdued mood on board owing to the medivac, today is World Ocean Day, which is celebrated by NOC at the annual open day. This year the JC278 team participate too, through a live link with the lecture theatre in Southampton. The general theme is careers, and a variety of members from the scientific and technical team and ship's crew are on hand to answer questions about their roles and working together to deliver sustained ocean observations like PAP-SO. More generally the mood on board is subdued as the day is spent in transit to Falmouth, but experiments and sample analysis continue in the labs.

Monday 9th June 2025 Arrival off Falmouth at approximately 08:30 am and await a boat for the medivac. With a weather window on the horizon we make use of the sheltered waters of Falmouth Bay to move the PAP-1 buoy to its deployment position on the red deck with a plan to deploy as soon as possible after arrival back at PAP-SO, completing the most weather dependent of tasks. When the boat departs at 09:30 we immediately set off back out to PAP.

Tuesday 10th June 2025 During a day of transit back to PAP chief scientist and chief technician attend the ship's safety meeting. The good weather window approaching at PAP appears to be holding, but is followed by a more unsettled period, so we are eager to arrive in time to deploy the buoy at the earliest opportunity.

Wednesday 11th June 2025 On arrival back at PAP at 02:17 we await the 04:00 shift to commence and then re-start over-the-side scientific operations with a 1000 m CTD at the intended buoy location (JC278-027). We then move into position for the PAP buoy deployment, the first with a new design Met Office bridle to overcome challenges with recent losses. The science team complete final set up and checks on the PAP buoy and move to the run-in location. The buoy is off deck at 09:15 the deployment proceeds, completing the task with the release of the anchor at 14:36 (JC278-028). We then transit to the HyBIS location for our first HyBIS dive of the cruise at the PAP site (JC278-029).

Thursday 12th June 2025 Overnight the HyBIS dive encountered strong currents on descent with the vehicle ending up quite far from the ship and delaying the start of the camera survey. Megafauna observed included some of PAP's common species, such as holothurians (e.g., *Psychropotes* sp.), cnidarians (e.g., Cerianthidae. and *Solubellula* sp.), goblet sponges, and crustaceans (e.g., *Munida* sp.), among others. Multiple trawl marks, often filled with plastic debris, were also observed. Once HyBIS was back in deck we return to PAP1 for a shallow CTD 500 m away from the buoy for sensor validation, before commencing the EMSO Generic Instrument Module (EGIM) deployment (JC278-031). The EGIM is lowered on the ship's wire to the seabed and released just above the bottom. There are some concerns about comms with the EGIM release but the team are confident to deploy. The whole operation takes 10 hours. After the EGIM deployment we recover the short term Bathysnap (JC278-025), with a plan to use the camera on later HyBIS dives, in place of the camera with obscured

images. As a result of the long EGIM deployment we are running late for the second HyBIS dive at PAP followed overnight (JC278-033) continuing observations of the PAP Central area, which again encountered strong currents in the water column.

Friday 13th June 2025 HyBIS is on deck at 03:25 and the ship moves before a busy day shift starts with a 04:00 1000 m CTD (JC278-033), followed by deployment of the NOC Argo float to the south of the PAP mooring area (JC278-034). This is quickly followed by deployment of the new AtantiS benthic chamber lander (JC278-035) developed by Alisson and Anna, then the first amphipod trap (JC278-036) of the cruise so far. We then re-position to the glider location and commence a glider drift survey in very calm weather (JC278-037). While doing so we decide that, because the gliders are not making much progress towards the PAP buoy, we will recover them and move them to the south of the survey box. The recovery is very smoothly achieved with the MOB boat and we do a 1000 m validation CTD (JC278-038) in the area the gliders were operating. The first glider (Sea038) is deployed over the side (JC278-039) in a similar manner to an argo float, south of PAP1. The second glider (Sea030) requires longer charging so we move to the PAP central area to carry out the next HyBIS dive (JC278-040).

Saturday 14th June 2025 The HyBIS dive encountered large *Colossendis colossea* specimens, *Octacnemus* sp., *Grimptoteuthis* sp., a scleractinian and polynoids before recovery to deck. An early 1000 m CTD (JC278-041) before attempting to recover PAP-1 from JC263. We range the release, then send the release command. It begins to rise very slowly and seems to stall. While waiting we range JC278-028, the newly deployed PAP-1, as our first triangulation point for refining our estimate of the anchor position. With very little progress on the mooring rising to the surface, we move south to deploy glider Sea030 (JC278-042) and then return to the mooring location. There is still no evidence of the rope at the surface. We spend the day looking for the rope and attempting to ranging the release, before attempting dragging operations to recover the lost equipment. This continues through the night with no success, meaning that the benthic team are unable to carry out any work overnight.

Sunday 15th June 2025 After a disappointing failure to recover the lost PAP1 mooring equipment, we re-locate to do a deep science CTD (JC278-043). We recover the benthic chamber lander deployed 2 days previously (JC278-035) then complete a shallow sensor validation and GEORGE sampler test CTD (JC278-044) at the PAP buoy as close to midday as possible, to align with sensor timings. The ATRAP (JC278-036) was then released at 14:24. Unfortunately it took 3 hours to reach the surface and be spotted, moving several km north in the process. The very slow ascent was attributed to an imploded glass sphere reducing the buoyancy to bring it to the surface. It was fortunate that we were able to spot it at the surface. The delayed ATRAP recovery impacts the rest of the day. A BBQ on deck is enjoyed by some but the timing of the ATRAP recovery means the nightshift team are unable to join, as work continues on sampling processing. The night's HyBIS deployment (JC278-045) is also delayed, not reaching the seabed until 23:00. It does however include a test of the Bathysnap camera in standalone mode on the HyBIS frame.

Monday 16th June 2025 Overnight, after the end of the HyBIS transects, there is a major incident with the vehicle. The deep tow wire became got caught in between the roller and the arm of the P-frame, causing damage to the wire. Captain, Chief Engineer, Senior Technician, Watch Leader and PSO are all involved in the discussions and a decision made to attempt to slowly recover the vehicle appears to be working, before the wire parts and HyBIS and the wire are lost to the seabed. The winch room is damaged in this incident so the only work that can be done is from the back deck, restricting scientific operations to mooring recoveries and deployments.

Despite low morale aboard, we attempt to make best use of this time by recovering PAP-3 (JC263-016) and re-deploying the benthic chamber lander (JC278-046), the amphipod trap (JC278-047) and long-term Bathysnap (JC278-048).

Having initially ruled out coring work because of damage to the P-frame and winch room, by the late evening the engineers have assessed and fixed the damage which was less severe than thought and confirmed that we can core again. The HyBIS loss has put much of the main PAP Central coring area out of use due to the proximity of the wreckage and wire, so only the furthest west sites are useable, in which we complete one core overnight (JC278-049).

Tuesday 17th June 2025 The overnight core returned a good set of macrofauna samples, after which the ship is moved on to station for the final deep science CTD (JC278-050). After this is completed our focus changes to gliders. First, we carry out a drift survey (JC278-051) with Sea038 right alongside the ship in perfect weather conditions. Sea030 is 3 km away. Recovery of Sea038 (JC278-039) is then efficiently achieved using the MOB boat before transiting to the Sea030 location (JC278-042) and again recover effectively. In the afternoon the gliders were mounted on the CTD for a 1000 m calibration cast with 3 hour-long stops (JC278-052) before moving to PAP Central for more coring (JC278-053). Samples are collected for macrofauna and for comparison with the in situ data collected with benthic chamber.

Wednesday 18th June 2025 For the remainder of the night a short multibeam survey is carried out around the PAP Central area to tidy up the bathymetry data already acquired in this area (JC278-054). At 0400 we begin a deep CTD (JC278-055) at the EGIM site for validation of the near-seabed LOC sensors. This has intentionally been left for a few days to allow the sensors time to settle after deployment. We then move to recover the benthic chamber lander (JC278-046). Again, it comes up north of the expected location. The lander is on deck before lunch and we move to do some further investigation of the lost PAP1 ropes, ranging the release but struggling to get meaningful ranges. After no further evidence of the ropes we move to do a CTD at the current PAP-1 location (JC278-056). The Amphipod trap (JC278-047) is then released, arriving at the surface at around 16:50 at a more sensible ascent rate with all glass spheres intact. After processing the samples a final megacore is launched at PAP Central (JC278-057).

Throughout recent days, discussions have been ongoing among the team on board and NOC about a possible recovery effort for HyBIS, the value of an such and effort and the way in which it could be done. The importance of the long-term observations at the PAP-SO and the location of the lost vehicle within this area, risking future work here, were the eventual reasons for justifying a recovery effort.

Thursday 19th - Friday 20th June 2025 Thursday and Friday are designated time for attempting to recover the lost HyBIS vehicle. This was particularly sensitive because HyBIS and the deep tow wire lay close to PAP Central, which as an internationally important time series site. It could therefore not be disturbed by operations that contact the seabed. Over several day of consideration the team planned a targeted dragging operation using a very small dragging rig and, crucially, the use of a USBL beacon on the core wire, combined with the beacon fitted to HyBIS which was still transmitting its position. Amidst palpable tension in the main lab, monitoring the beacons showed on the grapnels passed within 20-30 m of HyBIS, over the expected location of the deep-tow wire. If we were going to catch the wire it would have happened by now, but there was still no increase in tension on the winch. With the all eyes on the monitors after about half an hour of hauling we could see that the wire tension was increasing. This only increased anxiety among the team members, we had seemingly caught it, but could we keep it on the wire? The ship began reversing towards HyBIS to lift rather than drag it over the seabed. It took approximately 16 hours to bring HyBIS to the surface, with everyone in a state

of high alert for the duration as they monitored the tension on the wire. A gradually increasing swell was adding to our concerns. Eventually HyBIS emerged from the ocean in a tangled mess of wire. This took considerable time and skill to resolve but the vehicle was secured with limited damage. An impressive team effort by all involved.

Once the recovery operation was over the last scientific deployment was to collect a final CTD cast near the latest GEORGE project Argo surfacing location (JC278-058) for further sensor data validation before heading back towards PAP to get some more ranges for the PAP-3 and Bathysnap for trilateration purposes. Departure from PAP-SO was at midnight.

Saturday 19th June – Sunday 22nd June 2025 scientific measurement continued with the underway systems during the transit towards Southampton, with cruise reporting writing, packing and tidying labs ongoing. On Sunday the Chief Engineer arranged engine room tours which the science party greatly appreciated. In the afternoon we took a cruise photograph on the forecastle (below), followed by a well-attended science de-brief and show & tell for the whole crew aboard.

Monday 23rd June 2025 We wake up to views of the Solent where we are moored to the north of the Isle of Wight, opposite the entrance to Beaulieu River. The pilot is delayed by a few hours but the holdup is short and we arrive at NOC at around 10:30.



Figure 5.1: Cruise photograph taken in calm conditions on the transit back to Southampton

6. NMF Technical Report

Tim Powell (Senior Technical Officer), Juan Ward (SST), Tom Ballinger, Dan Comben, Christian Crowe, Basem Drawil, Alex Downer, Jade Garner, Howard King, Emre Mutlu, Martin Yeomans

6.1 Mooring operations

Tom Ballinger, Chris Crowe, Tim Powell

Mooring Deck Operations

The planned mooring work for JC278 included the deployment of the full PAP 1 mooring (less the sensors frame), along with the Whittard Canyon and PAP 3 mooring turnarounds. Also, to be deployed were 2 PISCES moorings, a Hydrophone Lander, short term amphipod traps and Bathysnap short and long term deployments plus a benthic chamber lander.

To facilitate the work, the Romica PAP winch and two North Sea 5T deck winches were loaded aboard. The large orange guard buoy was also sent however was not required.

Mooring Deployments

PISCES 1 (JC278-006)

- Setup Distance: 750m
- Over run: 50m
- Deployment Duration: 40 minutes

The recovery line was deployed by hand, followed by the 44" ADCP sphere which was lowered on a SeaCatch release by the starboard crane. The following lengths and glass were deployed using the 5t deck winch and block on the port crane. The load was transferred to the anchor using a deck eye and slip line. The anchor was deployed on a SeaCatch using the starboard crane.

PISCES 2 (JC278-005)

- Setup Distance: 750m
- Over run: 50m
- Deployment Duration: 49 minutes

The recovery line was deployed by hand, followed by the 44" ADCP sphere which was lowered on a SeaCatch release by the starboard crane. The following lengths and glass were deployed using the 5t deck winch and block on the port crane. The load was transferred to the anchor using a long loop to the deck winch. The anchor was deployed on a SeaCatch using the starboard crane.

Hydrophone Lander (JC278-007)

The Hydrophone Lander was deployed anchor first as it required lowering to the seabed for a soft deployment. A release was fitted to the top of the recovery line, this was lowered using a length of rope until approx. 5m above bottom at which point the release command was sent.

Whittard Canyon Mooring (JC278-011)

- Setup Distance: 500m
- Over run: 100m
- Deployment Duration: 23 minutes

The recovery line, first three glass and 35m of rope were deployed by hand. The two ADCPs were deployed simultaneously using both starboard and port cranes. Some sacrificial rope was connected to the bottom of the 6 glass spheres and run through the eye on the deck winch wire. The winch was used to take the weight of the 6 glass, Hydrophone and Anderson trap with a slip to the acoustic releases ready for the load transfer. The anchor was deployed using the starboard crane and SeaCatch.

PAP3 (JC278-020)

- Setup distance: 2000m (recommend increasing this distance in 2026 to allow ships speed increase for the 1500m of rope).
- Over run: 200m
- Deployment Duration: 1 hour 35 minutes

The rope for PAP 3 was would onto the 5t deck winch prior to deployment. A SeaCatch was used to deploy the sediment traps to keep them vertical prior to entry into the water. The anchor was deployed using a SeaCatch on the starboard crane.

PAP1 (JC278-028)

- Setup Distance: 7.4 km (4 nautical miles)
- Over run: 500m
- Deployment Duration: 5 hours 30 minutes

The PAP buoy was moved into position for deployment using the starboard crane while in Falmouth Bay. The bridal and chain were connected and deployed while the buoy was on the deck, two 5t deck winches were used to lower the chain. The final length of chain directly below the buoy was tied to the port deck winch and used as a steadying line for the deployment of the buoy. The buoy was lifted using the port crane and steadied with two taglines from the red deck and one at the base connected to the 5t winch. Once the buoy was clear of the stern the rope to the winch was removed and the buoy lowered to the surface.

The 3t sinker was deployed using the starboard 5t deck winch and the A frame.

Bathysnap Short Term (JC278-025)

Deployed without issue.

Bathysnap Long Term (JC278-048)

Deployed without issue.

Benthic Lander 1 (JC278-035) / Benthic Lander 2 (JC278-046)

Deployed without issue and had a decent rate of ~ 46m/min.

Amphipod Trap 1 (JC278-036) / Amphipod Trap 2 (JC278-047)

Deployed without issue and had a decent rate of 45m/min.

Mooring Recoveries

Whittard Canyon (JC263-007)

Mooring failed to ascend after release command sent, roughly 17 hours after initial release command was sent the mooring was on the surface. Fishing line was present on the recovered releases. This delay was not due to release failure but to interference from external factors. Time on the surface caused the mooring to tangle, during recovery the recovery line parted at a knot within the tangle of chain and spheres. The second attempt at recovery used a snap hook to the frame of the ADCP buoy. After close to 24 hours at the surface the Anderson trap had been washed out – no sediment was present upon recovery.

Bathysnap Long Term (JC263-072)

System deployed in 2024 recovered without issue.

Bathysnap Short Term (JC278-025)

Recovered without issue.

Amphipod Trap 1 (JC278-036)

Iridium beacon failed (M10-042). Recovery float imploded causing a small amount of tangling.

Amphipod Trap 2 (JC278-047)

Recovered with no issue.

Benthic Lander 1 (JC278-035)

Recovered with no issue.

Benthic Lander 2 (JC278-046)

Recovered with no issue.

PAP 3 (JC263-016)

The recovery line became tangled with the first package of glass. There was also a small amount of tangling at the second Nortek. *A shackle link shackle should be added below the second sediment trap to allow for easier recovery.*

Hybis Loss and Recovery

At 0118 on 16th June 2025, the HyBIS ROV was lost in 4835m of water following damage to the connecting deep tow wire which caused it to part. HyBIS had just completed a survey dive at the PAP site, was at the start of its recovery and 12.5m above the seabed. The deep tow wire was damaged when it moved off the P-frame roller onto the extended arms of the anti-pendulum frame. The subsequent movement of the DT wire with the AHC in operation, resulted in the outer layers of the DT becoming shredded.

An attempt was made to recover HyBIS by slowly hauling in, however the DT wire parted at the damaged section once it reached the back tension damper in the winch room. Having parted, approximately 4835m of DT wire unthreaded itself through the winch system and released itself to the sea floor along with HyBIS.

HyBIS Recovery

At approximately 0900 on 19th June a recovery attempt began. HyBIS and the deep tow wire lay approximately 200m east of an area used for coring and video survey. It was important that this area be left undisturbed by the dragging operation therefore a very small dragging rig was used.

A dragging rig consisting of several grapnels and 250m of ground wire, was attached to the core wire led aft over the ships stern gantry. Joining the core wire to the dragging rig was a large swivel and weak link. 50m up the core wire a USBL beacon was attached, combined with the USBL beacon fitted to HyBIS this allowed for a targeted drag with minimal ground sweep.

The first part of the dragging gear was lowered to the seabed about 100m North and 100m West of HyBIS. The ship moved east at 0.2kts whilst the 250m ground wire was payed out after which it began to move south, south west and then south again.

Monitoring of the Sonardyne ranger 2 software showed that the beacon on the core wire passed within 20-30m of HyBIS.

The ship continued to move south until it was about 1200m south of HyBIS. The dragging gear had moved about 50m south of HyBIS before ceasing to move any further.

At this point we believed we had caught something despite not yet seeing an increase in wire tension.

The ship came to a stop and the core wire was slowly hauled in, initially at 6m/min. After about half an hour we could see that the wire tension was increasing. The ship began reversing towards HyBIS to lift rather than drag HyBIS and the deep tow wire.

Due to the weight of wire being recovered it was necessary to haul very slowly to avoid exceeding the safe working load of the core wire. It took approximately 16hours to bring HyBIS to the surface.

Once HyBIS was untangled from the mess of wire and secured the ship proceeded away from the science area so the deep tow wire could be discharged back to the seabed.

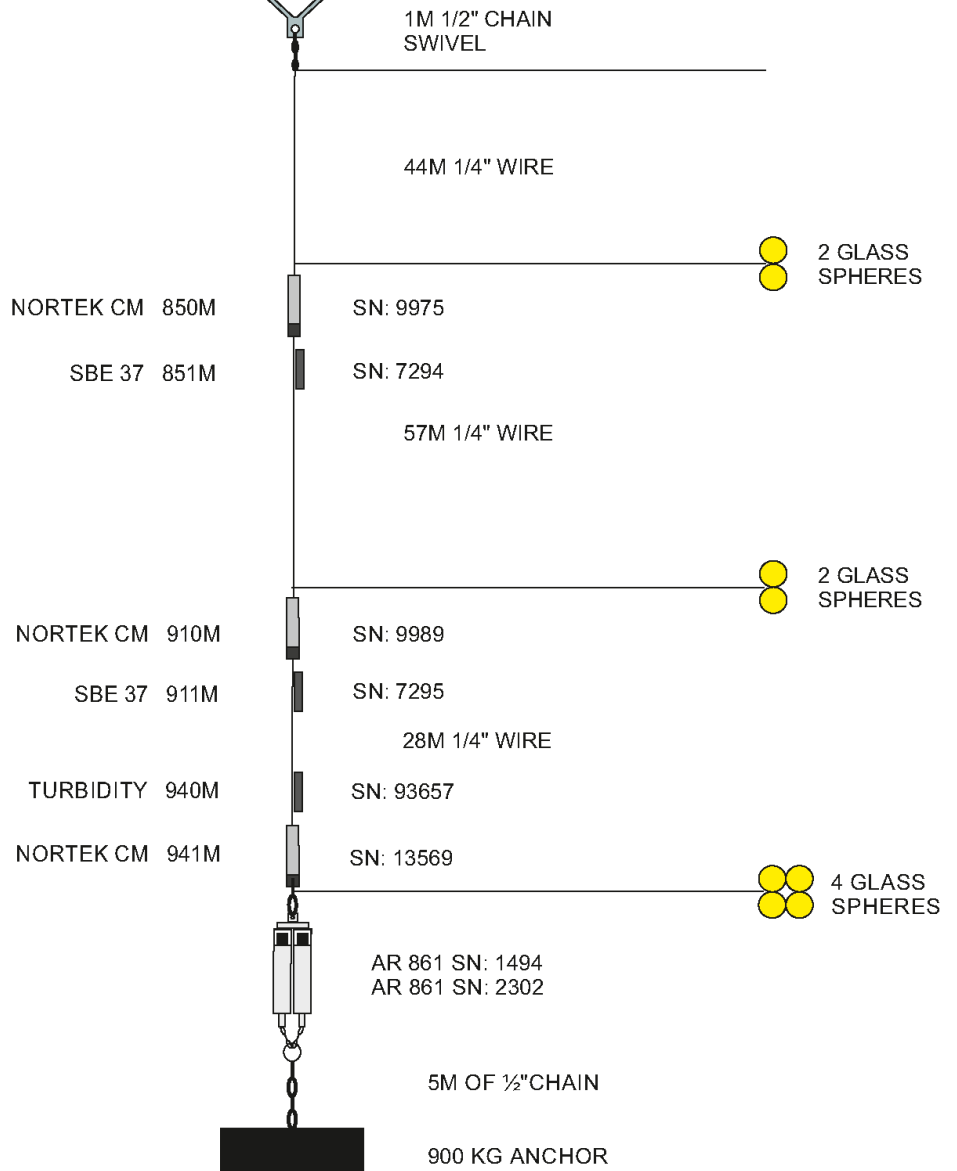
PISCES 1 DANGEARD CANYON (DC) AS DEPLOYED JC278 PAP 2025

Latitude: 48° 21.41'N
Longitude: 9° 32.61'W
Depth: 955m

ADCP 75kHz 800M
44" SPHERE

RECOVERY FLOAT
15M POLYPROP
RECOVERY LINE

ADCP SN: 15519 IRIIDIUM SN: M10-043
BUOY SN: J16297-002 LIGHT SN: A08-018



SENSORS & MOORINGS

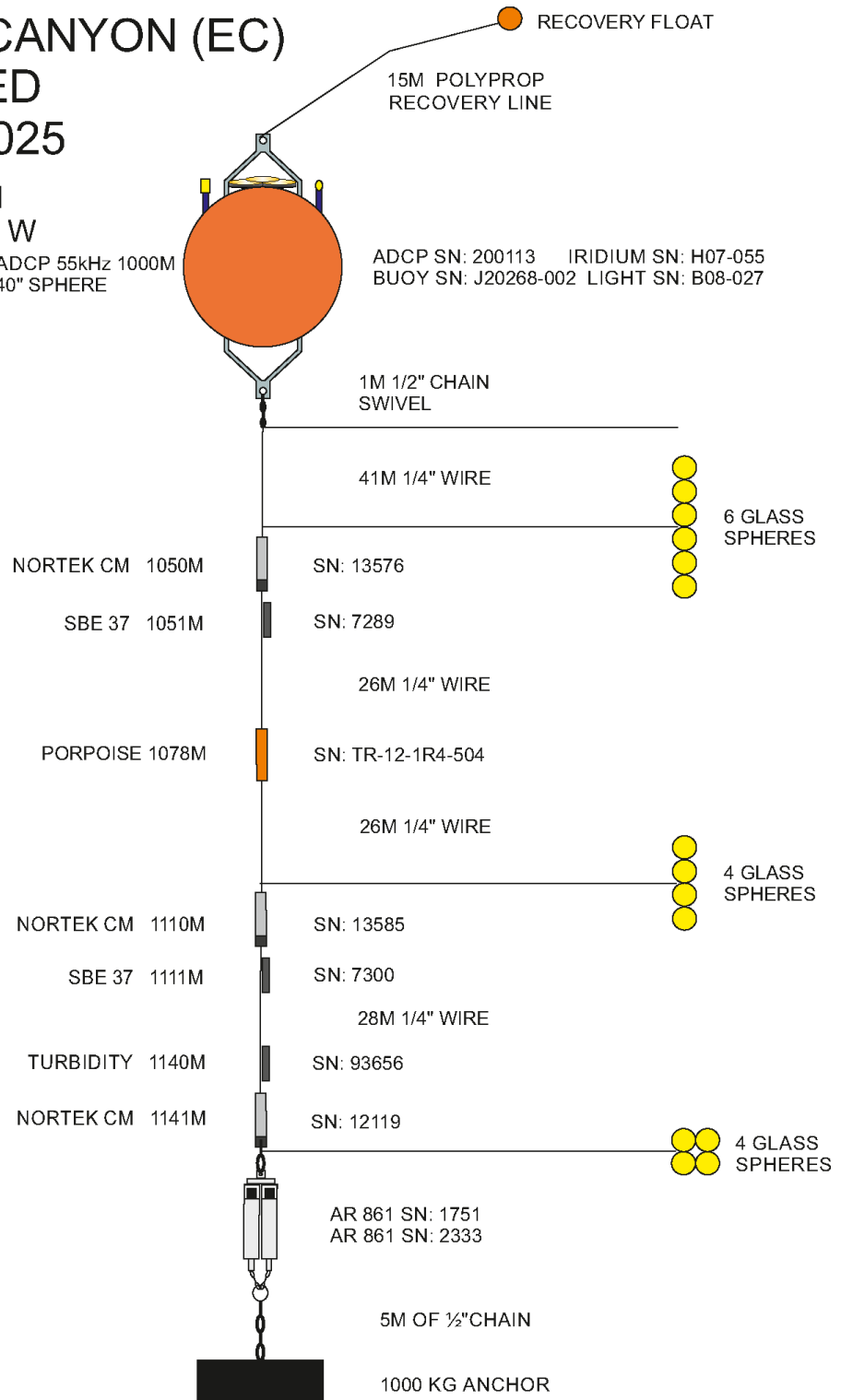
Figure 6.1: PISCES-1 mooring diagram (JC278-006)

PISCES 2 EXPLORER CANYON (EC) AS DEPLOYED JC278 PAP 2025

Latitude: 48° 26.9' N
Longitude: 9° 41.16' W
Depth: 1165 m

ADCP 55kHz 1000M
40" SPHERE

ADCP SN: 200113 IRIDIUM SN: H07-055
BUOY SN: J20268-002 LIGHT SN: B08-027

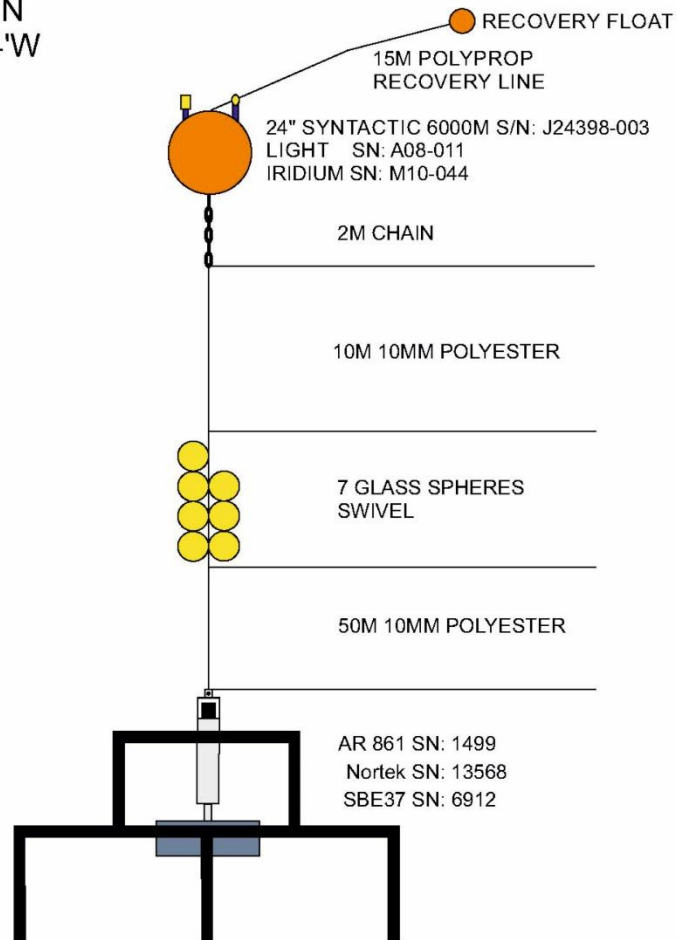


SENSORS & MOORINGS

Figure 6.2: PISCES-2 mooring diagram (JC278-005)

HYDROPHONE LANDER AS DEPLOYED JC278 PAP 2025

Latitude: 48° 23.02'N
Longitude: 9° 44.24'W
Depth: 350m

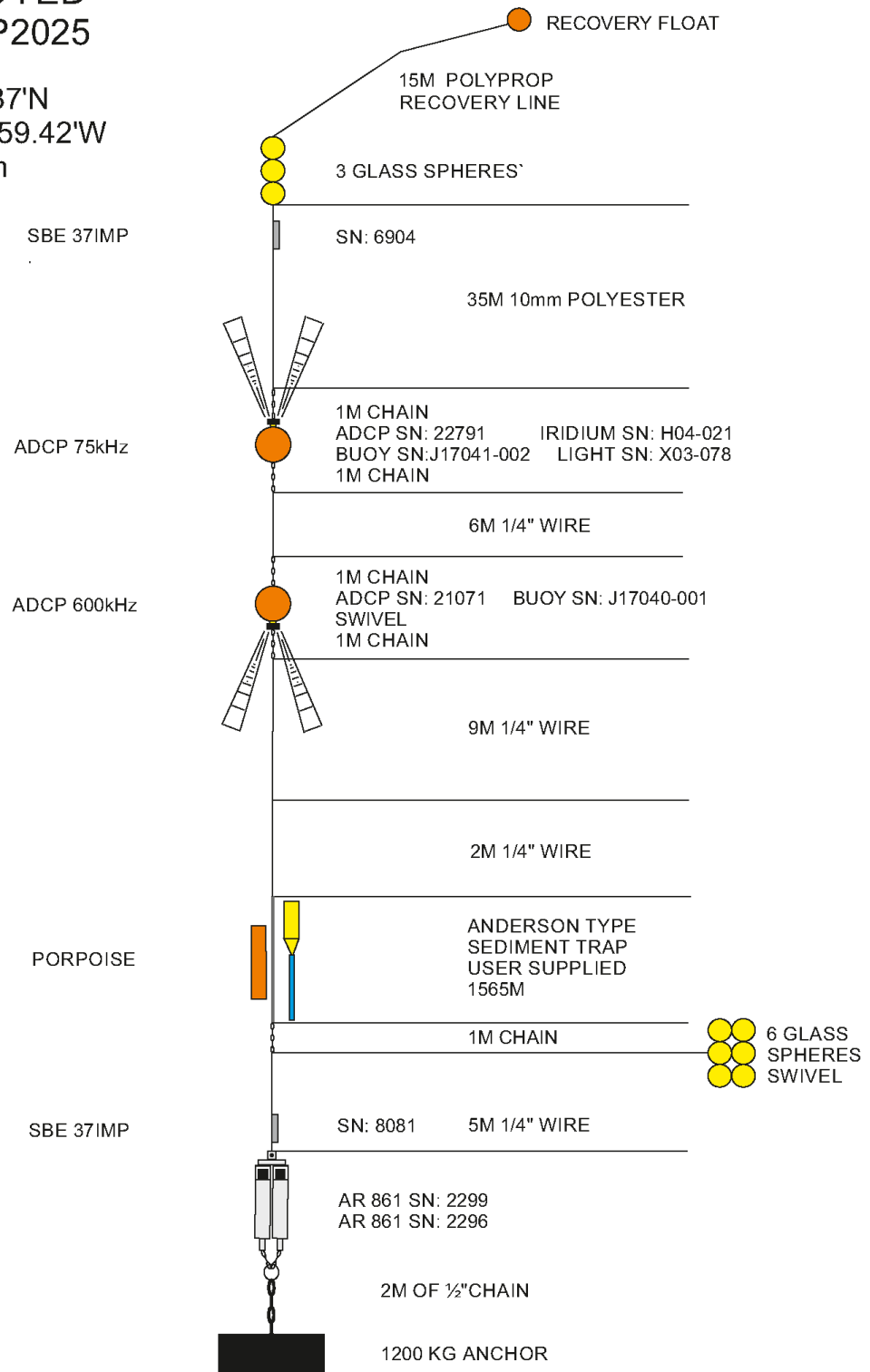


SENSORS & MOORINGS

Figure 6.3: Hydrophone Lander mooring diagram (JC278-007)

WHITTARD CANYON AS DEPLOYED JC278 PAP2025

Latitude: 48° 37'N
Longitude: 9° 59.42'W
Depth: 1585m



SENSORS & MOORINGS

Figure 6.4: Whittard Canyon Mooring diagram (JC278-011)

PAP 3 AS DEPLOYED JC278 PAP 2025

Latitude: 48° 58.48'N
Longitude: 016° 29.45'W
Depth: 4844m

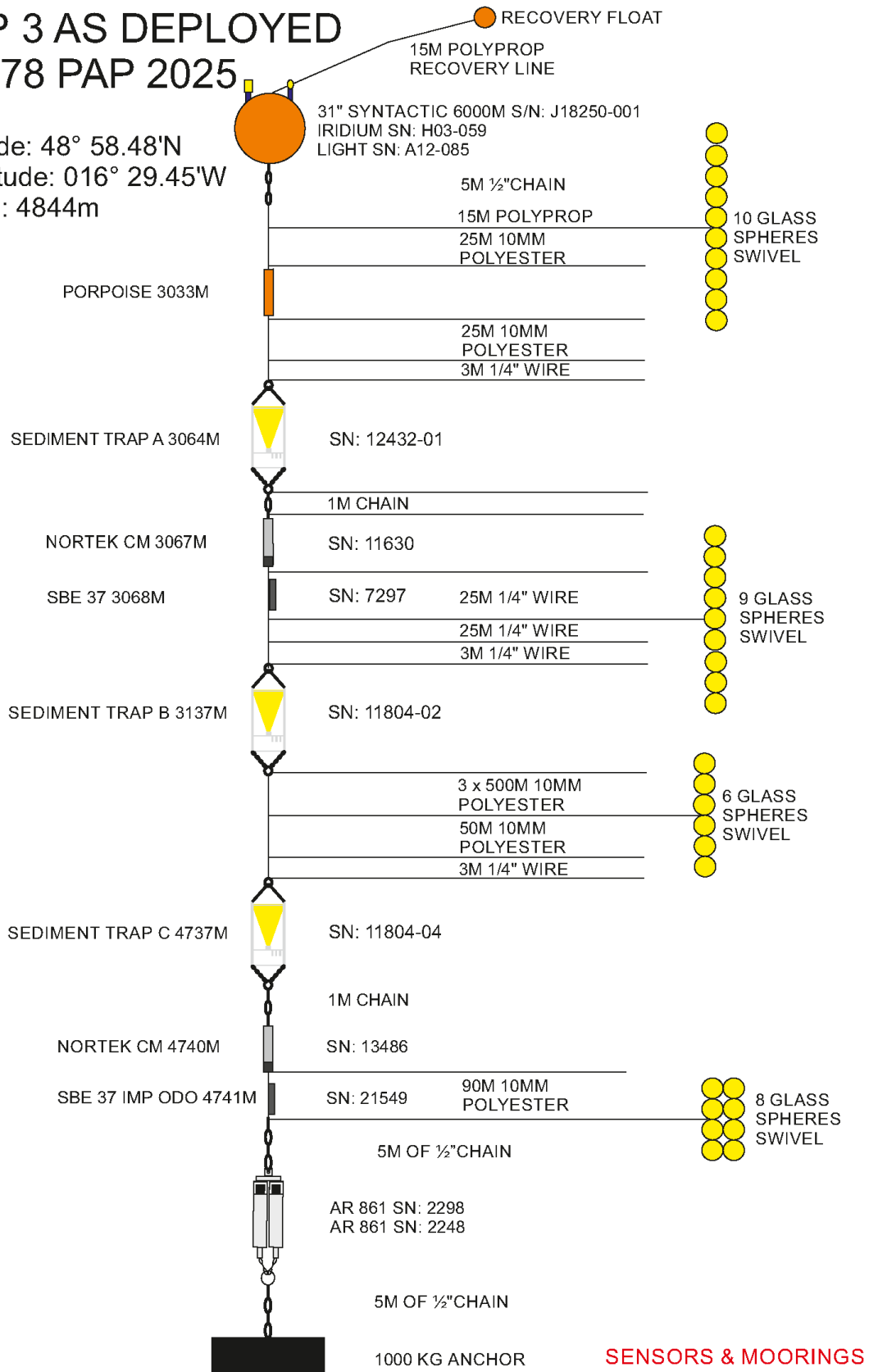


Figure 6.5: PAP-3 mooring diagram (JC278-020)

Met Office Moored Buoy PAP



Charted Position:
 Design depth: 4850m
 Not to scale
 Drawing date: 18/02/2025

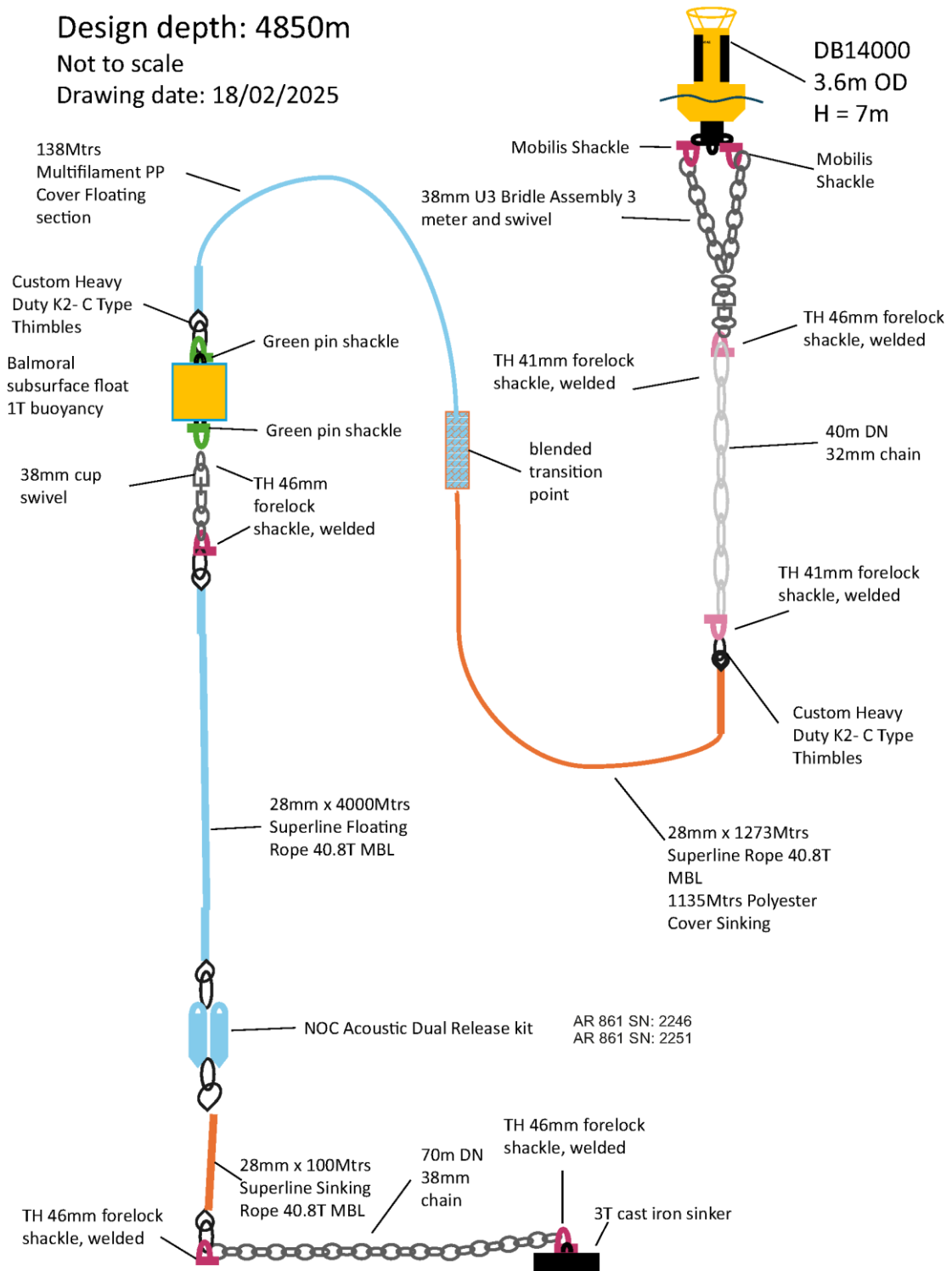
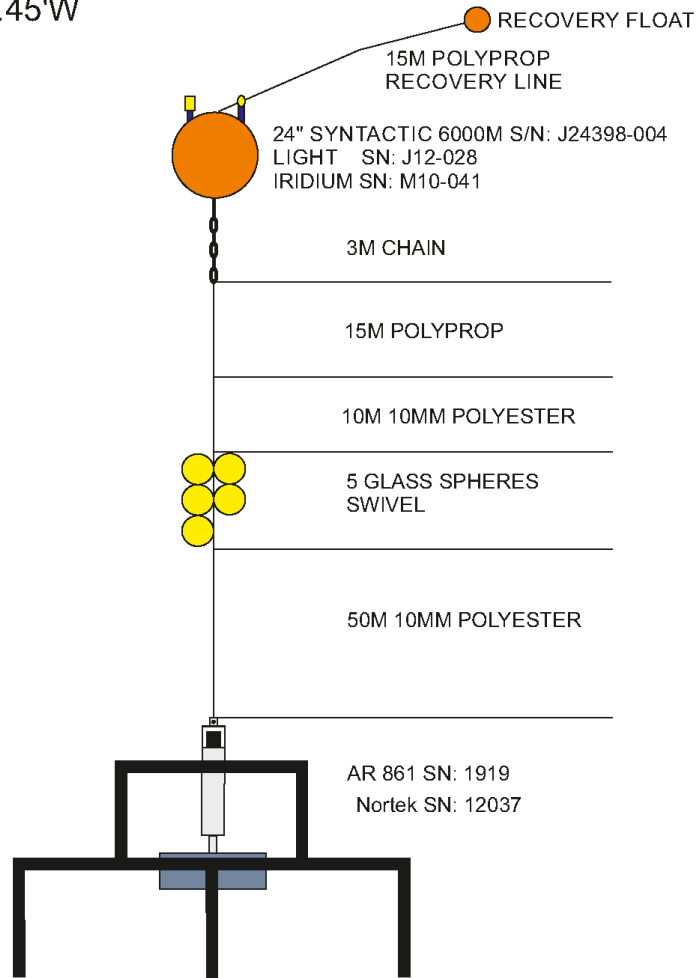


Figure 6.6: PAP-1 mooring diagram (JC278-028)

BATHYSNAP AS DEPLOYED JC278 PAP 2025

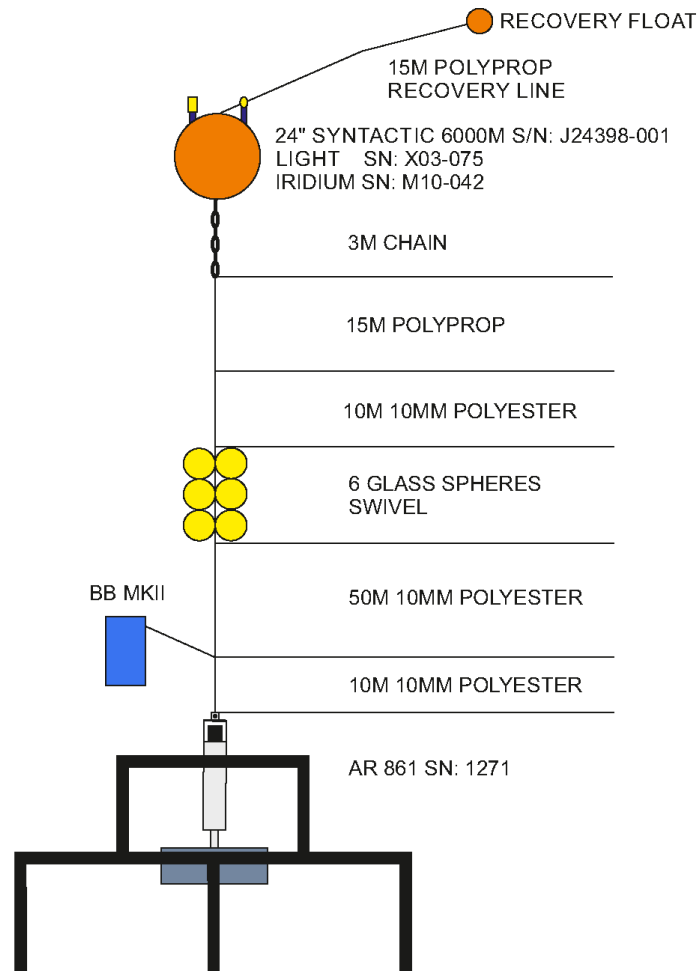
Latitude: 49° 00.21'N
Longitude: 016° 26.45'W
Depth: 4850m



SENSORS & MOORINGS

Figure 6.7: Bathysnap mooring diagram (JC278-048)

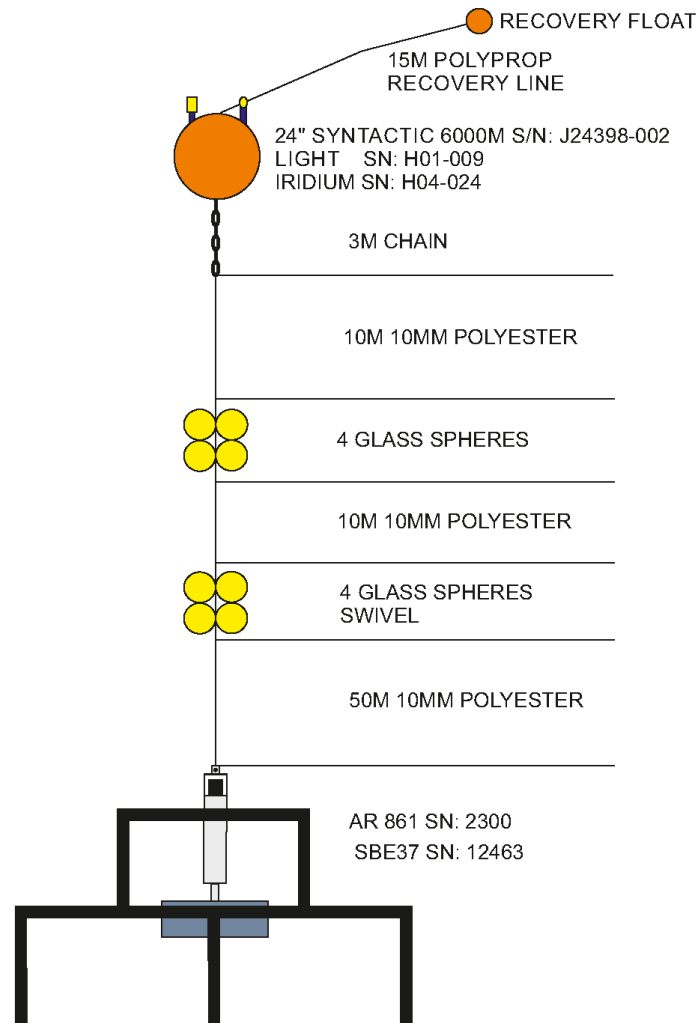
AMPHIPOD TRAP AS DEPLOYED JC278 PAP 2025



SENSORS & MOORINGS

Figure 6.8: Amphipod trap mooring diagram (JC278-036 & JC278-047)

BENTHIC LANDER AS DEPLOYED JC278 PAP 2025



SENSORS & MOORINGS

Figure 6.9: Benthic chamber mooring diagram (JC278-035 & JC278-046)

6.2 Instrumentation Report

The various instruments Deployed/Recovered on cruise JC278 consisted of as follows:

SBE 37 SMP, SBE 37 IMP ODO, Nortek Aquadopp cm, Mclane 21 bottle Sediment Trap, RDI 75KHz ADCP, RDI 600KHz ADCP, Nortek Signature 55 ADCP.

All instrumentation was serviced, batteries installed and tested back at NOC prior to being loaded for JC278.

All Instrument setups capture file`s Including SBE 37`S calibration dip data files before deployment can be found in the appropriate projects mooring Teams folder.

All Data From recovered instruments will placed within the sensors and moorings shared folder onboard and on teams.

All Ixsea acoustic releases were serviced, and bench tested at NOC prior to the cruise, but to verify their operation at depth all of the releases were attached to the CTD frame and then tested using the TT801 Deck Unit and the ship fitted transducer on the drop keel.

PISCES-2 as deployed (JC278-005)

Table 6.1: PISCES 2 instrumentation

Instrument	Serial Number
Light Beacon	B08-027
Iridium Beacon	H07-055
Nortek sig 55 ADCP	200113
Nortek CM	13585
Sea-Bird SBE 37	7289
Porpoise	TR-12-1R4-504
Nortek CM	13585
Sea-bird SBE 37	7300
Turbidity	93656
Nortek CM	12119
Ixsea Release	1751
Ixsea Release	2333

The SIG 55 ADCP was programmed in the lab prior to being fitted into the deepwater syntactic buoyancy and visually checked on deck after the start date and time of the instrument had passed 30/05/25 1300 GMT. The following configuration settings were applied to the SIG 55 (Figure 6.10);

^ Performance				Name		Coarse profile	
Configured length (days)	128	Type	Single	^ Measurement range			
Estimated max length (days)	144.9	Plan	Average - Coarse...	Desired range (m)	1000		
Battery capacity (Wh)	3600	Deployment length (days)	128	Configured range (m)	1082		
Power usage (Wh)	3179	^ Environment		Estimated range (m)	1001.1		
Recorder capacity (MB)	15258.8	Geography	Open ocean	Blanking distance (m)	2		
Memory usage (MB)	296.1	Sound velocity	Measured	Cell size (m)	20		
Min configured baud rate	4800	Mounting	Subsurface buoy	Number of cells	54		
Max RS422 cable distance (m)	976	Orientation	Up-looking	Number of beams	3		
^ System information		Instrument depth (m)	1000	Altimeter	OFF		
Instrument name	Signature55	Salinity (ppt)	35	Ice drift	OFF		
Nickname	Virtual instrument	Tidal range (m)	1	Pulse distance	n/a		
Serial number	900001	^ Coarse profile		Altimeter start (m)	n/a		
Head frequency (kHz)	55	Start of profile (m)	2	Altimeter end (m)	n/a		
Opt. sensors	AHRS	End of profile (m)	1000	^ Sampling rate			
Firmware version	1.4.6678.2216_6	Cell size (m)	20	Measurement interval	00:10:00		
Recorder size (GB)	16 GB	Power level (dB)	-3	Configured average interval	00:10:00		
Connection	Not connected	Measurement load (%)	20	Actual average interval	00:10:00		
Orientation	Auto Z up/down	Average interval	00:10:00	Sampling rate (Hz)	n/a		
^ Application		Measurement interval	00:10:00	#Samples	n/a		

Figure 6.10: Deployment settings for PISCES Signature 55.

Three Nortek Current Meters were deployed on PISCES 2 for a duration of 128 days. With a 100Wh battery the usage would be 77% allowing enough redundancy to prevent any issues upon recovery.

Table 6.2: Nortek Current Meter settings on PISCES-2

Nortek CM settings
Deployment: 13576 Current time: 22/05/2025 14:06:01 Start at: 30/05/2025 13:00:00 Comment: 13576 pices jc278 2025 -----
Measurement interval (s): 300 Average interval (s): 60 Blanking distance (m): 0.50 Measurement load (%): 4 Power level: HIGH Diagnostics interval(min): 720:00 Diagnostics samples: 20 Compass upd. Rate (s): 10 Coordinate System: ENU Speed of sound (m/s): MEASURED Salinity (ppt): 35 Analog input 1: NONE Analog input 2: NONE Analog input power out: DISABLED Raw magnetometer out: OFF File wrapping: OFF TellTale: OFF AcousticModem: OFF Serial output: OFF Baud rate: 9600 -----
Assumed duration (days): 128.0 Battery utilization (%): 77.0 Battery level (V): 13.8 Recorder size (MB): 9 Recorder free space (MB): 8.973 Memory required (MB): 1.7 Vertical vel. prec (cm/s): 1.4 Horizon. vel. prec (cm/s): 0.9 -----
Instrument ID: AQD13576 Head ID: A6L 8342 Firmware version: 3.39 -----
Aquadopp Deep Water Version 2.00.02 Copyright (C) Nortek AS =====

Two SeaBird SBE37 MicroCats were deployed on PISCES 2. They were programmed using Sea-Bird SeaTerm V2. The battery endurance was calculated at 300 days, more than sufficient for the 128 day deployment.

Table 6.3: PISCES 2 SBE37 setup

SN: 7289	SN: 7300
S>DS SBE37SM-RS232 3.0h SERIAL NO. 7289 01 Jun 2025 08:49:49 vMain = 6.95, vLith = 2.98 samplenumber = 0, free = 559240 not logging, waiting to start at 01 Jun 2025 09:00:00 sample interval = 60 seconds data format = converted engineering alternate transmit real-time = no sync mode = no pump installed = yes, minimum conductivity frequency = 3000.0 S>	S>DS SBE37SM-RS232 v3.1 SERIAL NO. 7300 01 Jun 2025 08:54:40 vMain = 6.96, vLith = 3.17 samplenumber = 0, free = 559240 not logging, waiting to start at 01 Jun 2025 09:00:00 sample interval = 60 seconds data format = converted engineering alternate transmit real-time = no sync mode = no pump installed = yes, minimum conductivity frequency = 3063.0 S>

Pisces 2 also had a PORPOISE Hydrophone, this was user supplied and supplied setup ready to deploy.

A Valeport MIDAS was also user supplied, this was setup for 4Hz sampling in 30 second bursts every 10 minutes (120 sample burst every 10 minutes).

A light beacon was fitted to the 40" ADCP Sphere, this was visually inspected prior to deployment. An Iridium Beacon (s/n: H07-055) was also fitted to the sphere, email alerts were received from this beacon prior to deployment.

PISCES-1 as deployed (JC278-006)

Table 6.4: PISCES-1 instrumentation

Instrument	Serial Number
Light Beacon	A08-018
Iridium Beacon	M10-043
RDI 75KHZ ADCP	15519
Nortek CM	9975
Sea-Bird SBE 37	7294
Nortek CM	9989
Sea-bird SBE 37	7295
TURBIDITY	93657
Nortek CM	13569
Ixsea Release	1494
Ixsea Release	2302

Table 6.5: The RDI 75kHz ADCP programmed using the following commands;

```
[BREAK Wakeup A]
WorkHorse Broadband ADCP Version 50.40
Teledyne RD Instruments (c) 1996-2010
All Rights Reserved.
>CR1
[Parameters set to FACTORY defaults]
>CQ255
>CF11101
>EAO
>EBO
>ED8000
>ES35
>EX11111
>EZ1111101
>WA50
>WB1
>WD111100000
>WF704
>WN50
>WP12
>WS1600
>WV175
>TE00:10:00.00
>TP00:50.00
>TF25/05/30 13:00:00
>CK
[Parameters saved as USER defaults]
>The command CS is not allowed in this command file. It has been ignored.
>The following commands are generated by this program:
>CF?
CF = 11101 ----- Flow Ctrl (EnsCyc;PngCyc;Binry;Ser;Rec)
>CF11101
>RN pices
>cs
```

The ADCP had 4 alkaline battery packs installed giving a total power of 1800Wh. Two 2GB memory cards were installed. 10-minute sampling was set at the request of the principal scientist to allow the ADP to record for the duration of the 128-day deployment.

The Nortek Current Meters and the SBE37 MicroCats were setup as per PISCES 2 as was the Valeport MIDAS.

The light beacon fitted to the ADCP sphere was tested prior to deployment and the Iridium beacon (M10-043) was sending email alerts prior to deployment.

Hydrophone Lander: As deployed (JC278-007)

The Hydrophone Lander is scheduled for recovery on the PISCES moorings recovery cruise. As a result it was decided to give the Nortek Current Meter and the SBE37 MicroCat the same deployment settings.

Table 6.6: Instrumentation deployed on the Hydrophone lander;

Instrument	Serial Number
Light Beacon	A08-011
Iridium Beacon	M10-044
Nortek CM	13568
Sea-Bird SBE 37	6912
Ixsea Release	1499

Table 6.7: SBE37 configuration on hydrophone lander

```

SBE 37 SN: 6912
S>#09DS
SBE37-IM 3.0b SERIAL NO. 6912 01 Jun
2025 09:10:06
vMain = 6.90, vLith = 2.89
samplenum = 0, free = 559240
not logging, waiting to start at 01 Jun 2025
10:00:00
sample interval = 60 seconds
data format = converted engineering
transmit sample number
pump installed = yes, minimum
conductivity frequency = 3133.3
PC baud rate = 9600
<Executed/>
S>

```

- Nortek deployment configuration as per PISCES.

Whittard Canyon Mooring: As deployed (JC278-011)

Table 6.8: Instrumentation deployed on the Whittard Canyon mooring;

Instrument	Serial Number
Light Beacon	X03-078
Iridium Beacon	H04-021
RDI 75KHZ ADCP	22791
Sea-Bird SBE 37	6907
Sea-bird SBE 37	8081
Ixsea Release	2299
Ixsea Release	2296

The SBE37 MicroCats deployed on Whittard Canyon were configured with a sampling frequency of 1800 seconds to allow for a 12+ month deployment.

Table 6.9: SBE37 MicroCat configurations deployed on Whittard Canyon Mooring:

SBE37 SN: 6907	SBE37 SN: 8081
S>#12DS	S>DS
SBE37-IM 3.0b SERIAL NO. 6907 02 Jun 2025 09:34:39	SBE37SM-RS232 3.0j SERIAL NO. 8081 02 Jun 2025 09:37:47
vMain = 6.84, vLith = 2.95	vMain = 6.91, vLith = 3.12
sample number = 0, free = 559240	sample number = 0, free = 559240
not logging, waiting to start at 02 Jun 2025 10:00:00	not logging, waiting to start at 02 Jun 2025 10:00:00
sample interval = 1800 seconds	sample interval = 1800 seconds
data format = converted engineering	data format = converted engineering
do not transmit sample number	alternate
pump installed = yes, minimum conductivity frequency = 3098.8	transmit real-time = no
PC baud rate = 9600	sync mode = no
<Executed/>	pump installed = yes, minimum conductivity frequency = 3000.0
S>	S>

An **RDI 75kHz ADCP** was deployed looking up on the Whittard Canyon mooring, setup for 30 second sampling. The deployment commands used are detailed in Table 6.10;

An **RDI 600kHz ADCP** was deployed looking down on the Whittard Canyon mooring. The deployment commands used are detailed in Table 6.10;

Table 6.10: RDI 75kHz and RDI 600kHz ADCP configuration on Whittard Canyon Mooring.

RDI 75kHz ADCP	RDI 600kHz ADCP
<pre> >CR1 [Parameters set to FACTORY defaults] >CQ255 >CF11101 >EA0 >EBO >ED14550 >ES35 >EX11111 >EZ1111101 >WA50 >WB1 >WD111100000 >WF704 >WN91 >WP10 >WS1600 >WV175 >TE00:30:00.00 >TP00:05.00 >TF25/05/30 14:00:00 >CK [Parameters saved as USER defaults] >The command CS is not allowed in this command file. It has been ignored. >The following commands are generated by this program: >CF? CF = 11101 ----- Flow Ctrl (EnsCyc;PngCyc;Binry;Ser;Rec) >CF11101 >RN WC075 >cs </pre>	<pre> >CR1 [Parameters set to FACTORY defaults] >CF11101 >EA0 >EBO >ED15500 >ES35 >EX11111 >EZ1111101 >WA50 >WB0 >WD111100000 >WF88 >WN30 >WP10 >WS100 >WV175 >TE00:01:30.00 >TP00:05.00 >TF25/05/30 15:00:00 >CK [Parameters saved as USER defaults] >The command CS is not allowed in this command file. It has been ignored. >The following commands are generated by this program: >CF? CF = 11101 ----- Flow Ctrl (EnsCyc;PngCyc;Binry;Ser;Rec) >CF11101 >RN WC600 >cs </pre>

PAP 3: As deployed (JC278-020)

Table 6.11: Instrumentation deployed on PAP 3;

Instrument	Serial Number
Light Beacon	A12-085
Iridium Beacon	H03-059
Sediment trap	12432-01
Nortek cm	11630
SBE 37 SMP	7297
Sediment trap	11804-02
Sediment trap	11804-04
Nortek cm	13486
SBE 37 IMP ODO	21549
Ixsea Release	2299
Ixsea Release	2248

Table 6.12: SBE37 MicroCats deployed with these settings;

SN: 7297	SN: 21549
<p>S>DS SBE37SM-RS232 v3.1 SERIAL NO. 7297 05 Jun 2025 13:59:35 vMain = 6.96, vLith = 2.93 samplenumber = 0, free = 559240 not logging, waiting to start at 06 Jun 2025 10:00:00 sample interval = 1800 seconds data format = converted engineering alternate transmit real-time = no sync mode = no pump installed = yes, minimum conductivity frequency = 3000.0 S></p>	<p>S>#33ds SBE37IMP-ODO v6.1.1 SERIAL NO. 21549 05 Jun 2025 13:54:53 vMain = 13.80, vLith = 3.01 samplenumber = 0, free = 399457 not logging, start at 06 Jun 2025 10:00:00 sample interval = 1800 seconds data format = converted engineering output temperature, Celsius output conductivity, S/m output pressure, Decibar output oxygen, ml/L output sample number minimum conductivity frequency = 3168.2 adaptive pump control enabled nTau = 7.0 RS232 baud rate = 9600 <Executed/> S></p>

The command file for the ODO would not use autosbe so was programmed manually for calibration dip and deployment.

Table 6.13: Configuration for two Nortek Current Meters were deployed on PAP-3

Deployment: 11630 Current time: 23/05/2025 10:41:21 Start at: 30/05/2025 13:00:00 Comment: 11630 JC278 2025

Measurement interval (s): 1800 Average interval (s): 30 Blanking distance (m): 0.50 Measurement load (%): 9 Power level: HIGH Diagnostics interval(min): 720:00 Diagnostics samples: 20 Compass upd. Rate (s): 10 Coordinate System: ENU Speed of sound (m/s): MEASURED Salinity (ppt): 35 Analog input 1: NONE Analog input 2: NONE Analog input power out: DISABLED Raw magnetometer out: OFF File wrapping: OFF TellTale: OFF AcousticModem: OFF Serial output: OFF Baud rate: 9600

Assumed duration (days): 400.0 Battery utilization (%): 50.0 Battery level (V): 13.9 Recorder size (MB): 9 Recorder free space (MB): 8.973 Memory required (MB): 1.4 Vertical vel. prec (cm/s): 1.4 Horizon. vel. prec (cm/s): 0.9

Instrument ID: AQD11630 Head ID: A6L 6502 Firmware version: 3.37

Aquadopp Deep Water Version 2.00.02 Copyright (C) Nortek AS

Table 6.14: Settings for the three sediment traps on PAP-3

Event 1 of 22 = 06/08/2025 12:00:00
Event 2 of 22 = 06/22/2025 12:00:00
Event 3 of 22 = 07/06/2025 12:00:00
Event 4 of 22 = 07/27/2025 12:00:00
Event 5 of 22 = 08/17/2025 12:00:00
Event 6 of 22 = 09/07/2025 12:00:00
Event 7 of 22 = 09/28/2025 12:00:00
Event 8 of 22 = 10/19/2025 12:00:00
Event 9 of 22 = 11/09/2025 12:00:00
Event 10 of 22 = 11/30/2025 12:00:00
Event 11 of 22 = 12/28/2025 12:00:00
Event 12 of 22 = 01/18/2026 12:00:00
Event 13 of 22 = 02/08/2026 12:00:00
Event 14 of 22 = 03/01/2026 12:00:00
Event 15 of 22 = 03/22/2026 12:00:00
Event 16 of 22 = 04/12/2026 12:00:00
Event 17 of 22 = 05/03/2026 12:00:00
Event 18 of 22 = 05/17/2026 12:00:00
Event 19 of 22 = 05/31/2026 12:00:00
Event 20 of 22 = 06/14/2026 12:00:00
Event 21 of 22 = 06/28/2026 12:00:00
Event 22 of 22 = 07/12/2026 12:00:00

Individual capture files available in JC278 cruise data and S&M Teams drive.

Bathysnap (short term): As deployed (JC278-025)

Table 6.15: Instrumentation deployed on Bathysnap (short term) as below;

Instrument	Serial Number
Light Beacon	H01-009
Iridium Beacon	H04-024
Nortek cm	12037
SBE 37 SMP	9386
Ixsea Release	1919

Table 6.16: The SBE37 MicroCat was deployed with the following settings;

SBE37 SN:9386
S>DS SBE37SM-RS232 v4.1 SERIAL NO. 9386 07 Jun 2025 13:39:34 vMain = 13.50, vLith = 3.05 samplenumber = 0, free = 559240 not logging, waiting to start at 07 Jun 2025 14:00:00 sample interval = 300 seconds data format = converted engineering alternate transmit real-time = no sync mode = no pump installed = yes, minimum conductivity frequency = 3330.6 S>

Table 6.17: The Nortek Current Meter was deployed with the following settings;

```

Deployment: bsnap1
Current time: 07/06/2025 13:43:19
Start at: 07/06/2025 14:00:00
Comment:
-----
Measurement interval (s): 600
Average interval (s): 30
Blanking distance (m): 0.50
Measurement load (%): 9
Power level: HIGH
Diagnostics interval(min): 720:00
Diagnostics samples: 20
Compass upd. Rate (s): 10
Coordinate System: ENU
Speed of sound (m/s): MEASURED
Salinity (ppt): 35
Analog input 1: NONE
Analog input 2: NONE
Analog input power out: DISABLED
Raw magnetometer out: OFF
File wrapping: OFF
TellTale: OFF
AcousticModem: OFF
Serial output: OFF
Baud rate: 9600
-----
Assumed duration (days): 40.0
Battery utilization (%): 10.0
Battery level (V): 13.7
Recorder size (MB): 9
Recorder free space (MB): 8.973
Memory required (MB): 0.3
Vertical vel. prec (cm/s): 1.4
Horizon. vel. prec (cm/s): 0.9
-----
Instrument ID: AQD12037
Head ID: A6L 6947
Firmware version: 3.37
-----
Aquadopp Deep Water Version 2.00.02
Copyright (C) Nortek AS
=====

```

Bathysnap (Long Term): As deployed (JC278-048)

Table 6.18: Instrumentation deployed on Bathysnap Long Term;

Instrument	Serial Number
Light Beacon	J12-028
Iridium Beacon	M10-041
Nortek cm	12037
Ixsea Release	1919

Table 6.19: Bathysnap (long term) Nortek CM setup configuration;

NORTEK SN: 12037
=====
Deployment: 12037
Current time: 16/06/2025 16:23:00
Start at: 16/06/2025 17:00:00
Comment: 12037 JC278 2025 long term

Measurement interval (s): 1800
Average interval (s): 30
Blanking distance (m): 0.50
Measurement load (%): 9
Power level: HIGH
Diagnostics interval(min): 720:00
Diagnostics samples: 20
Compass upd. rate (s): 10
Coordinate System: ENU
Speed of sound (m/s): MEASURED
Salinity (ppt): 35
Analog input 1: NONE
Analog input 2: NONE
Analog input power out: DISABLED
Raw magnetometer out: OFF
File wrapping: OFF
TellTale: OFF
AcousticModem: OFF
Serial output: OFF
Baud rate: 9600

Assumed duration (days): 400.0
Battery utilization (%): 50.0
Battery level (V): 13.5
Recorder size (MB): 9
Recorder free space (MB): 8.973
Memory required (MB): 1.4
Vertical vel. prec (cm/s): 1.4
Horizon. vel. prec (cm/s): 0.9

Instrument ID: AQD12037
Head ID: A6L 6947
Firmware version: 3.37

Aquadopp Deep Water Version 2.00.02
Copyright (C) Nortek AS

PAP 1: As deployed (JC278-028)

PAP 1 required no Instrumentation Tech support other than the service and battery replacement for the SBE37's fitted to the Buoy at NOC prior to JC278.

Benthic Lander (JC278-035 & JC278-046)

There was a Benthic Lander onboard for JC278 for opportunistic testing, two deployments and recoveries were completed.

Table 6.20: Instrumentation used on the benthic lander

Instrument	Serial Number
Light Beacon	H01-009
Iridium Beacon	H04-024
SBE 37	12463
Ixsea Release	2300

Table 6.21: SBE37 deployment configuration

```
SBE37 SN: 12463
S>DS
SBE37SM-RS232 v4.1 SERIAL NO. 12463 12 Jun 2025
17:10:46
vMain = 13.34, vLith = 3.08
samplenum = 0, free = 559240
not logging, waiting to start at 12 Jun 2025 17:30:00
sample interval = 300 seconds
data format = converted engineering alternate
transmit real-time = no
sync mode = no
pump installed = yes, minimum conductivity frequency =
3009.4
S>
```

Hybis

The SBE37 deployed on the benthic lander was also used on Hybis for two deployments. Deployment settings were the same as the Benthic Lander.

PAP 3: As recovered (JC263-016)

SBE 37 ODO IMP SN:24771 had recorded 17308 samples and had stopped logging due to a low battery with a time difference -25s from GMT. The deployment settings were checked using the SBE battery calculator. This deployment configuration gave an operational duration of 277 days. Going forward it is recommended that the sample interval is increased to 3600s for the ODOs, this would give enough redundancy to allow for the deployment duration and a pre and post deployment calibration dip.

SBE 37 SMP SN:9385 had recorded a full data set with 18584 samples with a difference to GMT of +4 minutes 16 seconds.

Nortek CM SN:8351 had a full data set of 1.4mb time difference to GMT of +1 minute.

Nortek CM SN:6178 1.4mb and time difference to GMT of +55 seconds.

Sediment traps:

SN:15681-03 stopped on bottle 19 due to low battery alert, time difference of -7 seconds GMT

SN:15681-01 stopped on bottle 20, recovered before the completion of scheduled rotations with a time difference of +4 seconds GMT.

SN:15681-02 stopped on bottle 20, recovered before the completion of scheduled rotations with a time difference of -8 seconds GMT.

Whittard Canyon Mooring: As recovered (JC263-007)

RDI ADCP 75kHz Sn:5575 upon recovery and data download attempted the memory card wasn't showing as present. After disassembling to investigate the issue the card was loose in the holder and not fully home with the card release button extended fully. The ADCP had only sampled while on deck as the card had dislodged possibly on deck while moving into position or whilst being deployed.

RDI ADCP 600kHz SN:23184 stopped at 09:46 GMT, had a full data set and had recorded 267,897KB of data.

SBE 37 SN:9368 had recorded a full data set of 18067 samples, the deployment and recovery are present in the pressure record. This unit was +17 seconds in relation to GMT. Sampling was stopped at 19:04 03/06/25.

SBE 37 SN:12463 had recorded a full data set of 18066 samples, this unit was +2 seconds in relation to GMT. Sampling was stopped at 18:56 GMT on the 03/06/25.

Bathysnap Long Term (2024): As recovered (JC263-072)

Nortek CM SN:12123 was recovered and sampling stopped at 16:47GMT on 05/06/2025 with a time difference from GMT of +56 Seconds. A full dataset was recovered using 1.3MB of storage.

Software Used

- Sea-Bird SeaTerm v2 (SBE37)
- Sea-Bird SBE Data Processing 7.26.6.28 (SBE 37)
- TRDI WINSC, PLAN ADCP (RDI ADCP setup/recovery)
- Nortek Signature deployment (SIG 55 set up)
- Nortek Aquadopp deep water v2.00.02 (NORTEK CM setup/recovery)
- Crosscut v 1.1.0 (McLane Sediment Trap setup)
- Mc lane pro 1.15 (McLane Sediment Trap data recovery)
- Autosbe (SBE37 setup)

CTD Summary

JC278 CTD work supports science at the Porcupine Abyssal Plain Sustained Observatory, this includes calibration for mooring sensors, releases, OTE sensors and scientific sampling.

19 CTD casts were undertaken with an NMF 24-way Stainless Steel CTD frame with 24 off 20l Niskin water samplers, at the start of the cruise the Niskin bottles were leak tested. Dual SBE 43 dissolved oxygen sensors were used. The primary temperature, conductivity and dissolved oxygen sensors were fitted to the Sea-Bird 9Plus with the secondary sensors mounted on the vane. The shallowest cast was CTD001 at 125m, the deepest was CTD 013 at 4840m.

The CTD was deployed on CTD wire storage drum 2. The CTD was operated out of the water bottle annex by the ship's crew using the winch belly box, once over the side the CTD was lowered to a depth of 10m allowing time for the SBE 5T pumps to prime. The winch system Active Heave Compensation was used throughout JC278 when below 100 metres with no issues. Between casts the whole CTD package was rinsed with fresh water with particular attention paid to the SBE 32 latch assembly. After each cast the primary and secondary sensors were flushed three times with Milli-Q. Periodically the optical sensors were cleaned with Milli-Q and Optic Prep wipes.

There were no major technical issues with the Stainless Steel CTD suite during JC278. During the first 2 casts I noticed the Oxygen differences were ranging from 8 – 12 % saturation (Sea-Bird recommends below 4%). Once I had received oxygen sampling data from the scientists, I could pinpoint the issue to the primary sensor. I changed the sensor and from then onwards saturation was below 1%. The following sensors were used:

- Cast 001 – 002 – Primary Oxygen 43-0363 & Secondary Oxygen 43-0862
- Cast 003 – 018 - Primary Oxygen 43-0862 & Secondary Oxygen 43-0709

During cast 007 the PC crashed (during the downcast) and PC was restarted. There are 2 files named CTD_007 & CTD_007_2, 007 for the downcast and 007_2 for the upcast.

CTD Stations

Table 6.22 CTD station summary. An asterisk (*) next to the station number indicates that the cast was used for sensor calibration as below. (Also see Table 9.1 for scientific sampling details)

CTD no.	Start Date	Start Time	End time	Latitude	Longitude	Water depth (corr. m)	Profile depth (m)	Number of bottle stops	Active Heave Compensation
1	31/05/2025	09:15	09:40	49 5.466'N	7 10.442'W	125	117	23	No
2*	31/05/2025	20:06	20:47	48 24.240' N	9 41.700'W	337	327	18	Yes
3	01/06/2025	06:01	07:27	48 26.309'N	9 44.662'W	1301	1295	18	Yes
4*	02/06/2025	06:00	08:30	48 30.660' N	9 55.880'W	2141	2130	18	Yes
5*	05/06/2025	04:35	08:26	48 59.993' N	16 30.006' W	4834	4822	18	Yes
6*	05/06/2025	10:10	14:11	49 0.329' N	16 28.469' W	4815	1000	14	Yes
7*	07/06/2025	04:55	05:52	49 0.000'N	16 30.002' W	4829	4820	24	Yes
8	11/06/2025	04:13	05:11	48 55.901' N	16 22.901' W	4814	1000	24	Yes
9	12/06/2025	05:01	06:12	48 58.200' N	16 22.871' W	4881	1000	24	Yes
10	13/06/2025	04:08	05:16	48 50.494' N	16 31.124' W	4849	1000	24	Yes
11	13/06/2025	12:17	13:25	49 2.178' N	16 19.062' W	4814	1000	24	Yes
12	14/06/2025	04:56	06:05	48 57.727' N	16 23.011' W	3815	1000	24	Yes
13	13/06/2025	04:11	08:09	49 0.000' N	16 29.999' W	4849	4840	24	Yes
14*	13/06/2025	13:03	13:24	48 58.213' N	16 22.679' W	4813	200	24	Yes
15	17/06/2025	04:06	07:45	49 0.005' N	16 29.999' W	4835	4830	24	Yes
16*	17/06/2025	12:38	16:31	48 58.384' N	16 22.607' W	4813	1000	18	Yes
17*	18/06/2025	04:13	07:54	49 0.688' N	16 27.106' W	4836	4830	23	Yes
18*	13/06/2025	13:45	14:16	48 58.450' N	16 22.621' W	4815	200	24	Yes
19	20/06/2025	18:06	19:42	48 34.416' N	16 56.683' W	4636	2000	23	Yes

2 – Releases, Microcats and USBL on frame.

4 – Microcats on frame.

5 – Microcats and releases on frame.

6 – 2 x OTE gliders on frame.

7 – Releases on frame

14 – GEORGE sampler on frame.

16 – 2 x OTE gliders on frame.

17 – 2x Microcats on frame.

18 – GEORGE sampler on frame.

CTD Configuration

Table 6.23: Stainless Steel CTD Instrument Package *Cast 001 - 002

SENSOR INFORMATION SHEET

SHIP: RRS JAMES COOK	CRUISE: JC278
FORWARDING INSTRUCTIONS / ADDITIONAL INFORMATION:	
<p>Setup of Stainless Steel 24-way CTD frame</p> <p>■ - Oxygen sensors used for cast 001 & 002</p>	
Checked By: D. Childs	DATE: 06/05/2025

Instrument / Sensor	Manufacturer/ Model	Serial Number	Channel	Casts Used
Stainless steel 24-way CTD frame	NOCS	SBE CTD10	n/a	
Primary CTD deck unit	SBE 11plus	11P-24680-0589	n/a	
CTD Underwater Unit	SBE 9plus	09P-77801-1182	n/a	
24-way Carousel	SBE 32	32-31240-0423	n/a	
Primary Temperature Sensor	SBE 3P	03P-4116	F0	
Primary Conductivity Sensor	SBE 4C	04C-3874	F1	
Diquartz Pressure sensor	Paroscientific	129735	F2	
Secondary Temperature Sensor	SBE 3P	03P-4383	F3	
Secondary Conductivity Sensor	SBE 4C	04C-4140	F4	
Primary Pump	SBE 5T	05T-3609	n/a	
Secondary Pump	SBE 5T	05T-4513	n/a	
Primary Dissolved Oxygen Sensor	SBE 43	43-0363	V0	
Secondary Dissolved Oxygen Sensor	SBE 43	43-0862	V1	
Altimeter	Valport VA500	81632	V2	
Light Scattering Sensor	WET Labs ECO BBrd	BBRTD-6043	V3	
Transmissometer	WET Labs C-Star DR	CST-1602DR	V4	
Fluorometer	CTG AquaTracka Mk3	88-2615-126	V5	
PAR Down-looking UWIRR	Satlantic Cosine PAR-LOG	PARLOGICSW-2367	V6	
PAR Up-looking DWIRR	Satlantic Cosine PAR-LOG	PARLOGICSW-2366	V7	
20L Water Samplers	Ocean Test Equipment	1 through 24	n/a	
Titanium EM CTD Swivel	MDS ST6003-2E2-Ti	1267-1	n/a	

Table 6.24: Stainless Steel CTD Instrument Package *Cast 003 - 019

FORWARDING INSTRUCTIONS / ADDITIONAL INFORMATION:

Setup of Stainless Steel 24-way CTD frame

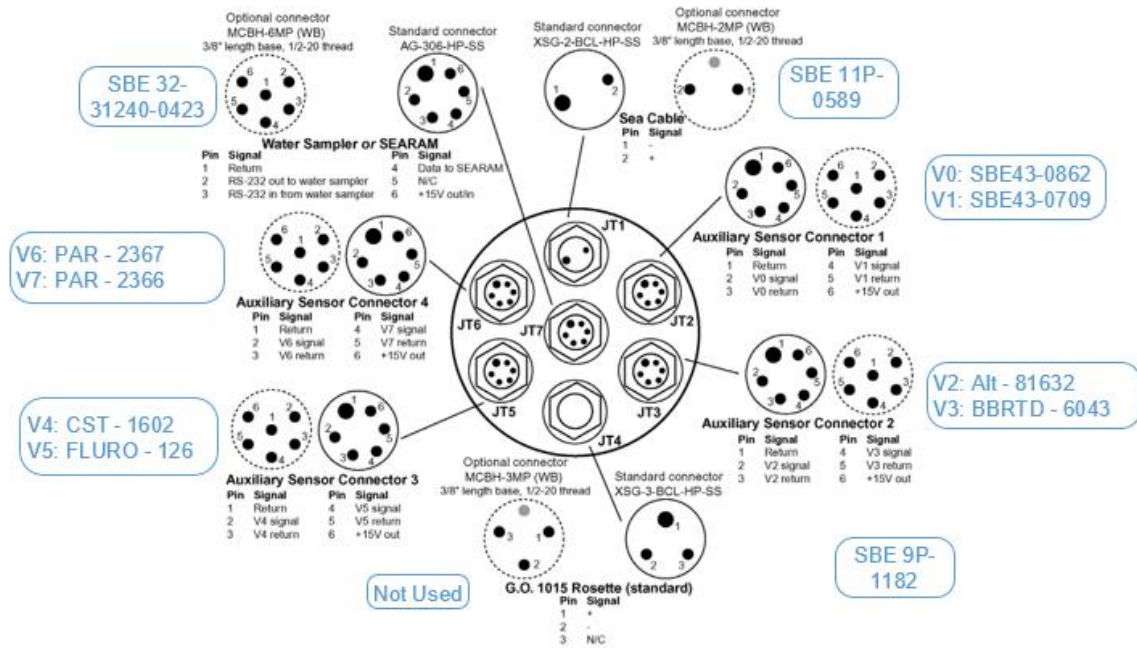
- Oxygen sensors swapped from cast 003

Checked By: J Garner

DATE: 30/05/2025

Instrument / Sensor	Manufacturer/ Model	Serial Number	Channel	Casts Used
Stainless steel 24-way CTD frame	NOCS	SBE CTD10	n/a	
Primary CTD deck unit	SBE 11plus	11P-24680-0589	n/a	
CTD Underwater Unit	SBE 9plus	09P-77801-1182	n/a	
24-way Carousel	SBE 32	32-31240-0423	n/a	
Primary Temperature Sensor	SBE 3P	03P-5495	F0	
Primary Conductivity Sensor	SBE 4C	04C-3874	F1	
Digiquartz Pressure sensor	Paroscientific	129735	F2	
Secondary Temperature Sensor	SBE 3P	03P-4383	F3	
Secondary Conductivity Sensor	SBE 4C	04C-4140	F4	
Primary Pump	SBE 5T	05T-3609	n/a	
Secondary Pump	SBE 5T	05T-4513	n/a	
Primary Dissolved Oxygen Sensor	SBE 43	43-0862	V0	Oxygens changed
Secondary Dissolved Oxygen Sensor	SBE 43	43-0709	V1	Oxygens changed
Altimeter	Valeport VA500	81632	V2	
Light Scattering Sensor	WET Labs ECO BBrted	BBRTD-6043	V3	
Transmissometer	WET Labs C-Star DR	CST-1602DR	V4	
Fluorometer	CTG AquaTracka Mk3	88-2615-126	V5	
PAR Down-looking UWIRR	Satlantic Cosine PAR-LOG	PARLOGICSW-2367	V6	
PAR Up-looking DWIRR	Satlantic Cosine PAR-LOG	PARLOGICSW-2366	V7	
20L Water Samplers	Ocean Test Equipment	1 through 24	n/a	
Titanium EM CTD Swivel	MDS ST6003-2E2-Ti	1267-1	n/a	

SBE 9plus CTD Top End Cap Configuration



SBE 9plus CTD Bottom End Cap Configuration

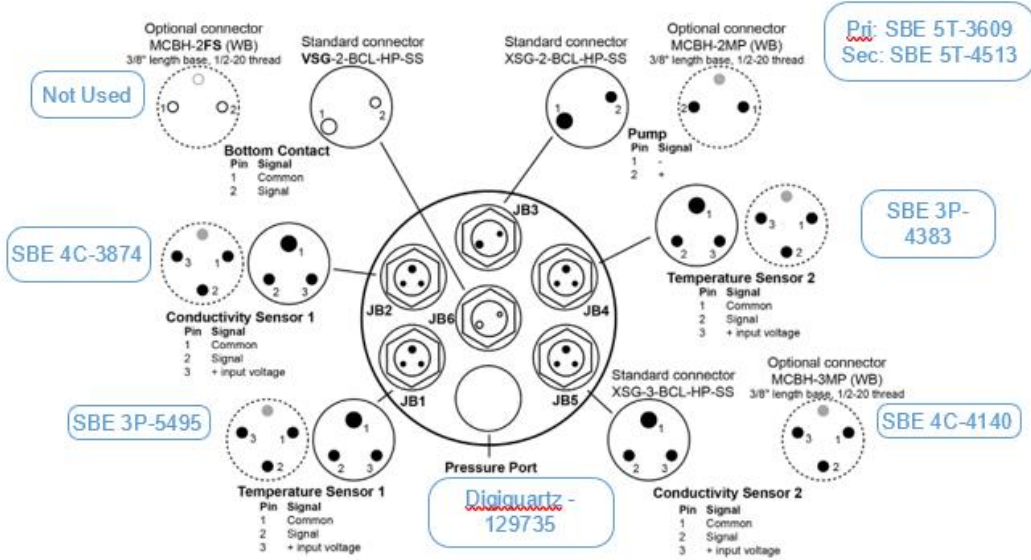


Figure 6.11: CTD end cap configurations

Seasave Configurations & Instrument Calibrations

PSA file: C:\Users\sandm\Documents\Cruises\JC278\Data\Seasave Setup Files\JC278_1182_SS_NMEA.psa
 Date: 06/19/2025
 Instrument configuration file: C:\Users\sandm\Documents\Cruises\JC278\Data\Seasave Setup Files\JC278_1182_SS_NMEA_B.xmlcon

Table 6.25: Configuration report for SBE 911plus/917plus CTD

<p>Frequency channels suppressed : 0 Voltage words suppressed : 0 Computer interface : RS-232C Deck unit : SBE11plus Firmware Version >= 5.0 Scans to average : 1 NMEA position data added : Yes NMEA depth data added : No NMEA time added : Yes NMEA device connected to : PC Surface PAR voltage added : No Scan time added : Yes</p> <p>1) Frequency 0, Temperature Serial number : 03P-5495 Calibrated on : 22-Nov-24 G : 4.34851194e-003 H : 6.29199221e-004 I : 2.03707999e-005 J : 1.68498770e-006 F0 : 1000.000 Slope : 1.00000000 Offset : 0.0000</p> <p>2) Frequency 1, Conductivity Serial number : 04C-3874 Calibrated on : 19-Sep-24 G : -1.01643861e+001 H : 1.39798634e+000 I : -5.63969591e-004 J : 1.08095736e-004 CTcor : 3.2500e-006 CPcor : -9.57000000e-008 Slope : 1.00000000 Offset : 0.00000</p>	<p>3) Frequency 2, Pressure, Digiquartz with TC Serial number : 129735 Calibrated on : 17-Sep-24 C1 : -6.064446e+004 C2 : 6.966022e-002 C3 : 1.971200e-002 D1 : 2.882500e-002 D2 : 0.000000e+000 T1 : 3.029594e+001 T2 : -6.713680e-005 T3 : 4.165390e-006 T4 : 0.000000e+000 T5 : 0.000000e+000 Slope : 0.99980000 Offset : -3.77620 AD590M : 1.279180e-002 AD590B : -8.821250e+000</p> <p>4) Frequency 3, Temperature, 2 Serial number : 03P-4383 Calibrated on : 17-Sep-24 G : 4.39850561e-003 H : 6.55038429e-004 I : 2.39547131e-005 J : 1.94539917e-006 F0 : 1000.000 Slope : 1.00000000 Offset : 0.0000</p> <p>5) Frequency 4, Conductivity, 2 Serial number : 04C-4140 Calibrated on : 25-Jul-24 G : -9.84206890e+000 H : 1.48567874e+000 I : -2.48532864e-003 J : 2.77477026e-004 CTcor : 3.2500e-006 CPcor : -9.57000000e-008 Slope : 1.00000000 Offset : 0.00000</p>
--	---

6) A/D voltage 0, Oxygen, SBE 43

Serial number : 43-0862
Calibrated on : 08-Aug-24
Equation : Sea-Bird
Soc : 5.28100e-001
Offset : -5.02500e-001
A : -3.15720e-003
B : 8.17870e-005
C : -1.64320e-006
E : 3.60000e-002
Tau20 : 9.60000e-001
D1 : 1.92634e-004
D2 : -4.64803e-002
H1 : -3.30000e-002
H2 : 5.00000e+003
H3 : 1.45000e+003

7) A/D voltage 1, Oxygen, SBE 43, 2

Serial number : 43-0709
Calibrated on : 07-Sep-24
Equation : Sea-Bird
Soc : 4.52100e-001
Offset : -5.24500e-001
A : -3.10950e-003
B : 1.22650e-004
C : -1.77960e-006
E : 3.60000e-002
Tau20 : 1.31000e+000
D1 : 1.92634e-004
D2 : -4.64803e-002
H1 : -3.30000e-002
H2 : 5.00000e+003
H3 : 1.45000e+003

8) A/D voltage 2, Altimeter

Serial number : 81632
Calibrated on : 09-Jun-22
Scale factor : 15.000
Offset : -0.013

9) A/D voltage 3, OBS, WET Labs, ECO-BB

Serial number : BBRTD-6043
Calibrated on : 05-Jan-23
ScaleFactor : 0.003084
Dark output : 0.069200

10) A/D voltage 4, Transmissometer, WET Labs C-Star

Serial number : CST-1602DR
Calibrated on : 08 April 25
M : 21.2652
B : -0.1297
Path length : 0.250

11) A/D voltage 5, Fluorometer, Chelsea Aqua 3

Serial number : 88-2615-126
Calibrated on : 10-Jul-23
VB : 0.166500
V1 : 2.148400
Vacetone : 0.257850
Scale factor : 1.000000
Slope : 1.000000
Offset : 0.000000

12) A/D voltage 6, PAR/Irradiance, Biospherical/Licor

Serial number : PARLOGICSW-2367
Calibrated on : 16-Apr-24
M : 0.80989300
B : 1.03035300
Calibration constant : 735890000.00000000
Conversion units : umol photons/m²/sec
Multiplier : 1.00000000
Offset : 0.00000000

13) A/D voltage 7, PAR/Irradiance, Biospherical/Licor, 2

Serial number : PARLOGICSW-2366
Calibrated on : 16-Apr-24
M : 0.80709400
B : 1.05595400
Calibration constant : 735890000.00000000
Conversion units : umol photons/m²/sec
Multiplier : 1.00000000
Offset : 0.00000000

Scan length : 45

Pump Control

This setting is only applicable to a custom build of the SBE 9plus.

Enable pump on / pump off commands: NO

Data Acquisition:

Archive data: YES

Delay archiving: NO

Data archive:

C:\Users\sandm\Documents\Cruises\JC278\Data\CTD Raw Data\JC278_CTD_018.hex

Timeout (seconds) at startup: 60

Timeout (seconds) between scans: 20

Instrument port configuration:

Port = COM5

Baud rate = 19200

Parity = N

Data bits = 8

Stop bits = 1

Water Sampler Data:

Water Sampler Type: SBE Carousel

Number of bottles: 36

Port: COM6

Enable remote firing: NO

Firing sequence: User input

Tone for bottle fire confirmation uses PC sound card.

Header information:

Header Choice = Prompt for Header Information

prompt 0 = Ship: RRS James Cook

prompt 1 = Cruise: JC278

prompt 2 = Cast:

prompt 3 = Station:

prompt 4 = Event:

prompt 5 = Date:

prompt 6 = Time (UTC):

prompt 7 = Latitude:

prompt 8 = Longitude:

prompt 9 = Depth (uncorrected m):

prompt 10 = Principal Scientist: Andrew Gates

prompt 11 = Operator: JG

TCP/IP - port numbers:

Data acquisition:

Data port: 49163

Status port: 49165

Command port: 49164

Remote bottle firing:

Command port: 49167

Status port: 49168

Remote data publishing:

Converted data port: 49161

Raw data port: 49160

Miscellaneous data for calculations

Depth, Average Sound Velocity, and TEOS-10

Latitude when NMEA is not available: -16.00000000

Longitude when NMEA is not available: 0.00000000

Average Sound Velocity

Minimum pressure [db]: 20.00000000

Minimum salinity [psu]: 20.00000000

Pressure window size [db]: 20.00000000

Time window size [s]: 60.00000000

Descent and Acceleration

Window size [s]: 2.00000000

Plume Anomaly

Theta-B: 0.00000000

Salinity-B: 0.00000000

Theta-Z / Salinity-Z: 0.00000000

Reference pressure [db]: 0.00000000

Oxygen

Window size [s]: 2.00000000

Apply hysteresis correction: 0

Apply Tau correction: 1

Potential Temperature Anomaly

A0: 0.00000000

A1: 0.00000000

A1 Multiplier: Salinity

Serial Data Output:

Output data to serial port: NO

Mark Variables:

No variables are selected.

Shared File Output:

Output data to shared file: NO

TCP/IP Output:

Raw data:

Output raw data to socket: NO

XML wrapper and settings: NO

Seconds between raw data updates:

0.00000000

Converted data:

Output converted data to socket: NO

XML format: NO

SBE 11plus Deck Unit Alarms

Enable minimum pressure alarm: NO

Enable maximum pressure alarm: NO

Enable altimeter alarm: NO

SBE 14 Remote Display

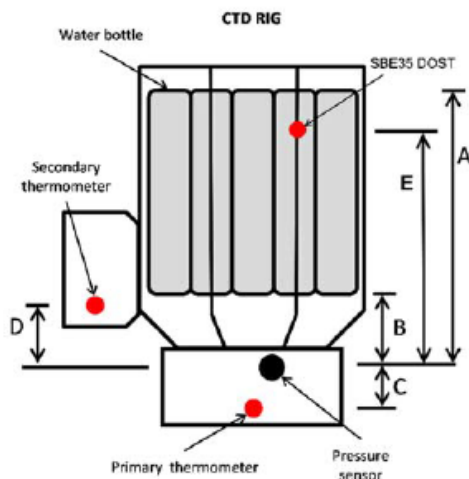
Enable SBE 14 Remote Display: NO

PC Alarms

Enable minimum pressure alarm: NO

	<p>Enable maximum pressure alarm: NO Enable altimeter alarm: NO Enable bottom contact alarm: NO Alarm uses PC sound card.</p> <p>Options: Prompt to save program setup changes: YES Automatically save program setup changes on exit: NO Confirm instrument configuration change: YES Confirm display setup changes: YES Confirm output file overwrite: YES Check scan length: YES Compare serial numbers: YES Maximized plot may cover Seasave: NO</p>
--	--

Stainless Steel CTD Frame Geometry



ID	Vertical distance from pressure sensor (m positive-up)
A	1.2 (Top of water samplers)
B	0.34 (Bottom of water samplers)
C	-0.075 (Primary T mounted on 9p)
D	0.085 (Secondary T mounted on Vane)
E	1.025 (SBE35 DOST probe sheath tip)

(No SBE 35 on frame)

Figure 6.12: Stainless steel CTD frame geometry

Technical Report

CTD

All stainless-steel casts were carried out using wire CTD2, which was terminated using the potting method during JC274. The CTD wire was electrically tested prior to sailing breakdown resistance >1000 M Ω , Resistance 73.3 Ω . Termination in good condition, the mechanical termination was load tested during JC276. The mechanical termination did not slip under load. The mechanical termination was checked periodically throughout the cruise with no slipping noticed. Few issues occurred during the cruise:

- Oxygen sensors as mentioned above.
- PC crashed during cast 007 and 1 modulo error showed when cast was re-started. Cable connections were cleaned before cast 008 and no more modulo errors occurred. PC crashed again further into the cruise (not whilst CTD'ing).
- From cast 10 onwards bottles 5 and 7 intermittently leaked, Oring's were changed and seemed better for a few cast's but started leaking again.

Gliders were added to the frame for 2 CTD's (see station list) for calibration, these were attached using OTE brackets and ratchet straps. GEORGE sensor from OTE was also on the frame for 2 CTD's for calibration, this was connected through the carousel port on the 9plus (JT7). OTE provided their own cable.

AUTOSAL

A Guildline 8400B, s/n 72227 was installed in the electronics workshop as the main Autosal for salinity analysis. The bath temperature was set to 21°C with the lab ambient temperature ranging

between 18oC – 18.5°C. The salinometer was standardised during the mobilisation, then again prior to the start of analysis. 72227 was used for 5 crates with no issues. The Autosol was standardised using IAPSO Seawater batch P168 (K15 = 0.99993, 2 x K15 = 1.99986). Salinity data was added to the SALform for OTE (N:\JC278\Autosol Data).

Sea-Bird Data Processing

Table 6.25 below lists the Sea-Bird processing routines run by Sensors and Moorings Technicians. Note this is only the modules that were run by NMF, not by scientific staff.

Table 6.25: Seabird processing routines

Module	Run?	Comments
Configure	N	
Data Conversion	Y	As per BODC guidelines Version1.0 October 2010 (Oxygen Concentration umol/l and umol/kg, Latitude and Longitude (degrees), Scan Count, Time and Pressure Temperature)
Bottle Summary	Y	As per BODC guidelines Version1.0 October 2010, with above variables added (except not averaging Scan Count and Time)
Mark Scan	N	
Align CTD	Y	As per BODC guidelines Version1.0 October 2010 (dissolved oxygen advanced 6 seconds) (appended file name)
Buoyancy	N	
Cell Thermal Mass	Y	As per BODC guidelines Version1.0 October 2010 (appended file name)
Derive	Y	As per BODC guidelines Version1.0 October 2010 (appended file name)
Bin Average	Y	As per BODC guidelines Version1.0 October 2010 (2Hz bins) (appended file name)
Filter	N	As per BODC guidelines Version1.0 October 2010 (appended file name)
Loop Edit	N	As per BODC guidelines Version1.0 October 2010 (appended file name)
Wild Edit	N	Not applicable.
Window Filter	N	
ASCII In	N	
ASCII Out	N	
Section	N	
Split	N	
Strip	Y	As per BODC guidelines Version1.0 October 2010 (appended file name)
Translate	N	
Sea Plot	N	
SeaCalc II	N	

Software Used

- SeaBird SeaSave 7.26.7.121
- SeaBird SBE Data Processing 7.26.6.28

6.4 Hybis report

Emre Mutlu, Martin Yeomans, Alex Downer (Trainee)

Cruise Outline

The Porcupine Abyssal Plain Sustained Observatory (PAP–SO), located at 4,850 m depth in the Northeast Atlantic, is one of a small number of oceanic sites that has achieved monitoring to full ocean depths over several decades. It has monitored seafloor ecology since 1985, water column particle flux since 1992, and surface ocean and atmosphere parameters since 2003. The observatory is serviced annually, providing the opportunity to carry out conventional ship-based observations, sensor data collection, and sampling.

PAP-SO has sought to understand long-term change in the ocean—from surface to seafloor. The initial aim was to study seasonality in the supply of food particles that settle from the surface ocean to the deep-sea floor and their role in structuring the ecosystem. Today, observatory research is increasingly focused on the causes and consequences of multidecadal change and on monitoring essential ocean variables such as ocean temperature and salinity; carbon dioxide, oxygen, and nutrient content; particulate matter; and phytoplankton, zooplankton, and seafloor invertebrate abundance and diversity. HyBIS was used during JC278 for HD video and stills survey at the Porcupine Abyssal Plain (PAP) site.

Table 6.26: Hybis dive statistics

No. of dives JC278 (Dive nos. HY100 to HY106)	7
Water Depths	330 - 4847 m
Total time at seabed or survey depth:	27:08 hrs
HyBIS total time in water:	149:44 hrs
Total Video (Apple ProRes 422)	HD 2.27 TB Tooling 2.3 TB
Scorpio Images	9791 images – 34.83 GB
Bathysnap Images	99 images – 3.96 GB

MASTER #1 SanDisk RAID unit SER# SPUAA42100409 will be installed in the NOC Media Room for BODC to archive and provide access for scientists post cruise.

BACKUP #1 SanDisk RAID unit SER# SPUAA44430022 will be handed over to the scientists.

Mobilisation

NOC Southampton: 27th May to 29th May 2025

The mobilisation of Hybis in preparation for JC278 was conducted by the HyBIS team on-board as well as the rest of the ROV team.

On Tuesday 27th The HyBIS monitors and control rack were assembled on the second bay of the main lab, with the winch operator's CCTV monitor mounted at the end of the bench. The HyBIS HV power supply unit was mounted on top of the portable table, inside of the High Voltage Cage, using a trolley move the PSU. The HYBIS team were given responsibility of the HV cage keys.



Figure 6.13: left - Hybis Lab Setup-Pilot area, right; Hybis - Lab setup-Data Transfer Area



Figure 6.14 - HV Cage

On Wednesday the 28th, the Evergrip termination was installed and cable insulation and fibre tests conducted.

The lab setup and network connections were completed. The RAID drives and the QNAP along with the Mac mini was installed and connected. The remote camera stream setup was completed and the stream to the Main Lab TV was successfully tested.

The termination was load tested to four Tonnes, in one Tonne increments holding for 5min at each increment. The top of the Evergrip wraps were marked with tape and movement of approximately 6mm was seen as the load was applied, which is normal as the Evergrip beds in.

After fitting the Evergrip and load testing, the umbilical was tested electrically and fibre optically. The results of the testing are shown below:

Optical readings were taken from the Main Lab Junction box to the terminated end of the Deep Tow.

	1310 nm	1550 nm
Red	-7.5 dB	-6.7dB
Black	-9.2dB	-11.1dB
Grey	-11.2dB	-10.4dB

OTDR readings:

	1310 nm	1550 nm
Red	7.3 km	7.3 km
Black	7.3 km	7.3 km
Grey	7.3 km	7.3 km

The deep tow umbilical was connected to HyBIS using the red fibre for telemetry and the black fibre for the Scorpio camera. The grey fibre was left unconnected as the spare.

The electrical conductor readings were taken from the outboard end of the Deep Tow, in the deck workshop. During testing it was noticed that the JC Megger has a broken black lead.

Table 6.27 – RRS *James Cook* deep tow cable during JC278 Mobilisation

Continuity of Conductors & Earth	Test Results Ω
L1 – L2	70
L1 – L3	69.3
L2 – L3	69
Insulation Resistance Test	Test Results (M Ω)
L1 – L2	846
L1 – L3	726
L2 – L3	791
L1 – Earth	782
L2 – Earth	699
L3 – Earth	314

Following the connection of the deep tow, HYBIS was powered via the high-voltage (HV) supply. A comprehensive systems check was performed, verifying the functionality of all instruments and operational components. During this check, the tooling camera exhibited intermittent flickering (Camera S/N: AUR804), while the rest of the system operated as expected.

The tooling camera was replaced with a spare unit (Camera S/N: AUR805), which functioned as expected for approximately five minutes until the flickering issue reoccurred. The camera was switched over to the second line on the pie connector, but the issue persisted. A continuity check was conducted on the camera tail, which showed it was ok.

Upon reapplying HV power, the same fault reappeared after five minutes. In addition, all telemetry feed ceased, and the vehicle became unresponsive to commands, although live video from the Scorpio camera was still being received.

Inspection of the topside focal board revealed that it was transmitting a signal but had failed to establish a return link, indicating it was not receiving any signal from the vehicle bottom side.

The low-power tube was removed, and the focal board inside was powered on a test bench using the deck supply. The board was powered in situ and left for 30 minutes, during which it experienced a single, brief power loss. Testing of the 240V–5VAC/DC power supply confirmed a stable 5V output to the focal board which ruled out the PSU.

A decision was made to replace the bottom-side focal board with a spare unit. This board was powered and tested on the bench for 30 minutes without incident before being reinstalled into the low-pressure tube and re-integrated into the vehicle.

The vehicle was powered up, with no recurrence of the fault. A complete system check was performed, confirming that all functions were operating correctly. The system was left powered for one hour under observation, during which no further issues were noted.

A final full pre-dive check was carried out, again confirming full functionality with no faults present.

Suggestions/Recommendations

- Replace the broken black lead of the JC Megger cable tester. – replacements are incorrect.
- Send focal board back to Moog for repair

De-Mobilisation

The HyBIS system was prepared for demobilisation after a dredged recovery post dive HY106 back to NOC Southampton. The vehicle was stripped of lights and sensors and the cages were packed so that the HyBIS system was ready to be lifted off the ship on arrival.

Deep Tow Cable

Umbilical Termination

During JC278, HyBIS was the only piece of equipment attached to the deep tow cable. HyBIS and coring operations were planned in blocks, to minimise the required swapping of cables over the P frame, reducing the risk of damage to the fibre optic connectors. The termination was only disconnected from the vehicle once during the trip.

Due to the parting of the deep tow cable, there is an insufficient length of less than 1500m available to conduct any future science operations. The remaining cable on the winch is to be removed in port

and an existing unused deep tow cable (Rochester A302351) at $\approx 10\text{km}$ in length, is to be installed as a replacement.

Suggestions/Recommendations

- Replace Deep Tow with existing cable at NOC

Active Heave Compensation

The AHC was used for every HyBIS dive and gave good image stability and video quality. The AHC compensated well for the heave of the ship and HyBIS maintained a constant altitude off the sea bed ($\sim 2\text{m}$, $\pm \sim 0.5\text{m}$) providing stable video footage and reducing the constant winch adjustments that are normally required.

HyBIS was deployed and stopped at 100m depth. The HV was then turned on and the winch control was transferred to the deck console. The descent after sufficient load on the wire was 45m/min (0.75m/s) until 100m above the seabed (typically 4750m). At this point, the control of the Deep Tow was moved from the desk console to the belly-box. The rest of the descent was done at a speed of 20m/min while checking the HyBIS altimeter. The AHC was turned on after 100m of depth, on recoveries, Hybis was recovered at 45m/min until 100m depth, and then AHC disabled. This was done on strong recommendation via ships crew with justification being less loading on the cable on stress points over the rollers. On previous deployments, the AHC is activated at 100m altitude from the seabed before bottom approach and de-activated 100m above for recovery.

High Voltage Operations

As with previous cruises, the HV operations were discussed and agreed with the Chief Engineer and the ETO prior to sailing. The key to the HV cage remained in the possession of the HyBIS HV appointed person for the duration of the trip. The HV was turned on at 100m depth, which allowed just one stop during descent.

During recovery, the power to HyBIS was turned off at 200m depth and the bridge was notified when this was done so that HyBIS could be recovered to deck.

Suggestions/Recommendations

- None

HyBIS System

During JC278, HyBIS was kept outside on the Starboard deck, outside of the deck workshop. It was sat on a pallet and was manoeuvred under the hydra-boom prior to each launch using the yellow crane.

The associated HyBIS spares boxes and consumables were stowed in cages in the main hangar. Deck testing was achieved using the 240V AC deck lead plugged into a socket in the deck workshop.

Vehicle

Hydraulic System

The hydraulic system was not used on this cruise.

Suggestions/Recommendations

- Flush and replace hydraulic oil before next HyBIS cruise.

Thrusters

The thrusters were utilised to maintain a constant heading throughout the dives.

The port thruster was functional but was operating at a lower RPM in comparison to the starboard (STB) thruster which meant maintaining heading was primarily correction on one thruster. This was run for the duration of the cruise with no additional faults.

Suggestions/Recommendations

- Drain all thrusters. Strip and check for signs of wear.
- Investigate cause of motor lower RPM. (Suggestion: check motor controller parameters)

Modules

SAMPLING

Not mobilised for this cruise.

DOWNWARD VIDEO FRAME

The downward video frame was used for all of the dives during JC278.

After the dredged recovery of Hybis post HY106 - the downward video frame had suffered significant damage beyond repair, making it unusable for any future operations.

GRAB MODULE

Not mobilised for this cruise.

CAMERAS

A single Super Scorpio HD camera was available for JC278 from the Isis ROV equipment. Unit Serial# SSC103 was mounted onto HyBIS for all the cruise.

The white balancing was not required as this was done by post processing of the video and images. The stills were done on a 10 second auto-timer.

The download of images was done using the HyBIS laptop and the test lead in the Main Lab in order to keep the camera's battery topped up until the next dive to prevent the loss of configuration settings. The internal battery would not last any longer than 24 hours.

During the first dive (HY100), a small foreign object debris (FOD), resembling a hair was observed on the interior surface of the camera lens. This contamination likely occurred during the most recent servicing of the unit.

In addition, the camera appeared to have a smudge in the centre portion of the lens which obscured the image on both the stills and video footage. This made it a difficult task to identify and measure the subjects in frame. Due to no spare unit, this was run for the remainder of the cruise.

The black shroud of the for the lens could be seen on the imagery once subsea. The shroud has limited adjustability, an attempt was made to seat the shroud further back and rotate 90°. This reduced what could be seen of the shroud but did not totally remove from field of view.

An Aurora PAL (S/N AUR805) camera was mounted on the HyBIS hydraulic tilt mechanism at approximately 25 degrees from horizontal and gave a good forward-facing view during all dives.

Suggestions/Recommendations

- Send Super Scorpio camera back to rectify the lens moisture/oil and to remove the foreign object.
- Inspect shroud.
- Inspect and assess for any damage on cameras from dive HY106.

Super Scorpio Specs:

HD: 1920 x 1080 / (50P), **50i**, 25p

12.3 MEGA-PIXEL quality for Ultra-High Definition (4672 x 2628-pixel) Still Images

Sensor: Exmor Back-illuminated CMOS 1/2.88" (6.2mm)

10X Optical Zoom Lens (26.3mm - 263mm in 35mm format)

Focal Distance= $f = 3.8\text{mm} - 38\text{mm}$

Aperture: F1.8 - F9.6

64GB Internal Flash Memory

On recovery deck download of images (Ethernet deck cable)

BATHYSNAP 4 Camera Integration

Due to the faults with the Scorpio camera providing less than adequate results, a proposal was made to fix the AESA camera system from BATHYSNAP 4 onto HYBIS running alongside the downward SCORPIO camera setup. Both camera systems were operating simultaneously with the AESA camera being used as a standalone unit with its own battery power source.

To achieve the integration, the flash bracket for the BATHYSNAP system were mounted onto the central lower beam of HYBIS facing downward with a 20° forward angle from the vertical axis so the flash illuminates the centre portion of the image.

The camera was mounted onto a C channel bracket with 2x Jubilee clips on the forward upper bar on HYBIS. It was positioned in the same vertical plane as the flash just off centre of the vehicle. See *Image below*

The battery pack was mounted on the side profile of the centre beam, opposite side of the SCORPIO camera with the aim to keep the mass centre of the vehicle. This was secured in place with four Jubilee clips and the bulkhead connectors facing forwards of the vehicle, due to the cameras tail length not being long enough to reach the aft.



Figure 6.14: AESA camera setup-side view

The camera was set up to take still at 4 min interval, with this being the shortest achievable with the camera system. This timing change was conducted by the scientists onboard that had the training to reprogram the BATHYSNAP camera system prior to the cruise.



Figure 6.15: AESA camera setup

During the dredged recovery of Hybis, the AESA camera module (S/N CAMERA #05/IMS:260007930) was lost.

The flash module (IMS:260007931) and battery bottle (IMS:260007840) were recovered and images were downloaded by the scientist.

The camera position gave a good image with no obstruction in frame and the height was optimal with a survey height of $\approx 2\text{m}$ ALT. The lighting from the vehicles downward light will need to be adjusted and should be considered when mounting onto MPUS in the future, optimising the quality of the image as this was blowing out the bottom portion of the image.

Lights

During video transect dives, three Cathx Aphos lights were pointed downwards to illuminate the Scorpio camera and one LED DSPL light faced forwards to illuminate the Aurora PAL tooling camera.

The downward lighting set-up was arranged to the same configuration as JC263 lighting set-up, which had the bracket positions marked.

The position for the downward lights gave adequate illumination but there were dark spots on the outer edges of the images that cannot be avoided, not given an even spread of light. The forward light position was good, given adequate lighting.

Lights Used – IMS Numbers

- CATHX - 250008084, 250008085, 250007602
- DSPL LED Light - 250007741

Suggestions/Recommendations

- Inspect and assess any damage to all lights used on dive HY106
- Return Cathyx lights to ISIS spares container.

Scaling Lasers

Two HyBIS NOC lasers were used for JC278 with two ISIS NOC lasers kept as spares. The lasers were set to 100mm apart and the parallelism was checked prior to the expedition, at a distance of 5 metres. The lasers worked well for the duration of the expedition.

IMS Numbers

- 260006438
- 260006442

Suggestions/Recommendations

- Check lasers for damage and replace seals as part of their routine maintenance.
- Return ISIS NOC lasers to ISIS spares.

Valeport VA500 Pressure / Altimeter Sensor

The pressure/altimeter sensor (260001285) worked well for the duration of JC278 and was essential for the winch driver during bottom operations.

The altimeter had signs of being knocked during the dredged recover although no obvious signs of damage to the unit.

Suggestions/Recommendations

- Inspect and assess for damage
- Calibrate the sensor prior to the next expedition

Seabird MicroCAT 37

A Seabird MicroCAT CTD was requested to be fitted to HyBIS and was borrowed from the Sensors & Moorings group. The unit was fully self-contained and its preparation, mounting and post-dive data processing was handled by the Sensors & Moorings team.

Tritech Sonar

The AUV 6000m Tritech sonar (IMS:260006261) was used throughout JC278 and worked well for the duration of the cruise. The HyBIS 4000m unit was on board as a spare but wasn't used due to the depth at the PAP site.

Compass

The Xsense MTi-30 AHRS compass was used during JC278. It was noticed that there was an offset between the compass and the direction of travel as seen from the OFOP track, this was observed being +50°.

Suggestions/Recommendations

- Calibrate the sensor

Vehicle cabling

There were no issues with the vehicle cabling during JC278.

Suggestions/Recommendations

- None

Lab Setup and Rack Mount Case

The rack unit and lab setup were identical to that of HyBIS cruise JC263.

Mini HP GUI Machine

The GUI PC was used to run the Labview status displays for HyBIS. The new Scorpio Control GUI written on Qt was used on all dives with new "Format" and "White Balance" features. It worked successfully throughout the expedition with no bugs.

Suggestions/Recommendations

- Backup Labview code.
- Update Windows to latest version and create a full backup.

Mini HP OFOP Machine

The OFOP PC and monitor were used to run the OFOP software. A second monitor was provided for science logging of ocean floor observations.

Suggestions/Recommendations

- Backup Labview code.
- Update Windows to latest version and create a full backup.

QNAP NAS

HyBIS QNAP is used to sync the science data and to hold ROV team's operational files for easy access. For this reason, it's configured as dual-network – ROVNet and ShipNET. It worked successfully throughout the expedition.

Suggestions/Recommendations

- Consider development of a basic web page for science guide

AJA KiPro video recorders

Two AJA Rack-mounted KiPro units were used to record video. The Top unit was assigned to the Scorpio HD camera. The lower unit was connected to the 720P50 quad which was connected to the PAL tooling camera. The copying of the KiPro disks to the SanDisk units was done by the HyBIS team.

The units performed well throughout the expedition.

Suggestions/Recommendations

- Consider purchase of Blackmagic Hyperdeck 4K Pro units for MPUS

SanDisk G-RAID Shuttle 4

Two 24 TB SanDisk G-RAID units were used for the first time for HyBIS operations due to LaCies becoming EOL. These units were setup as MASTER and BACKUP and configured as RAID5 to maximise the redundancy.

The units performed well for the duration of the expedition.

Suggestions/Recommendations

- None.

HD Video Overlay

The new modified HYBIS video overlay worked well for the duration of the expedition.

HDMI feed to Main Lab/Bridge

Using the Blackmagic ATEM Mini Pro and the Raspberry Pi built by Emre, the Scorpio feed was duplicated to the main lab TV.

Handheld Radios

Radios performed well for the duration of the expedition.

Sonardyne Beacon

One of the ROV Sonardyne WMT beacons (2709) was used for each HyBIS deployment on JC278. The Starboard USBL pole was used and the beacon tracked well.

The beacon was removed from the vehicle after each dive and connected to the charger and HyBIS laptop in preparation for the next dive.

The beacon was recovered with the battery charge of 48% after 4 days on the seabed following the deep-tow cable parting incident. (See Appendix B) Afterwards, the beacon was stored in its box with the battery disconnected by software as per the usual procedure.

Suggestions/Recommendations

- Inspect beacon and assess for any damage

HyBIS Dive Summary

HyBIS dives were planned back-to-back as operationally possible to minimise the risk of damage to the termination when swapping out the deep tow and coring wires.

The first three dives were commenced at Whittard with depths between 330-380m. There were gradual sea mounds of 3-5m to navigate that was assessed via bathymetry data prior to the dives. The dives were conducted where hybis would only be pulled downwards and away due to the uncertainty of accuracy from the data showing the height of the mounds.

After the first three dives at Whittard, there was a transit to PAP, coring operations were planned conducted due to adverse weather conditions. After a week of coring and a transit back to Falmouth for a medevac, the first HyBIS dive at PAP site commenced on 11/06/2025.

Dives HY103 to HY106 were successfully done at the same site, PAP central, covering 9 lines on the AESA grid, in a North-South orientation covering approx 2.5km per dive (about 2.5 lines) at the depth of 4845m. HyBIS performed well, with no down-time or dive aborts and no signs of the previous telemetry issues once the focal board was replaced.

Throughout the operations, the launch was aimed to be around 1600hrs, with "Off Bottom" around 0100hrs and "On Deck around "0300hrs" to allow the Ship to complete the transit to the CTD site by 0400hrs.

After the successful completion of the camera survey for dive HY106, HyBIS was lost as a result of deep-tow cable parting and was subsequently recovered via dragging on 20/06/2025. (See Appendix B)

The vehicle frame had suffered significant damage and the AESA cam was lost during recovery, however all other instruments were recovered with Hybis and will be assessed further for damage at base.

Table 6.28: Hybis media

	Scorpio Video	Tooling Cams	Stills:	Image #	Data	Bathysnap
HY100	184.17	187.67		1057	19.4M	
HY101	194.32	199.16		1094	19.6M	
HY102	126.79	128.62		662	17.5M	
HY103	536.9	541.85		2131	21.7M	
HY104	433.92	435.05		1584	19.6M	
HY105	563.65	568.69		2432	22.3M	
HY106	240.31	240.72		831	11.6M	3.96
			# of Files:	9791		99
GB	2280	2301.7		34.8	0.13	3.96
TB	2.27	2.3		0.03	0.0001	0.003
			total storage used (GB)		4620.4	
			total storage used (TB)		4.60	TB

Table 6.29: Hybis dive Hr summary

Dive 1	31/05/2025	Depth:	330			
	HY100	GMT		Difference between times		
	In Water	23:20:00	Hr			
	Seabed	00:07:00	Hr	00:47:00	In Water Time	03:59:00
	Off Seabed	02:59:00	Hr	2:52:00	On Bottom Time	02:52:00
	On Surface	03:19:00	Hr	00:20:00		
Dive 2	01/06/2025	Depth:	370			
	HY101	GMT		Difference between times		
	In Water	19:31:00	Hr			
	Seabed	20:08:00	Hr	00:37:00	In Water Time	05:05:00
	Off Seabed	23:11:00	Hr	3:03:00	On Bottom Time	03:03:00
	On Surface	23:34:00	Hr	01:25:00		
Dive 3	02/06/2025	Depth:	330			
	HY102	GMT		Difference between times		
	In Water	00:52:00	Hr			
	Seabed	01:09:00	Hr	00:17:00	In Water Time	02:35:00
	Off Seabed	03:00:00	Hr	1:51:00	On Bottom Time	01:51:00
	On Surface	03:27:00	Hr	00:27:00		
Dive 4	11/06/2025	Depth:	4840			
	HY103	GMT		Difference between times		
	In Water	16:45:00	Hr			
	Seabed	19:07:00	Hr	02:22:00	In Water Time	10:10:00
	Off Seabed	01:02:00	Hr	5:55:00	On Bottom Time	05:55:00
	On Surface	02:55:00	Hr	01:53:00		
Dive 5	12/06/2025	Depth:	4845			
	HY104	GMT		Difference between times		
	In Water	19:06:00	Hr			
	Seabed	21:08:00	Hr	02:02:00	In Water Time	08:19:00
	Off Seabed	01:30:00	Hr	4:22:00	On Bottom Time	04:22:00
	On Surface	03:25:00	Hr	01:55:00		
Dive 6	13/06/2025	Depth:	4846			
	HY105	GMT		Difference between times		
	In Water	16:45:00	Hr			
	Seabed	18:45:00	Hr	02:00:00	In Water Time	10:41:00
	Off Seabed	01:30:00	Hr	6:45:00	On Bottom Time	06:45:00
	On Surface	03:26:00	Hr	01:56:00		
Dive 7	15/06/2025	Depth:	4847			
	HY106	GMT		Difference between times		
	In Water	20:43:00	Hr			
	Seabed	22:56:00	Hr	02:13:00	In Water Time	12:55:00
	Off Seabed	01:16:00	Hr	2:20:00	On Bottom Time	02:20:00
on 20/06/25	On Surface	09:38:00	Hr	08:22:00		

Certificate No: IC278

DEEP TOW WINCH FIBRE TEST CERTIFICATE

Cable Manufacturer:	Rochester
Manufacturer Part Number:	A302351
Owner of Cable & Cruise Number:	(Ship - Discovery /Cook)
Date of Test:	28/05/2025

SAFETY REQUIREMENTS:

The test should only be carried out by an appropriately authorised person using approved equipment and inside a cordoned off area. Appropriate notices to be posted and all other persons to remain outside the cordoned off area.

Test Procedure:

Cable is visually inspected for damage where practical and the outboard end is prepared for electrical and Fibre Optic testing.

An OTDR meter is connected at the winch fixed JB to each fibre in turn and a test carried out for each wavelength.

The power metres are to be connected to each end and results recorded for each fibre.


OTDR Test results recorded below:

Red Fibre @ 1310nm	7.3 km with loss of dB - N/A
Red Fibre @ 1550nm	7.3 km with loss of dB - N/A
Black Fibre @ 1310nm	7.3 km with loss of 2.8dB
Black Fibre @ 1550nm	7.3 km with loss of dB - N/A
Grey Fibre @ 1310nm	7.3 km with loss of dB - N/A
Grey Fibre @ 1550nm	7.3 km with loss of dB - N/A

Power Metre:

Red Fibre @ 1310nm	7.5 dB	(To be <15db)
Red Fibre @ 1550nm	6.7 dB	
Black Fibre @ 1310nm	9.2 dB	
Black Fibre @ 1550nm	11.1 dB	
Grey Fibre @ 1310nm	11.2 dB	
Grey Fibre @ 1550nm	10.4 dB	

Remarks: None

I, M. Yeomans, appropriately authorised person have carried out the above tests in accordance with the procedure stated (Signed)  (Date) 26 /05/2025

DEEP TOW CABLE ELECTRICAL TEST CERTIFICATE

Cable Manufacturer:	Rochester
Manufacturer Part Number:	A302351
Owner of Cable & Cruise Number:	(Ship – Discovery/Cook)
Date of Test:	28/05/2025

SAFETY REQUIREMENTS:

The test should only be carried out by an appropriately authorised person using approved equipment and inside a cordoned off area. Appropriate notices to be posted and all other persons to remain outside the cordoned off area.

Test Procedure:

Cable is visually inspected for damage and both ends are opened up to expose the conductors.

The continuity of each core is measured by shorting each core to an adjacent core at one end and applying a standard multi-meter at the other.

If necessary, an electrical reflectometry and/or an optical time domain reflectometry test should also be carried out.

The insulation resistance is tested by applying a 5kV test voltage between each bare conductor and the armouring and between each bare core and an adjacent core. The test voltage is applied for a minimum of 1 minute for each test.

Test results recorded below:

Continuity of Conductors	Test Results Ω
L1 – L2	70
L1 – L3	69.3
L2 – L3	69
Insulation Resistance Test	Test Results (M Ω)
L1 – L2	846
L1 – L3	726
L2 – L3	791
L1 – Earth	782
L2 – Earth	699
L3 – Earth	314

Remarks: L3 to earth is running lower. It's a pass but will need further investigation/monitoring to find the cause.

I, ~~M. Verma~~ M. Verma, appropriately authorised person have carried out the above tests in accordance with the procedure stated (Signed)

(Date) 28/05/2025



Hybis Incident

Equipment: HyBis Towed Vehicle, Deep Tow Wire, BATHYSNAP4 Camera, Flash and battery bottle

At 01:15, near the conclusion of the HYBIS video survey, the Hybis Team contacted the bridge to request that the vessel—previously proceeding due south at a speed of 0.3 knots, be brought to a stop. They informed the bridge that HYBIS had completed bottom operations and preparations for recovery were underway. They advised the winch operator, that operations had concluded and were ready to begin vehicle recovery.

At approximately 01:16, The crew started the recovery of HYBIS from the seafloor. The vehicle was hauled until it reached an altitude of 12 metres (depth of 4835 metres), at which point the winch unexpectedly stopped—an unusual occurrence. The winch operator had moved to the winch control area and proceeded outside to the deck, while the Hybis Team remained inside to monitor HYBIS.

At 01:18, HYBIS experienced a complete loss of communication, with all video and telemetry feeds ceasing. The Hybis Team immediately went to inspect the HV cage in the main lab, where they observed that the ground fault monitor (GF) was alarming. Both Alarm 1 and Alarm 2 lights on the ground fault monitoring system. Within moments, the incomer MCBO and Bender MCB had tripped, cutting power to the HV system. The HV cage was unlocked to isolate the system when one of the deck crew shouted that the cable was arcing. One of the Hybis Team performed the HV isolation and made safe, while the other went to look at the cable outside. At this moment, part of the P-Frame Hydraulic system burst and rained hydraulic oil down onto the deck and the winch operator. No further arcing was observed at this point due to the power being isolated.

After one of the Hybis Team went out to speak with the deck crew regarding the commotion, they promptly returned to the other member and reported that the cable had come off from the P Frame roller, becoming snagged, and sustained significant damage. In addition, it was mentioned that a blown hydraulic line that had discharged oil over the surrounding deck area. Once the high-voltage (HV) system was confirmed to be safe, fully isolated, and locked out, the Hybis Team retained the lockout keys and proceeded to the deck to assess the extent of the damage and notify the crew that the system is safe from HV. The wire had frayed down to the final layer of armour, exposing the conductors beneath. The total length of the damaged section was estimated to be approximately 6 to 10 metres. (Refer to image below)

The photo of the cable below was taken at 0120. This concluded the main event of the incident, at which point the Captain, CPOS, CE and other crew members arrived and the discussion of how best to proceed started.

After lengthy talks, and the order given that no one was to be near the cable due to the high tension upon it, approximately 4.5t, the decision was made to recover Hybis on the Deep Tow system. At 0550, the cable parted and Hybis was on the sea floor.



Figure 6.16: Damage to the deep tow cable after coming off the P-frame roller.

On Friday 20/06/2025 a recovery operation was carried out for Hybis and to remove the deep tow cable from the science site at PAP. The coring cable was used due to it having the highest working load limit (WLL) available and was past through over the back of the ship to utilise the A-Frame.

The core wire consisted of 3 grapplers over a 250m wire link with 2 being at the bottom and the 3rd 250m further up. A weak link was placed to connect the wire to the coring cable as a fail-safe and a USBL beacon above that for positioning.

With the Hybis beacon still operating, there was an accurate position to start the operation. The ship positioned itself north of the site where the cable was deployed. The vessel moved due south at 0.2 knts going to the east side of Hybis and passing beyond it. The beacon on Hybis was monitored to check for movement whilst the tension on the wire was monitored for an increase, indicating that Hybis had been grappled by the hooks. This was successful on the first attempt; the ship was stopped and a slow haul was started. The ship started to head aft whilst maintaining tension on the cable until it was above Hybis, allowing for a direct vertical pull.

The ship hauled Hybis and wire at approximately 5m/min which was driven by the tension as to not go above the WLL of the coring wire.

Once Hybis had reached the surface, it was seen to be snagged on the upper hook and with multiple lays of deep tow around it. When manoeuvring onto deck, the lays travelled on to Hybis's legs, ripping to off and buckling the remaining 2 at a 90° bend. Hybis was landed on deck and secured with the remaining deep tow wire hanging overboard, aft of the ship.

An attempt was made to recover the rest of the deep tow but it was too entangled. The deep tow was stoppered where possible to the deck and the ship moved at a slow rate due west approximately 30km, removing the deep tow cable out of the PAP site and into a location where it can dispose of the cable safely. Hybis was cut from the deep tow and moved to a secure location on deck out of the working area. The deep tow was then cut from the remaining hooks and safely disconnected from the ship, falling to the sea floor.

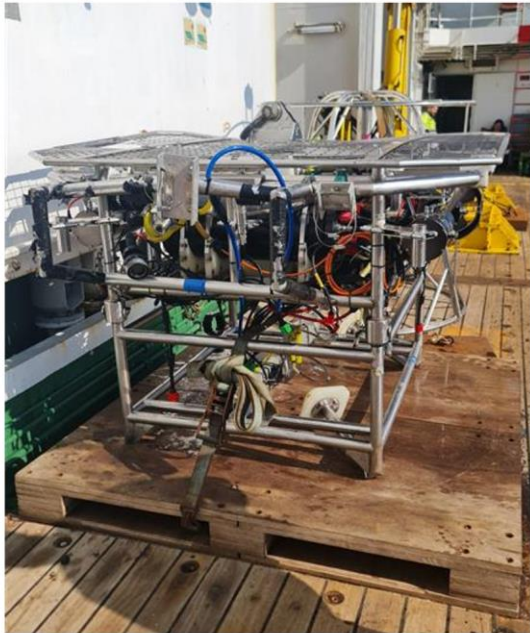


Figure 6.17: Images as Hybis was recovered to deck.

Table 6.30: Equipment on HyBis JC278 (PAP)

Instrument	IMS Number
CATHX Light(s)	250008084, 250008085, 250007602
Tooling Cam	260005914
Scorpio Camera	250007795
DSPL Light (ROV LED)	250007741
Lasers (ROV)	260006438, 260006442
WMT Beacon (ID:2709)	250008190
Altimeter	260001285
TRITEC Sonar	260006261
BathySnap 4 Equipment	
Camera 5 - LOST	260007930
Flash	260007931
Battery Bottle	260007840



Figure 6.18: Hybis set up for deployment.

Overview

Ship Scientific Systems (SSS) is responsible for operating and managing the Ship's scientific information technology infrastructure, data acquisition, compilation and delivery, and the suite of ship-fitted instruments and sensors in support of the Marine Facilities Programme (MFP)

The work site was Whittard Canyon and Porcupine Abyssal Plain observation site.

The main objectives for SSS and MARITT in the service of the science party on this cruise were:

1. Acquire underway data and metadata, including sea-surface, meteorological, position and attitude, depth and multibeam swath.
2. Provide services for recording metadata and events and monitoring data streams.
3. Provide IT support.

All times in this report are in UTC.

Summary

Table 6.31: A summary of the progress made against objectives is shown below.

[X] Objectives, [X] completed, [X] partially completed, [X] not completed.

Target	Outcomes	Objective met?
Acquire underway data and metadata, including sea-surface, meteorological, position and attitude, depth and multibeam swath.	Data and metadata was collected as detailed in this report.	Yes
Provide services for recording metadata and events and monitoring data streams.	Event Logging and other interactive services were provided to the science party.	Yes
Provide IT support	IT support was provided to the science party and marine and technical teams.	Yes

Scientific Computer Systems

Underway data acquisition

Data from the suite of ship-fitted scientific instrumentation was aggregated onto a network drive on the ship's file server. This was available throughout the voyage in read-only mode to permit scientists to work with the data as it was acquired. A Public network folder was also available for scientists to share files.

A copy of these two drives are written to the end-of-cruise disks that are provided to the Principal Scientist and the designated data centre.

The designated data centre for this cruise is: **British Oceanographic Data Centre**

List of logged ship-fitted scientific systems:

`/Cruise_Reports/[Keywords]_Ship_fitted_information_sheet.docx`

The data acquisition systems used on this cruise are detailed in the table below. The **data** and **data description documents** are filed per system in the *Data* and *Documentation* directories respectively within Ship Systems folder on the cruise data disk.

Table 6.32: Data acquisition systems used on JC278

Data acquisition system	Usage	Data products	Directory system name
Ifremer TechSAS	Continuous	NetCDF ASCII pseudo-NMEA	/TechSAS/
NMF RVDAS	Continuous	ASCII Raw NMEA SeaDataNet NetCDF (Testing)	/RVDAS/
Kongsberg SIS (EM122)	Continuous	Kongsberg .all, .wcd	/Acoustics/EM-122/
Kongsberg SIS (EM710)	Discrete	Kongsberg .all	/Acoustics/EM-710/
Kongsberg SBP	Continuous	None	/Acoustics/SBP-27/
Kongsberg EA640	Continuous	Processed, and DPT recorded on Techsas/RVDAS RAM	/Acoustics/EA-640/
Kongsberg EK80	Discrete		/Acoustics/EK-80/
UHDAS (ADCPs)	Continuous	ASCII raw, RBIN, GBIN, CODAS files	/Acoustics/ADCP/
VMDAS (ADCPs)	Unused		/Acoustics/ADCP/
Sonardyne Ranger2	Discrete	None, redirected to Techsas/RVDAS RAM	/Acoustics/USBL/

Data description documents per system:

`/Ship_Systems/Documentation/[systemName]/`

Data directories per system:

`/Cruise_Reports/Documentation/[systemName]/`

Significant acquisition events and gaps

On this cruise, the NMF Event Logger/BAS Event Logger was used with CSV records of events saved to the cruise data directory.

Path and pattern to event log CSV files:

`/Cruise_Reports/Event_Logs/backups/csv/[logName]/*.csv`

Table 6.34: Summary of main events

Date	Time start*	Time end*	Event

Table 6.35: Summary of data gaps

Date	Time start	Time end	Event

Internet provision

Satellite communications were provided with OneWeb, Starlink, VSat and Iridium Certus. The ship operated with bandwidth controls to prioritise business use.

Outreach and streaming

Hosted NOC Open Day Livestream interview on the James Cook on 2025-06-08.



Figure 6.19: JC278 team members speaking on live link to NOC open day

Instrumentation

Coordinate reference

Path to ship survey files:
/Ship_Systems/Documentation/Vessel_Survey

Origin (RRS James Cook)

The common coordinate reference was defined by the Blom Maritime survey (2006) as:

1. The reference plane is parallel with the main deck abeam (transversely) and with the baseline (keel) fore- and aft-ways (longitudinally).
2. Datum ($X = 0, Y = 0, Z = 0$) is centre topside of the Applanix motion reference unit (MRU) chassis.

Multibeam

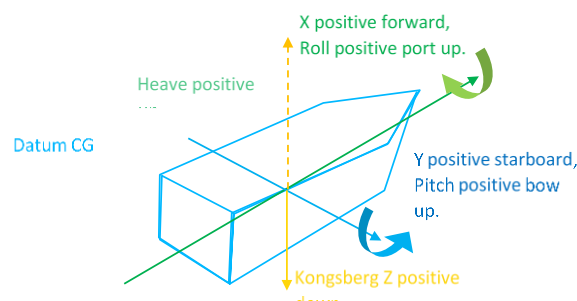


Figure 6.20: Conventions used for position and attitude. On the Discovery, the Datum is the CRP at the CG. On the Cook the Datum is on the centre, topside of the Applanix MRU.

The Kongsberg axes reference conventions are (see Figure) as follows:

1. X positive forward,
2. Y positive starboard,
3. Z positive downward.

The rotational sense for the multibeam systems and Seapath is set to follow the convention of Applanix PosMV (the primary scientific position and attitude system), as per Figure 6.20.

Primary scientific position and attitude system

The translations and rotations provided by this system (Applanix PosMV) have the following convention:

1. Roll positive port up,
2. Pitch positive bow up,
3. Heading true positive to starboard,
4. Heave positive up.

Table 6.36: Position, attitude and time

System	Navigation (Position, attitude, time)		
Data product(s)	NMEA (mvpos,mvatt,spatt,sppos,cnpos): /Ship_Systems/Data/TechSAS/NMEA/ NetCDF (GPS): /Ship_Systems/Data/TechSAS/NetCDF/ Raw NMEA (POSMV,SEAPATH,CNAV): /Ship_Systems/Data/RVDAS/rawdata		
Data description	/Ship_Systems/Documentation/GPS_and_Attitude/Data_Description		
Other documentation	/Ship_Systems/Documentation/GPS_and_Attitude		
Component	Purpose	Outputs	Headline Specifications
Applanix PosMV	Primary GPS and attitude.	Serial NMEA to acquisition systems and multibeam	Positional accuracy within 0.15 m.
Kongsberg Seapath 330	Secondary GPS and attitude.	Serial and UDP NMEA to acquisition systems and multibeam	Positional accuracy within 1 m.
Oceaneering CNav 3050	Correction service for primary and secondary GPS and dynamic positioning.	RTCM to primary and secondary GPS	Positional accuracy within 0.15 m.
Meinberg NTP Clock	Provide network time	NTP protocol over the local network.	

Table 6.37: Significant position, attitude or time events or losses

Date	Time start*	Time end*	Event

Ocean and atmosphere monitoring systems

Table 6.38: SURFMET

System	SURFMET (Surface water and atmospheric monitoring)	
Data product(s)	NMEA (surfm,sbe38,sbe45,winds): /Ship_Systems/Data/TechSAS/NMEA/ NetCDF (SURFMETV3, SBE38,TSG,WINDSONIC): /Ship_Systems/Data/TechSAS/NetCDF/ Raw NMEA (SURFMET,SBE38,SBE49, WINDSONIC): /Ship_Systems/Data/RVDAS/rawdata	
Data description	/Ship_Systems/Documentation/Surfmnet/Data_Description	
Other documentation	/Ship_Systems/Documentation/Surfmnet	
Calibration info	See Ship Fitted Sensor sheet for calibration info for each sensor. SBE45 TSG cross-reference data with Guildline Autosol: /Ship_Systems/Data/Surfmnet	
Component	Purpose	Outputs
Inlet temperature probe (SBE38)	Measure temperature of water at hull inlet.	Serial to Interface Box.
Drop keel temperature probe (SBE38)	Measure temperature of water in drop keel space.	Serial to Interface Box.
Thermosalinograph (SBE45)	Measure temp. and conductivity at sampling board. Salinity is calculated.	Serial to Interface Box.
Interface Box (SBE90402)	Signals management.	Serial to Moxa.
Debubbler	Reduces bubbles through instruments.	None.
Transmissometer (CST)	Measure of transmittance.	Analogue to NUDAM.
Fluorometer (WS3S)	Measure of fluorescence.	Analogue to NUDAM.
Air temperature and humidity probe (HMP45A, HMP155)	Temperature and humidity at met. platform.	Analogue to NUDAM.
Ambient light sensors (PAR, SKE510; TIR, CMP6)	Ambient light at met. platform.	Analogue to NUDAM.
Barometer (PTB110, PTB210)	Atmospheric pressure at met. platform.	Analogue to NUDAM.
Anemometer (Windsonic)	Wind speed and direction at met. platform.	Serial to Moxa.
NUDAM	A/D converter.	Serial NMEA to Moxa.
Moxa	Serial to UDP converter.	UDP NMEA to Surfmet VM.
Surfmnet Virtual Machine	Data management.	UDP NMEA to TechSAS, RVDAS.
Component	Calibrated product steps	
SBE38: Temperature (°C)	No calibration to apply because the residuals are below uncertainty.	
SBE45: Temperature (°C)	No calibration to apply because the residuals are below uncertainty.	
SBE45: Conductivity (S m ⁻¹)	No calibration to apply because the residuals are below uncertainty.	
CST: Transmission (%)	Product = $(Data - V_{dark}) / (V_{ref} - V_{dark})$. Here product has units % and data, V_{dark} and V_{ref} have units V.	
WS3S: Fluorescence (µg L ⁻¹)	Product = Coefficient × (Data – Offset). Here product has units µg L ⁻¹ , coefficient has units µg L ⁻¹ V ⁻¹ , and data and offset have units V.	
HMP45A / HMP155: Temperature (°C)	No calibration to apply because the residuals are below uncertainty.	

HMP45A / HMP155: Relative humidity (%)	No calibration to apply because the residuals are below uncertainty.
PTB110 / PTB210: Pressure (hPa)	No calibration to apply because the residuals are below uncertainty.
SKE510: PAR ($W m^{-2}$)	Product = Data \times $\left(\frac{10^6}{\text{Coefficient}}\right)$. Here product has units $W m^2$, data has units $10^{-5} V$, the 10^6 scalar has units $\mu V V^{-1}$, and coefficient has units $\mu V m^2 W^{-1}$.
CMP6: TIR ($W m^{-2}$)	Product = Data \times $\left(\frac{10^6}{\text{Coefficient}}\right)$. Here product has units $W m^2$, data has units $10^{-5} V$, the 10^6 scalar has units $\mu V V^{-1}$, and coefficient has units $\mu V m^2 W^{-1}$.
Windsonic: Wind speed ($m s^{-1}$)	No calibration to apply.
Windsonic: Wind direction ($m s^{-1}$)	No calibration to apply.

Note that while the residuals (difference of reference and measured) are below uncertainty and the output is considered calibrated for the SBE38, SBE45, HMP45A, HMP155, PTB110 and PTB210 instruments, a regression could still be made between the reference and measured data (see the calibration certificate) if desired. Follow the steps below:

1. Calculate $y = Bx + A$ from calibration data, where x is reference data.
2. Product = $(\text{Data} - A)/B$.

The NMF Surfmet system was run throughout the cruise, excepting times for cleaning, entering and leaving port, and whilst alongside. Please see the separate information sheet for details of the sensors used and whether their recorded data have calibrations applied or not.

Table 6.39 Surface water sampling board maintenance

Date	Time start*	Time end*	Event	Trans high (V)	Trans low (V)	Fluoro high/low (V)	Salinity high/low (PSU)
2025-06-09	08:27:05	09:56:53	Cleaning	4.642	0.004	0.589 / 0.017	34.93 / 0.02

The system was cleaned prior to the cruise.

Table 6.40: Summary of data gaps:

Date	Time start	Time end	Event
2025-06-18	04:57	2025-06-20 16:50	GO pCO2 System crashed, no data

Wave Radar

Table 6.41 Wave radar

System	WAMOS Wave Radar	
Data product(s)	NMEA (wamos, rexwr): /Ship_Systems/Data/TechSAS/NMEA/ NetCDF (NC): /Ship_Systems/Data/TechSAS/NetCDF/ Raw NMEA (WAMOS, REX2): /Ship_Systems/Data/RVDAS/rawdata	
Data description	/Ship_Systems/Documentation/Wamos/Data_Description	
Other documentation	/Ship_Systems/Documentation/Wamos	
Component	Purpose	Outputs
Rutter OceanWaves WAMOS	Measure wave height, direction, period and spectra.	Summary statistics in NMEA to TechSAS and RVDAS. Spectra files.
RsAqua Rex2 Wave Height Sensor	Measure wave height at bow to provide calibration reference dataset.	Wave height NMEA, UDP to TechSAS, RVDAS.
Furuno Radar	Measures radar reflection on sea surface.	Radar data to WAMOS.

The wave radar magnetron requires annual replacement. Following replacement, WAMOS needs to collect wave data within 5 km of another wave height sensor over the full range of sea-states in order to derive wave height calibration coefficients for the new magnetron. This reference dataset can be derived by examining the ship's track for wave buoys and downloading their data, or by using the onboard RsAqua Wave Height sensor fitted on the ship's bow.

On JC278, the WAMOS was calibrated from data collected in November-December 2024.

Table 6.42: Summary of WAMOS data gaps

Date	Time start	Time end	Event

Hydroacoustic Systems

Table 6.43: Hydroacoustic systems

System	Acoustics	
Data product(s)	Raw (EA-640, EM-122): /Ship_Systems/Data/Acoustics NMEA (eadep, emdep): /Ship_Systems/Data/TechSAS/NMEA NetCDF (EA600, DEPTH): /Ship_Systems/Data/TechSAS/NetCDF Raw NMEA (EA640, EM122cb): /Ship_Systems/Data/RVDAS/rawdata	
Data description	/Ship_Systems/Documentation/Acoustics	
Other documentation	/Ship_Systems/Documentation/Acoustics	
Component	Purpose	Operation and Outputs
10/12 kHz Single beam (Kongsberg EA-640)	Primary depth sounder	Continuous, master NMEA over serial, raw files
12 kHz Multibeam (Kongsberg EM-122)	Full-ocean-depth multibeam swath.	Continuous, synchronised Binary swath, centre-beam NMEA, *.all files, optional water column data
70 kHz Multibeam (Kongsberg EM-710)	Coastal/shallow multibeam swath.	Synchronised/Discrete Binary swath, centre-beam NMEA, *.all files.
Sub-bottom Profiler (Kongsberg SBP-27)	Multi-frequency echogram to provide along-track sub-bottom imagery.	Continuous, synchronised BMP, raw files, optional water column data.
Drop keel sound velocity sensor	Provide sound velocity at transducer depth	Continuous, free running Value over serial to Kongsberg SIS.
Sound velocity profilers (Valeport Midas, Lockheed XBT)	Direct measurement of sound velocity in water column.	Discrete ASCII pressure vs sound velocity files. Manually loaded into Kongsberg SIS or Sonardyne Ranger2.
75 kHz ADCP (Teledyne OS75)	Along-track ocean current profiler	Continuous, free running (via UHDAS)
150 kHz ADCP (Teledyne OS150)	Along-track ocean current profiler	Continuous, free running (via UHDAS)
USBL (Sonardyne Ranger2)	Underwater positioning system to track deployed packages or vehicles.	Discrete NMEA over serial
CARIS	Post-processing	Discrete CARIS Project file. CARIS Vessel files
MB-System	Post-processing	Unused XYZ, SegY files

NMF policy is to follow JNCC guidelines for marine mammal observations before operating any equipment which causes significant acoustic disturbance in the water column. Such equipment includes the deep-water multibeam and sub-bottom profiler. For these systems, an MMO procedure is followed, which, in summary, involves a 60-minute bridge observation with a ramped start 45 minutes into the observation.

Path to Marine Mammal Observations logs:
/Ship_Systems/Documentation/Acoustics/MMOs

A member of the scientific party was responsible for carrying out and recording MMO activities.

Table 6.44: Marine mammal observation events reported to SSS.

Date	System	Obs. Start Time	Sys. Start Time Full Power	Notes (inc. any observations or actions)
31/05/2025	EM122	19:10	20:10	None

Further details are reported in the Soundscapes Section [17](#).

Sound velocity profiles

Sound velocity profiles were measured directly with a Midas SVP, derived from CTD or calculated from the WOA13 model using Ifremer DORIS.

Path of sound velocity profile data on the cruise datastore:
 /Ship_Systems/Data/Acoustics/Sound_Velocity

Table 6.44: Details of when sound velocity profiles were taken and applied:

Date		Event	SV Profile Name	SV Type	Lat	Long	MB Depth (m)	Surface SSV (m/s)
2025-06-15 12:32:44	12	SVP applied to USBL	SVP_20250615_001	CTD	48.977775	-16.449572		1510.3
2025-06-15 12:30:09	11	SVP applied to EM122	SVP_20250615_001	CTD	48.978926	-16.459879	4844.9	1510.4
2025-06-13 16:37:53	10	SVP added to USBL	SVP_20250613_001	CTD	48.839095	-16.519787	4845.4	1511.4
2025-06-13 16:37:14	9	SVP added to EM122	SVP_20250613_001	CTD	48.839091	-16.519791	4845.7	1511.5
2025-06-11 08:43:58	8	SVP added to USBL	SVP_20250611_001	CTD	48.997333	-16.363994		1509.3
2025-06-11 08:35:10	7	SVP applied to EM222	SVP_20250611_001	CTD	48.997339	-16.363994	4828	1509.2
2025-06-05 18:54:13	6	SVP Applied to USBL	SVP_20250605_001	CTD	48.837343	-16.520829	4851.6	1507.5
2025-06-05 18:53:46	5	SVP Applied to EM122	SVP_20250605_001	CTD	48.837332	-16.520824		1507.5
2025-05-31 21:22:51	4	SVP Applied to EM710	SVP_20250531_001	CTD	48.401924	-9.692034	324.8	1508.8
2025-05-31 21:22:39	3	SVP Applied to EM122	SVP_20250531_001	Midas	48.401926	-9.692036	324.5	1508.8
2025-05-31 21:19:39	2	SVP Applied to USBL	SVP_20250531_001	Midas	48.401931	-9.692047	325.2	1508.8
2025-05-31 20:05:00	1	SVP Cast taken	SVP_20250531_001	Midas	48.403995	-9.69496		1508.1

Equipment-specific comments

ADCPs

Path of ADCP data on the cruise datastore:
/Ship_Systems/Data/Acoustics/ADCP

Table 6.45: ADCP details

Attribute	Value
Acquisition software	UHDAS
Frequencies used	75 kHz, 150 kHz
Running mode	Free-running (untriggered)

EM-122 Configuration and surveys

Path of Multibeam data on the cruise datastore:
/Ship_Systems/Data/Acoustics/EM-122
Path of EM122 CARIS Vessel Configuration File:
/Ship_Systems/Data/Acoustics/EM-122/CARIS_Processed/VesselConfig

Table 6.46: ADCP calibration

Attribute	Value			
Number of surveys	(Run continuously)			
Date of patch test	Not undertaken.			
Offsets and rotations	Item	X (m, + Forward)	Y (m, + Starboard)	Z (m, + Down)
	Tx transducer	19.205	1.830	6.934
	Rx transducer	14.094	0.950	6.932
	Item	Roll (deg)	Pitch (deg)	Yaw (deg)
	Tx transducer	-0.35	-0.1	0.19
	Rx transducer	-0.06	0.1	0.15
Post-processing undertaken	None.			

USBL Configuration and deployments

Path of Multibeam data on the cruise datastore:

NMEA: /Ship_Systems/Data/TechSaS/NMEA/usblp

NetCDF: /Ship_Systems/Data/TechSaS/NetCDF/USBL

\$PERSONLLD ASCII: /Ship_Systems/Data/RVDAS/rawdata/*RANGER2USBL*.txt

Table 6.47: USBL Configuration and deployments

Attribute	Value
No. of Deployments	13
Heads used for operations	Starboard HPT 7000
Datetime of last CASIUS	29/10/2023 00:01
Port Head 1DRMS	
Starboard Head 1DRMS	63.2% of positions within 13.89 m at 4586m depth 63.2% of positions within 0.3 % of depth

Table 6.48: USBL deployment information

Deployment name	Head used	Beacon(s) used	Datetime Start	Datetime End	SVP Used (Filename)
Coring	HPT 7000	2004	On bottom:		
			2025-06-05 00:39:51		SVP_20250531_001
			2025-06-05 20:30:49		SVP_20250605_001
			2025-06-07 19:54:59		"
			2025-06-16 23:11:24		SVP_20250611_001
			2025-06-19 00:33:57		SVP_20250615_001
EGIM Deployment	HPT 7000	2211	2025-06-12 07:14:41	2025-06-12 08:43:21	SVP_20250611_001
Hybis Dives	HPT 7000	2709	2025-05-31 23:21:16	2025-06-01 03:19:18	SVP_20250531_001
			2025-06-01 19:28:06	2025-06-02 03:26:53	"
			2025-06-11 16:46:32	2025-06-12 02:56:56	SVP_20250611_001
			2025-06-12 19:05:59	2025-06-13 03:25:22	"
			2025-06-13 16:45:09	2025-06-14 03:26:26	SVP_20250613_001

			2025-06-15 20:44:00	Lost	SVP_20250615_001
			2025-06-19 11:14:34	2025-06-20 08:58:56	"
Hybis Rescue, beacon on dragging wire	HPT 7000	2211	2025-06-19 09:34:16	2025-06-20 07:35:35	SVP_20250615_001

Other systems

Cable Logging and Monitoring

Winch activity is monitored and logged using the CLAM system.

7. PAP1 Recovered – Scientific report

Andrew Gates, Sue Hartman, Anita Flohr, Jon Campbell, Daisy Tong

7.1 Mooring loss

For a second year in succession the PAP1 Met Office Mobilis surface buoy parted from its mooring and went adrift. On this occasion the buoy (JC263-043) parted during ‘[Storm Bert](#)’ on 24th November 2024 between 0800 and 1200 (Table 7.1). The buoy’s movement was tracked and plans were being made to attempt a recovery, although weather conditions were not favourable. The most likely option was to use the Irish Light Vessel *Granuaile*, which preparing for work with the Met Office to service the K1 and K2 buoys in the vicinity. On 6th December 2024 communications were lost at 14:30 during another storm (‘[Storm Darragh](#)’), making a recovery unlikely. On 14th December at 1610, in response to an earlier notice to mariners, the vessel “*Pacific Reefer*” en route from Cristobal (Panama) to Dover (UK) reported a likely sighting on the buoy at position 49° 22.0 N 013° 55.6 W. It had capsized, explaining the lack of communications (Figure 7.2). Furthermore, the ILV *Granuaile* was no longer available as required for its statutory buoy operations. PAP1 eventually washed ashore during ‘[Storm Éowyn](#)’ (24th January 2025) causing some media interest. It was recovered from the beach by tractor and low-loader and moved to a nearby farm before the Met Office arranged its return to Southampton by road and sea.

Table 7.1: Positional information indicating the time period during which PAP1 parted

GPS_datetime	Latitude [degrees]	Longitude [degrees]	Distance from anchor [km]	Bearing from anchor [degrees]
24/11/2024 03:02	48.9829	-16.3378	1.738	59.7
24/11/2024 04:02	48.98268	-16.3363	1.825	62.1
24/11/2024 06:02	48.97901	-16.3334	1.879	76.3
24/11/2024 08:03	48.9753	-16.332	1.926	89
24/11/2024 12:02	48.96256	-16.2153	10.564	97.5
24/11/2024 15:03	48.94062	-16.154	15.441	104.3
24/11/2024 17:03	48.90578	-16.1325	18.241	115
24/11/2024 18:03	48.88799	-16.1218	19.839	119.2
24/11/2024 22:02	48.82175	-16.0697	27.145	128.9
24/11/2024 23:02	48.80867	-16.0564	28.822	129.9
25/11/2024 02:03	48.78652	-16.0062	33.227	129.1

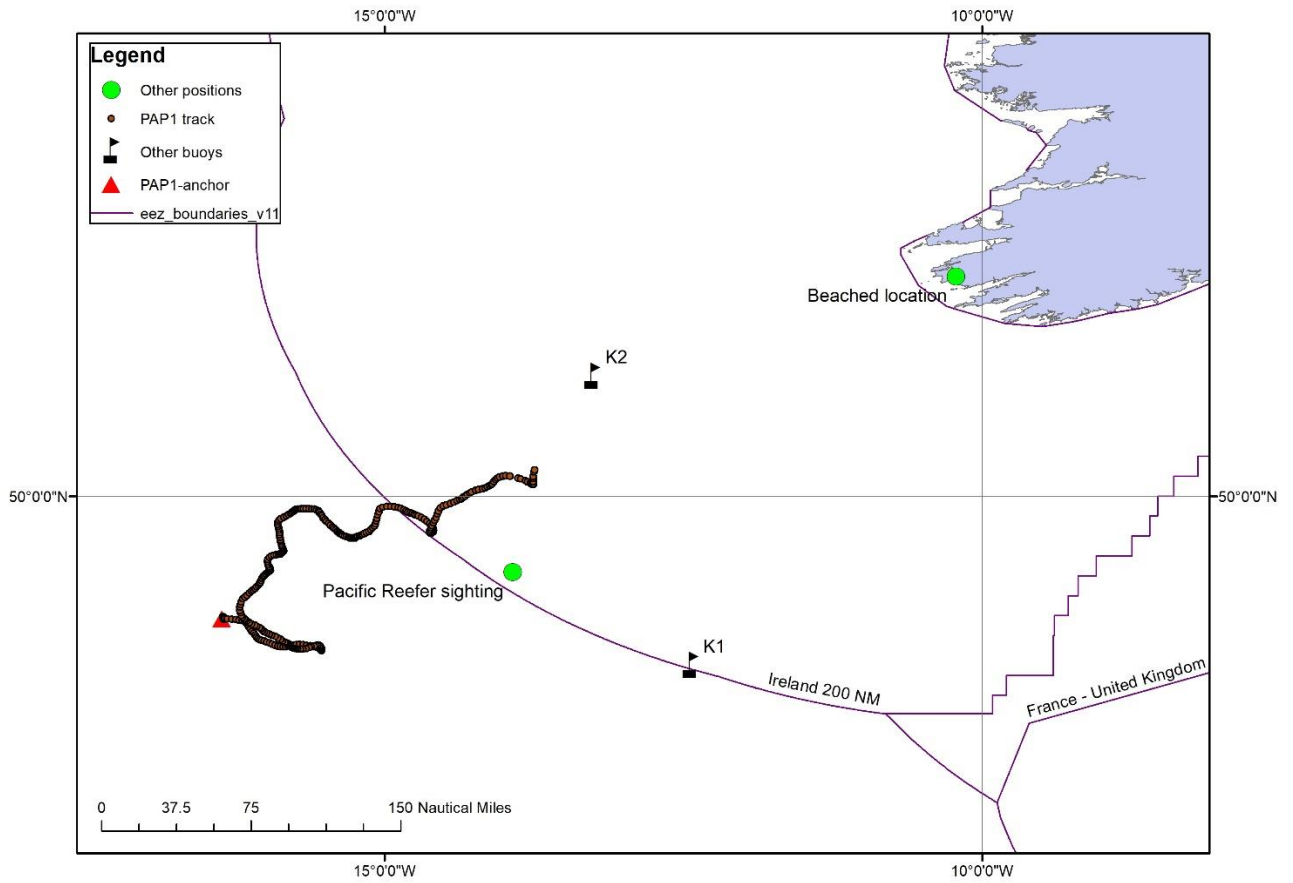


Figure 7.1: PAP1 track after detaching from its mooring, other key events and locations also marked.

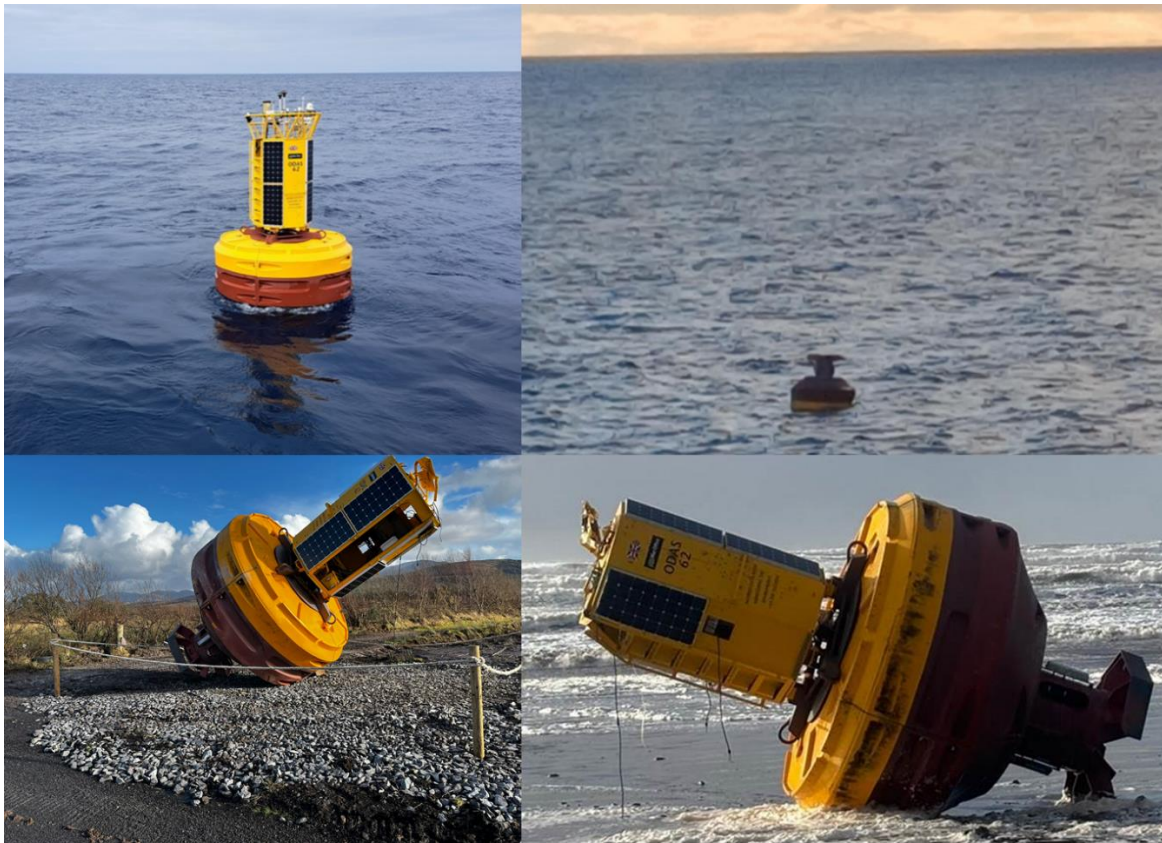


Figure 7.2: Clockwise from top left – newly deployed buoy in June 2024; the capsized buoy observed by the vessel *Pacific Reefer* on 14th December 2024; PAP1 washed ashore on Reenroe Beach in Ballinskelligs, Co. Kerry 24th January 2025; Secured ashore by a local farmer.

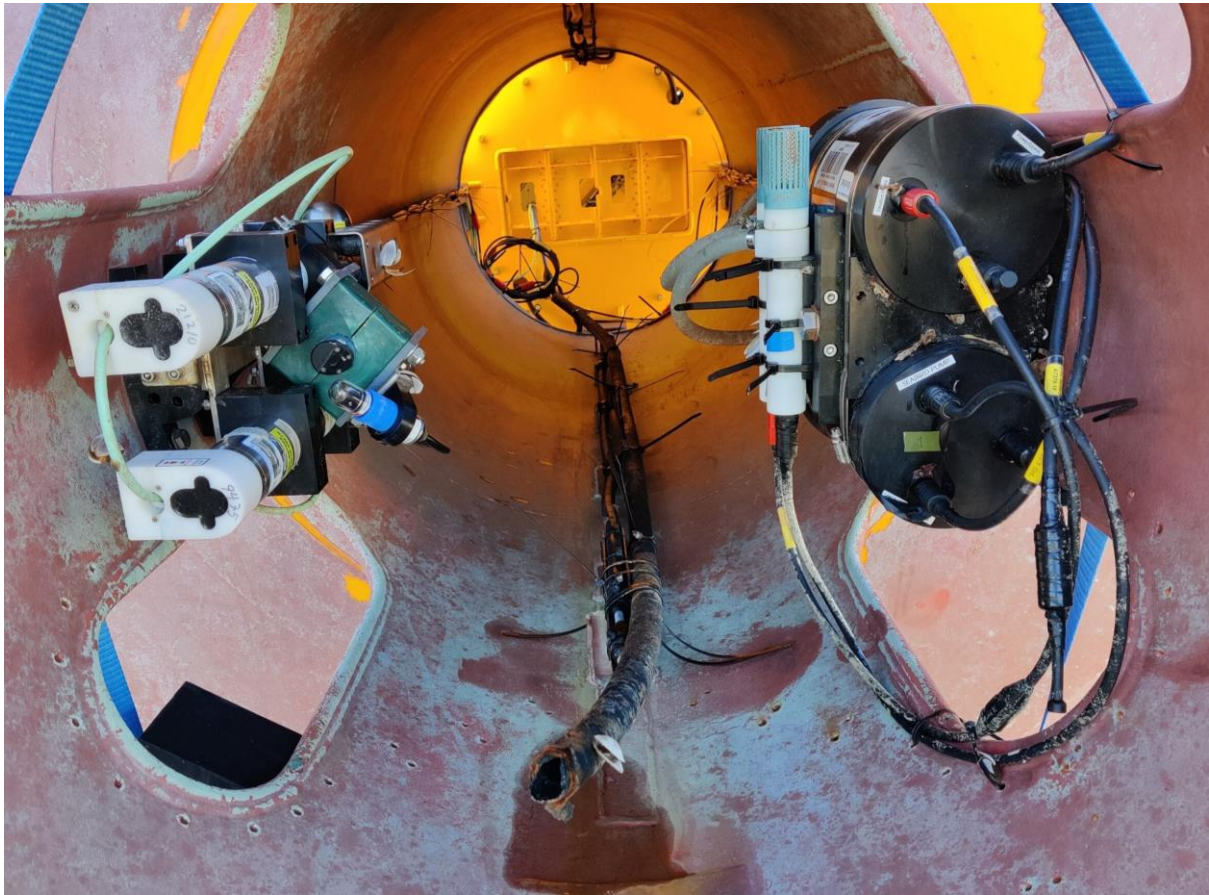


Figure 7.3: View of the inside of the buoy tower showing the parted umbilical and relatively intact sensors and anti-biofouling UV lamp.



Figure 7.4: All sensors were lost from the mast of the buoy.



Figure 7.5: Damage inside the keel where the attachment bar became detached from the buoy

7.2 Attempts at frame / rope recovery

Despite the releases apparently beginning to rise from the seabed after firing the release code, they stopped rising shortly after. An attempt was made to drag for the lost mooring but this was unsuccessful.

7.3 Scientific data recovered

The surface PAP1 sensors were switched off remotely and the position tracked in case of rescue. Most sensors were intact but as the buoy had turned upside down all sensors and antennae (plus the CO2 air box) had come off. One of the ICOS CO2 sensors had stopped working and later inspection showed that a washer had become jammed in the membrane and this will need to be fixed for the 2026 deployment, along with replacement of the CO2 air box. This and other sensors are listed in Table 7.2.

Table 7.2: Data recovered from JC263-043 deployment

Sensor list for the JC263 PAP1 deployment	Serial number	Recovered data	Sampling times (UTC)
BUOY			
New Buoy controller	B1	Lost – no data, NRT only	
Pro-Oceanus CO2-Pro with atmospheric option	39-599-50A	Data recovered and submitted to ICOS	Every 12 hours at 00:22, 12:22 (switches on 20 min before these times). AZPC every 12 hrs
Pro-Oceanus CO2-Pro (as a backup) with atmospheric option	42-060-50A	Data recovered and submitted to BODC	Every 6 hours at 01:55, 07:55, 13:55, 19:55 (switches on 20 min before these times). AZPC every 12 hrs
Vaisala GMP343 CO2 sensor	J0350007	Damaged on recovery, no recovered data	Every hour, ON for 32 mins at :22, sample at :52
SeaBird SBE 37IMP-ODO MicroCAT	21210	Data recovered	Every 30 mins at 00 and 30
SeaBird SBE 37IMP MicroCAT	9475	Data recovered	Every 15 minutes at 00, 15, 30, 45
Satlantic OCR-507 ICSA with Bioshutter II	201 with 123	Lost – no data, NRT only	Every 30 mins at 16 and 46, sampling at 1Hz for 2.5 mins NRT avg vals every 30 sec.
Aanderaa oxygen optode	1282	Data stored on buoy controller, NRT only	Every 30 mins at 08 and 38, sampling every 15 sec for 65secs
AML UV lamp	830328	N/A	Every 30min, at 10 and 40, for 15min
Met Office data logger (from MO secondary controller)	300025060208250	Lost – no data, NRT only	Every hour, at :00
FRAME			
New Frame controller	1	Lost – no data	
Pro-Oceanus CO2-Pro CV (Pete Browns, replacement)	40-774-75	Lost – no data	Every 8 hours at 00:00, 08:00, 16:00 (switches on 20 min before these times). AZPC every 12 hrs
SeaBird ECO FLNTUSB Fluorometer	7381	Lost – no data	Every 4 hours, at 0:00, 04:00, 08:00, 12:00, 16:00, 20:00 (similar time to CO2 and/or CWS)
Aanderaa 4330 oxygen optode	1298	Lost – no data	Every 30 mins at 15 and 45, sampling every 15 sec for 65secs, averaged over 30s
Satlantic OCR-507 ICSW irradiance (looking upwards) with Bioshutter II	200	Lost – no data	Every 30 mins at 16 and 46, sampling at 1Hz for 2.5 mins NRT avg vals every 30 sec.
SeaBird SBE 37IMP-ODO MicroCAT	26579	Lost – no data	Every 30 mins at 00 and 30
SeaBird SBE 37IMP MicroCAT	9469	Lost – no data	Every 15 minutes at 00, 15, 30, 45
Pro-Oceanus Mini TDGP sensor	38-506-31	Lost – no data	Every 30 mins at 02 and 32
Clearwater Phosphate	CWP-01-63	Lost – no data	Every 12 hour, @00:35, 12:35

LISST-HOLO	1701	Lost – no data	daily
Star-ODDIS		Lost – no data	
5 m depth	C11508	Lost – no data	from 24/06/2024 12:00, 6 hourly
10 m depth	C11509	Lost – no data	from 24/06/2024 12:00, 6 hourly
15 m depth	C11510	Lost – no data	from 24/06/2024 12:00, 6 hourly
20 m depth	C11511	Lost – no data	from 24/06/2024 12:00, 6 hourly
25 m depth	C11512	Lost – no data	from 24/06/2024 12:00, 6 hourly
Batteries for frame sensors			
subCtech 'Big Jim' Li ion battery, 140 Ah @ 14.4V	PP-LI-14.4-140-Ti-300-2202-01	Lost	#1 powering Frame hub
subCtech 'Big Jim' Li ion battery, 140 Ah @ 14.4V	PP-LI-14.4-140-Ti-300-2202-03	Lost	#3 powering frame CO2 (no tether power)
Develogic DW.TH housing, ~84 Ah @ 14.4V, 6000m	19075	Lost	Needs 28 x LSH20 cells
Develogic DW.TH housing, ~84 Ah @ 14.4V, 6000m	19076	Lost	Needs 28 x LSH20 cells
Lisst-Holo battery		Lost	

Example data

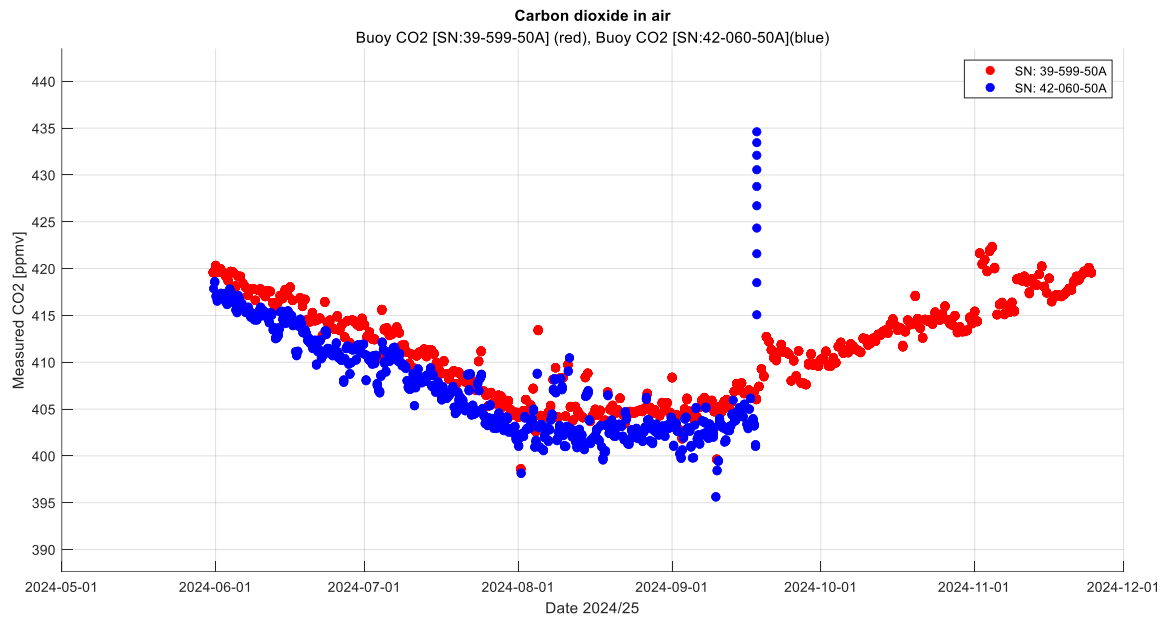


Figure 7.6: Recovered data for carbon dioxide in air on the buoy mast

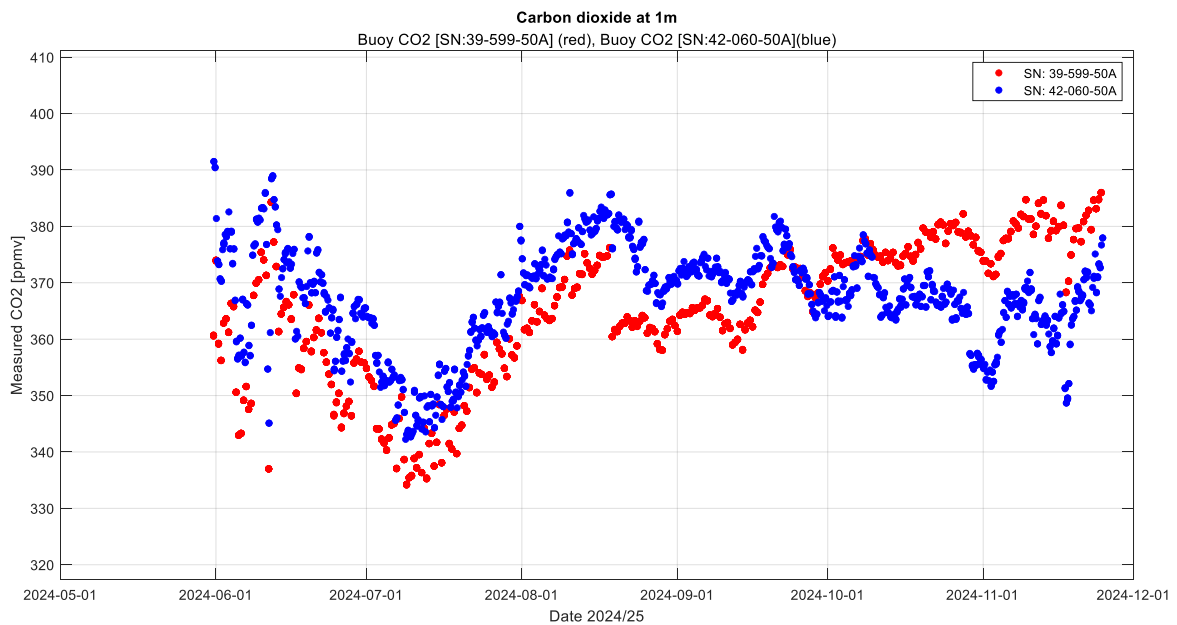


Figure 7.7: Recovered data for carbon dioxide at 1 m depth on the buoy keel

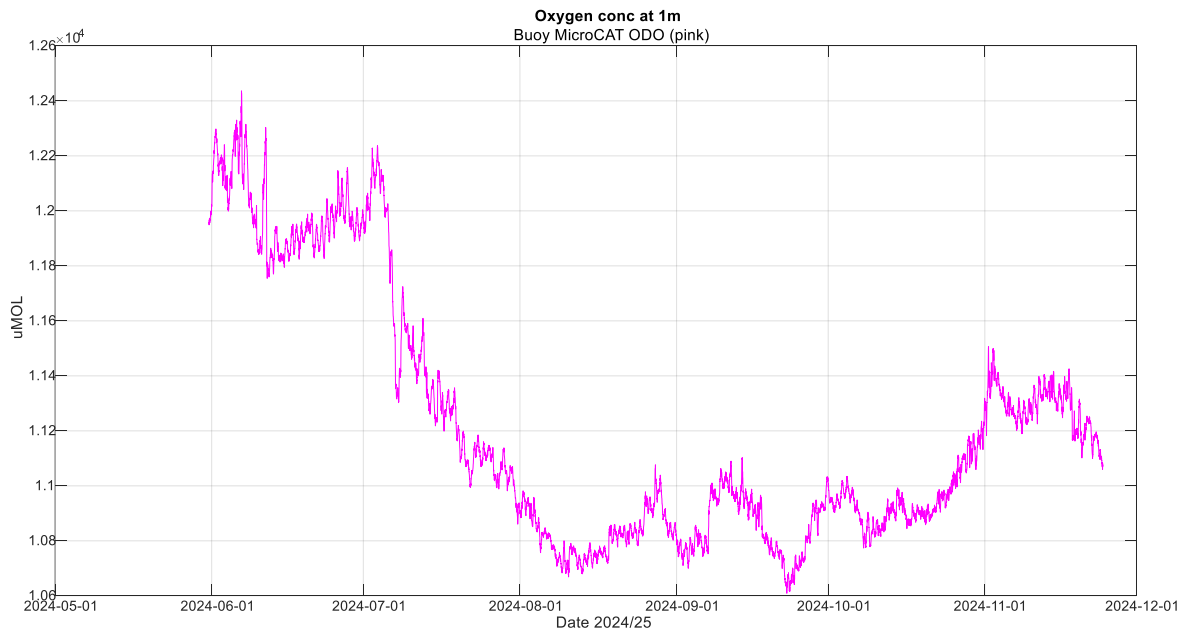


Figure 7.8: Recovered oxygen data at 1 m depth on the buoy keel

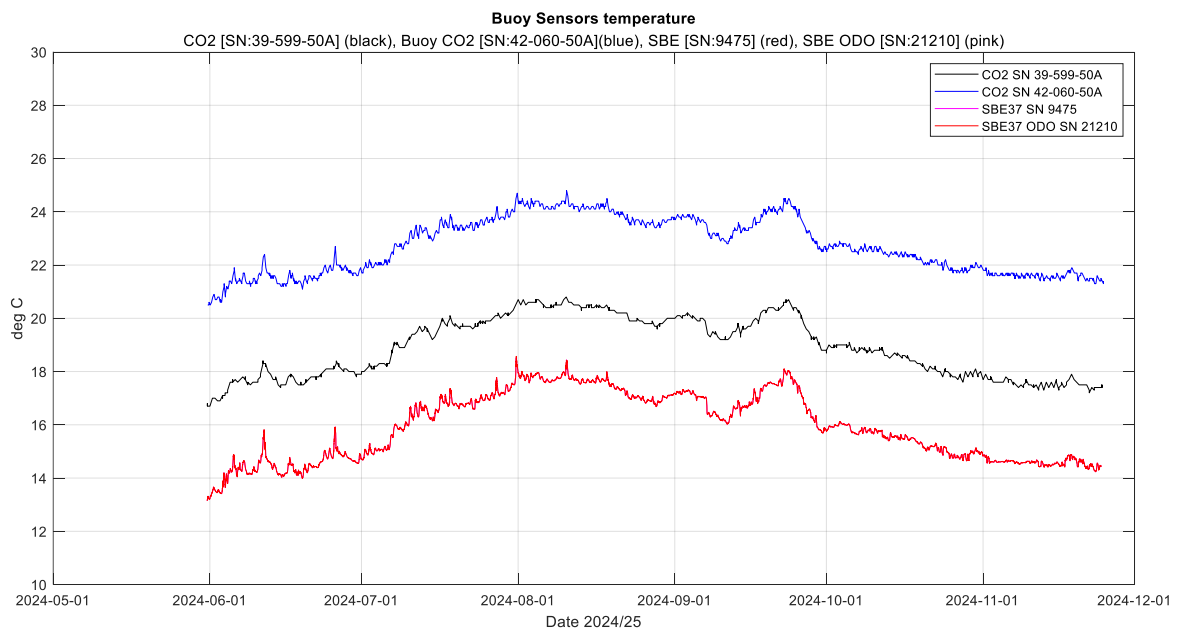


Figure 7.9: Recovered data for various temperature sensors at 1 m depth on the buoy keel

8. PAP1 Deployed – Scientific report

Sue Hartman (Anita Flohr, Jon Campbell, Daisy Tong ashore)

We refer to the biogeochemical sensors carried on the Met Office buoy (and the full mooring to 4850m) as PAP1. The PAP1 biogeochemical sensors and associated hub components were mostly prepared ashore by OTEG, NMF and Campbell Ocean data, including all sensor testing. Note that the 30m Frame could not be deployed in 2025, so the buoy carried additional sensors. This included a Seabird ECO FLNTSUB fluorometer for Chl-fluorescence, a Seabird Deep SeapHOx V2 for pH (and additional CTD) and a Seabird SUNA V2 nitrate sensor. The UK Met Office added two water temperature sensors this year too. They also made many of the brackets, and a bar to carry the SUNA nitrate and SeapHOx pH sensors.

The SUNA and SeapHox were new this year, the later has not be used at PAP-SO before. The GEORGE sampler was also added to the PAP1 buoy for JC278 (and the main unit had been painted with similar antifouling paint to the MO buoy). The 6 GEORGE samples are aligned to the PAP1 sensor timings with the aim of data comparison upon recovery of PAP1 next year. Table 8.2 lists the sensors deployed on PAP-1.

Figure 8.1 shows photographs of the sensors, just before deployment. From L-R (and from top to bottom) this shows the following: 1) Top of buoy showing CO₂ air box, Iridium antenna, yellow OTEG Hub, NOC trakka, green Cu cover for OCR (radiometer), and MO atmospheric sensors; 2) between tower and skirt – hosing added (by EGIM group); 3) Anode (and hosing added) on skirt; 4) CO₂-Pro, seabird pump with clear tubing and the pump copper ‘hat’; 5) Microcats from above (also shows AML light); 6) AML light and optode (cover removed); 7) CO₂-atmos (with clear tubing to the air box above, and wider clear tubing to the seabird pump); 8) Fluorometer (with hosing) showing copper shutter (and window) facing outwards); 9) One of two MO temperature sensors, with Cu guard under the SeapHox tubing, with amalgamation tape at the subcon connector; 10) CO₂ sensors (end on) – after pumps attached on 11th June; 11) MO buoy and chains; 12) SeapHox and Seabird SUNA nitrate (with brush) – both attached to the bar on the skirt of the buoy; 13) PAP telemetry hub mounted on the buoy mast (crown structure has been re-designed for better access); 14) Vaisala inside a water-resistant enclosure; 15) Inductive cable coupler (ICC) inside the buoy tower; 16) Power distribution box that provide power to the PAP buoy hub; 17) air-intake box of Pro-Oceanus CO₂ sensor; 18) OCR on buoy mast.

The power distribution box and the battery providing power to the NOC telemetry hub are mounted in the buoy tower (Tims group has a photo). These sit alongside two MO controllers with power systems. The Vasaila GMP343 CO₂ sensor is inside a box, inside the tower, to keep it relatively dry.

At the start of JC278 some modifications were made onboard by the EGIM team to secure and protect the cables. The buoy was moved into the final position in calmer waters of Falmouth Bay. The chain was laid out and welds made the day before deployment. Just before deployment amalgamation tape was added to various connectors (primarily the pumps, CO₂ and pH sensors) prior to deployment. As the CO₂ sensors must not run dry the pumps were attached just before deployment. Likewise, the SeapHox (pH sensor) start time was modified to 14th June, by Sue and Paco, (using UCI software and a ‘StartLater’ command in Teraterm).

A check list was followed for the final buoy preparations onboard (Table 8.1). The PAP1 deployment on IMS **PAP1 deploy JC278** should be linked to the IMS plan list [OBG JC263 PAP1 Buoy & Frame Sensors](#).

PAP1 deployment, on 11th June, was started at ~08:30 and ended ~15:30. It was a similar duration, despite the lack of frame, as the rope type was new and the subsurface float had to be welded. The anchor was dropped at 48° 55.6158 N, 016° 22.9782W, so the buoy was ~500m past the intended position and it sat to the north due to wind and current directions for most of JC278. Data are sent ashore by iridium and the intention is for the PAP website to show NRT data by the end of JC278. Near real time data for the early part of the deployment were plotted. A selection in Figure 8.2-8.7.

With thanks to the ship's crew and NMF team onboard for successful deployment of the buoy. And many thanks to David and Adrien for checking the system and adding hoses, likewise to Paco for assistance in setting up the SeapHOx.

Table 8.1: Onboard checklist, Pre-deployment JC278

PAP1 JC278 May 2025	Done?
On board - general tasks	
Release test (release used to deploy PAP1)	Yes
Take photos of sensors and buoy	Yes
Hosing added (EGIM team: David and Adrien 1/6/25)	
re-program seaphox (Sue and Paco) , initial start was on 9th of June	now 11:33 14th June (UCI
	then teraterm (StartLater)
Prep for deployment - Buoy on JC278 from 1st June 2025	
Check all brackets and cables are secure	Yes
Check OCR shutters moving (17 and 47 past the hour) (visual, filezilla)	Yes
Check copper hat is secure (CO2 pump)	yes screw is proud on each
Check, tighten cable ties and jubilee clips on CO2 sensors/pumps	Yes
Check the UV light is working (every 30 mins at 10 and 40 past, for 15 mins)	Yes
Evening before deployment 10th June 2025	
lay it all out the day before to meet morning window for deployment	
Send pics to team ashore for last check	
Just before deploy Bouy 11th June 2025	
Plug in CO2 pumps (between 08:00 and 11:00 hrs pre deploy) - 2 on the bouy; if it's not in the water by 12hrs, unplug the pump cables, next time window would be after 14:00-18:00 , plug in pump cable again	yes 8:00
Secure buoy pump leads - cable ties, other cable ties and amalgamation tape	yes tape from Tim
Remove optode covers (buoy)	Yes
Switch on buoy navigation light (NMF)	Yes
Switch on AIS (NMF)	Yes
Turn bolts on buoy door	Yes
Remove white cover of the fluorometer (do not touch copper shutter, it should move when plug attached), visual check it moves	yes 7:53
Remove any stickers from microcats (should be done already) (yellow stickers)	no stickers
Take pictures of sensors, connections etc. (esp CO2 pump) and new hose @	yes (pump screws
tower, CO2 and Fluntsb especially by EGIM team	stand proud but
Post deploy from 11th June 2025	check OK with NOC)
post deploy triangulate	N of 48° 55.9 N, 16° 22.9 W.
post deploy shallow CTD: CTD	CTD8 (1000m)
IMS update (deployed and recovered)	IMS deploy, 14th June

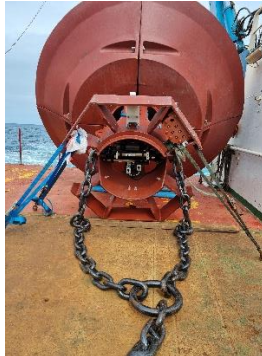
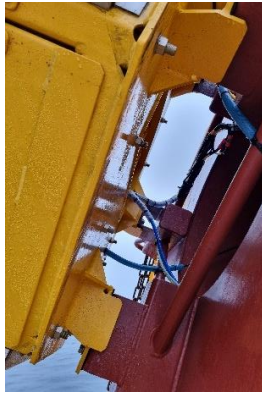




Figure 8.1 (over 2 pages): Photos of sensors deployed on the JC278 NOC/MO PAP1 buoy

Table 8.2: PAP1 sensors deployed, JC278

PAP1 Sensor list for 2025 deployment (JC278)	Serial number	IMS number	Sampling times (UTC)
BUOY			
New Buoy controller	B2	x	
Pro-Oceanus CO2-Pro with atmospheric option	41-824-50A	260006877	Every 6 hours at 00:22, 06:22, 12:22, 18:22 (switches on 20 min before these times). AZPC every 12 hrs
Pro-Oceanus CO2-Pro (as a backup)	34-200-45	250008747	Every 6 hours at 01:55, 07:55, 13:55, 19:55 (switches on 20 min before these times). AZPC every 12 hrs
Vaisala GMP343 CO2 sensor	J0350008	250008093	Every hour, ON for 32 mins at :22, sample at :52
SeaBird SBE 37IMP-ODO MicroCAT (350m)	16503	260005135	Every 30 mins at :00 and :30
SeaBird SBE 37IMP MicroCAT	6911	250005889	Every 15 minutes at :00, :15, :30, :45
Satlantic OCR-507 ICSA with Bioshutter II	226/230	250007461	Every 30 mins at :16 and :46, sampling at 1Hz for 2.5 mins NRT avg vals every 30 sec.
Aanderaa oxygen optode	1296	250008131	Every 30 mins at :08 and :38, sampling every 15 secs for 60 secs, averaged over 30 sec
AML UV lamp	x	260009253	Every 30 min, at :10 and :40, for 15min
Met Office data logger (from MO secondary controller)	62043	x	Every hour, at :00
OCTOHUB	6	x	x
New GEORGE sampler (x6 or 7)	1 to 7	x	OCTOHUB will do the power schedule for the GEORGE Samplers
SeaBird SUNA nitrate sensor	2393	260009157	Every 1 hour, sample at at :48, switched ON all the time
SeaBird Deep SeapHOx V2 pH & CTD sensor	721-2103 & 37-27127	260009114	Every 1 hour, at 0:33, ON all the time
SeaBird ECO FLNTUSB Fluorometer	8207	260008456	Every 4 hours, at 03:50, 07:50, 11:50, 15:50, 19:50, 23:50 (similar time to CO2 and/or CWS)
Xeos Rover beacon	2257	260009745	Sends daily ping

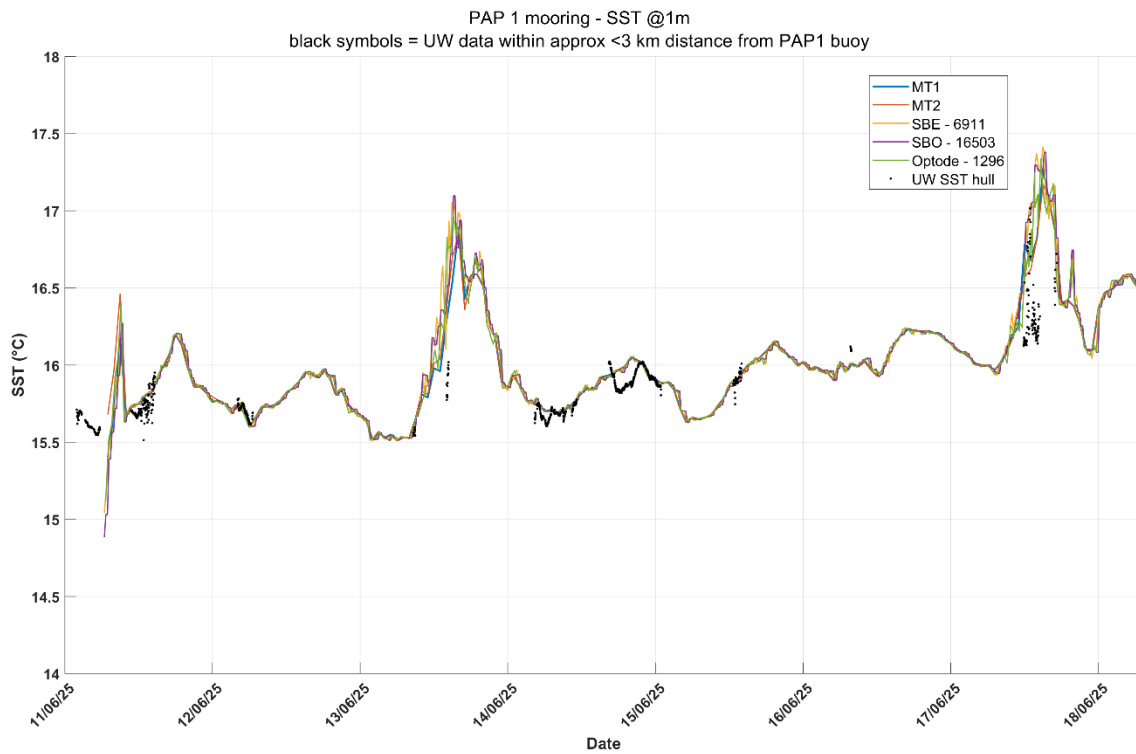


Figure 8.2: Early PAP1 near real time surface temperature sensor data from deployment until 18th June 2025. Includes underway data when the James Cook was within 3km of PAP1.

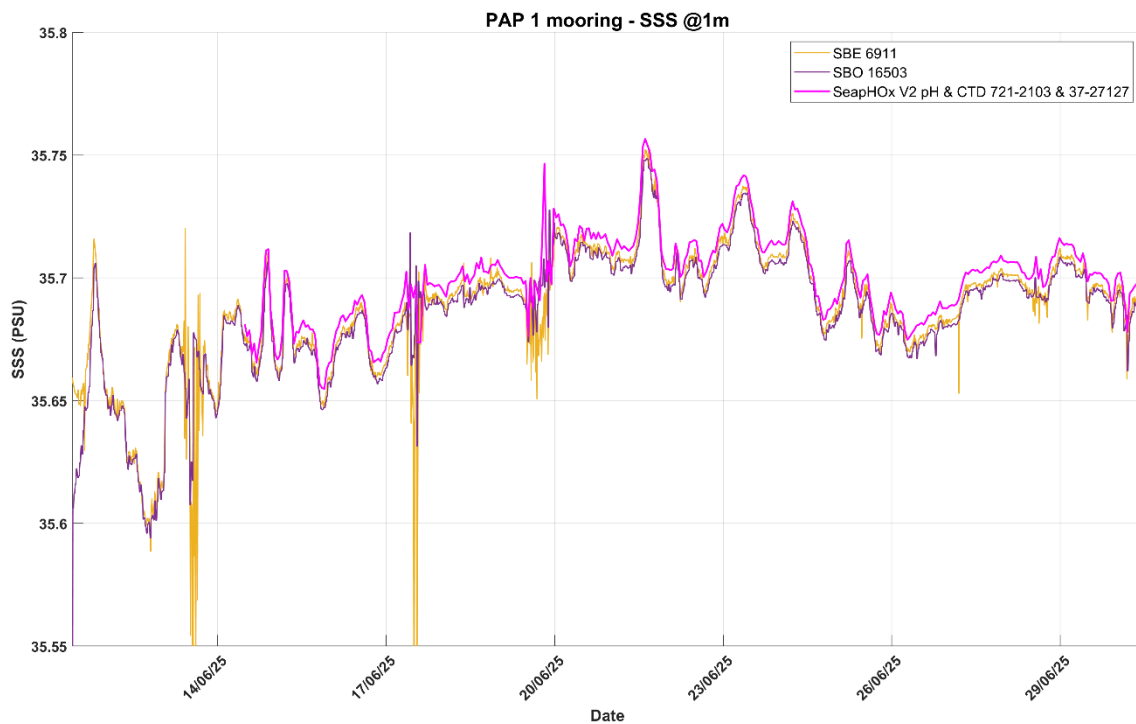


Figure 8.3: Early PAP1 near real time surface salinity sensor data from deployment until 29th June 2025

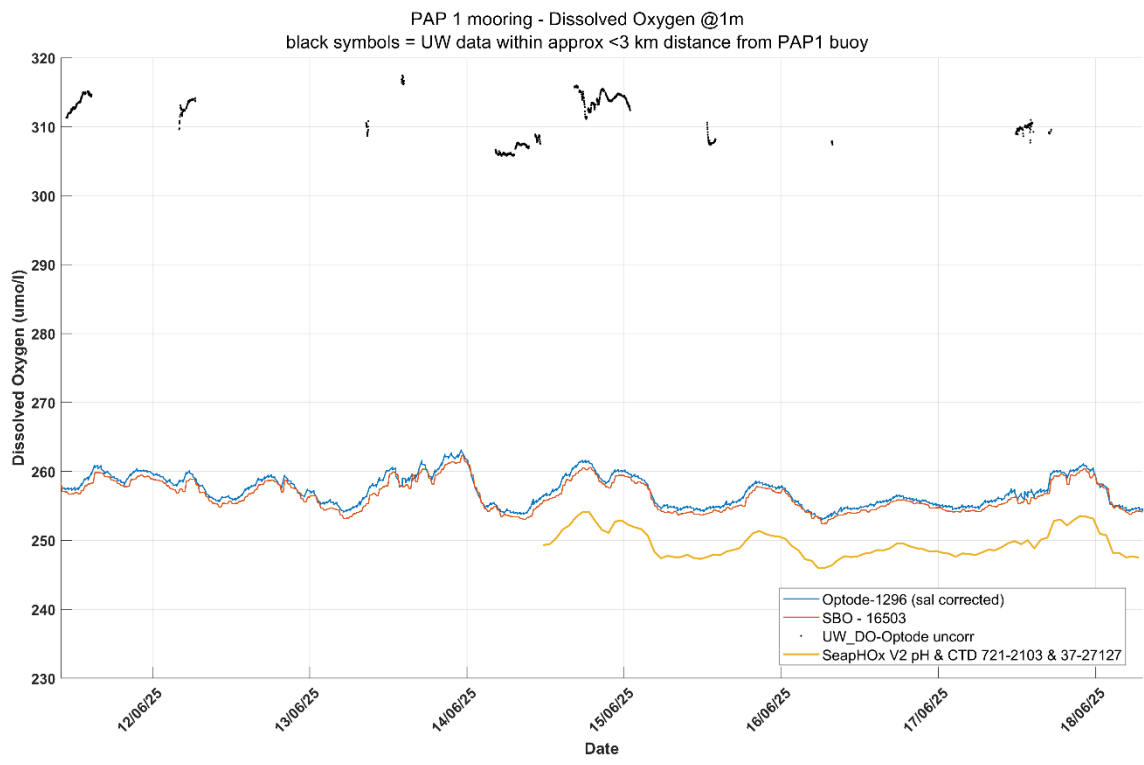


Figure 8.4: Early PAP1 Dissolved Oxygen sensor data from deployment until 18th June 2025, including underway data within 3 km of PAP1

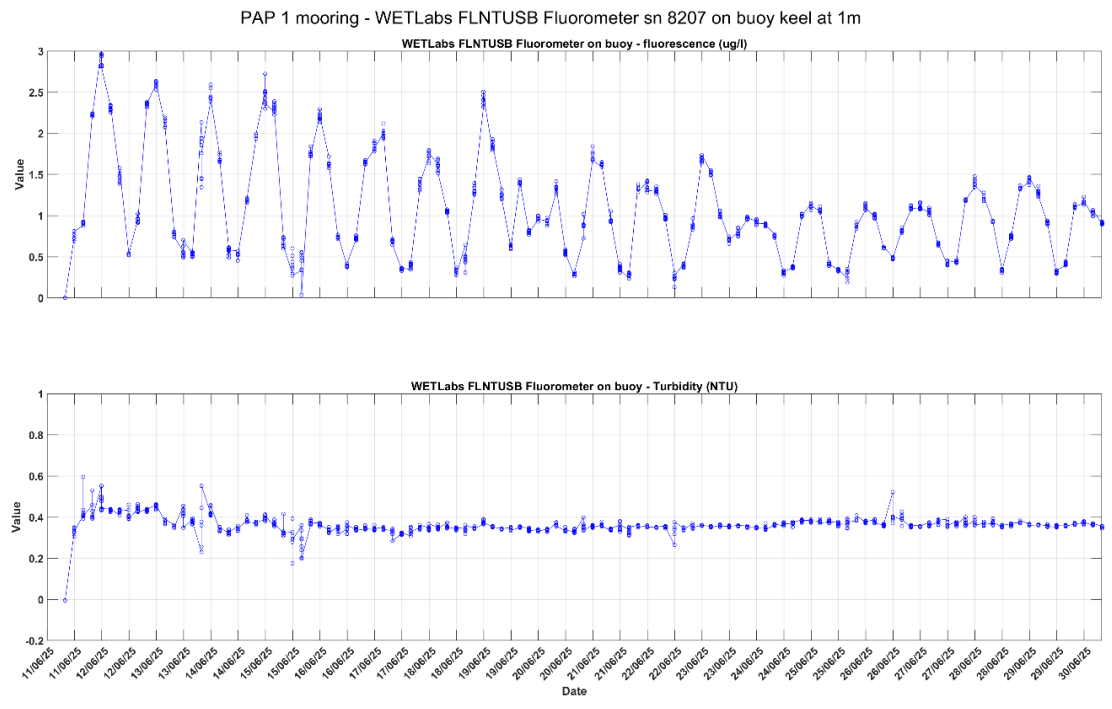


Figure 8.5: Early PAP1 near real time Fluorescence and Turbidity data until 30th June 2025

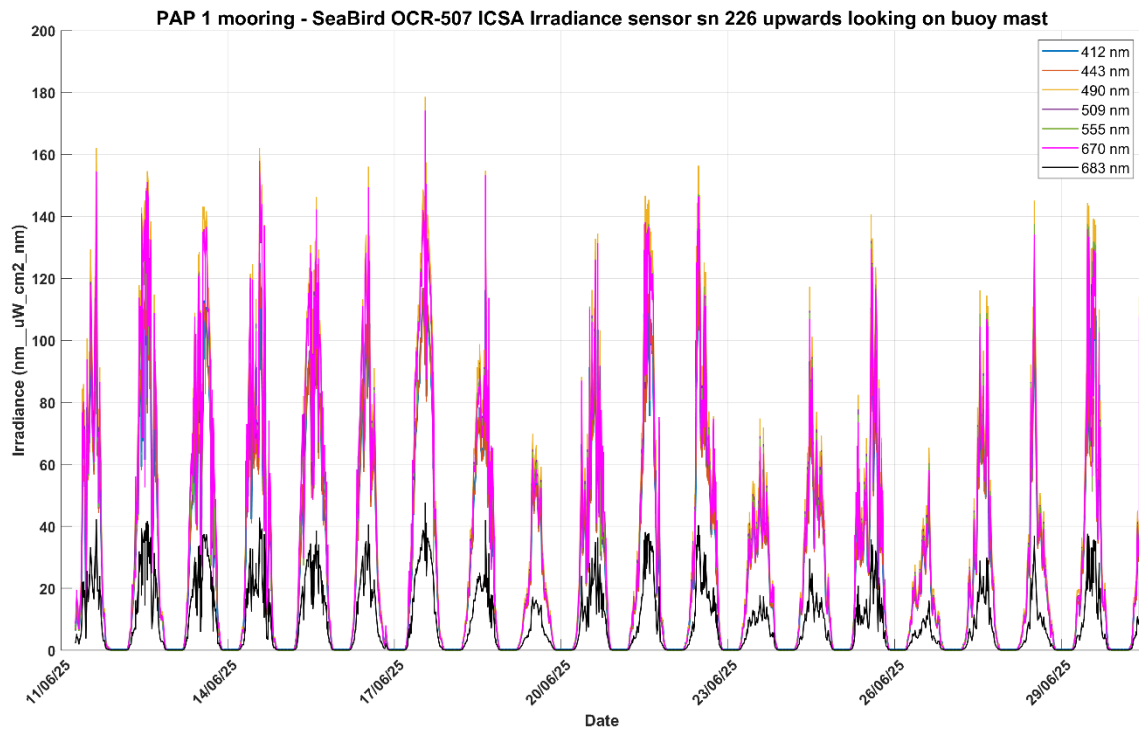


Figure 8.6: Early PAP1 near real time surface irradiance data from deployment until 29th June 2025

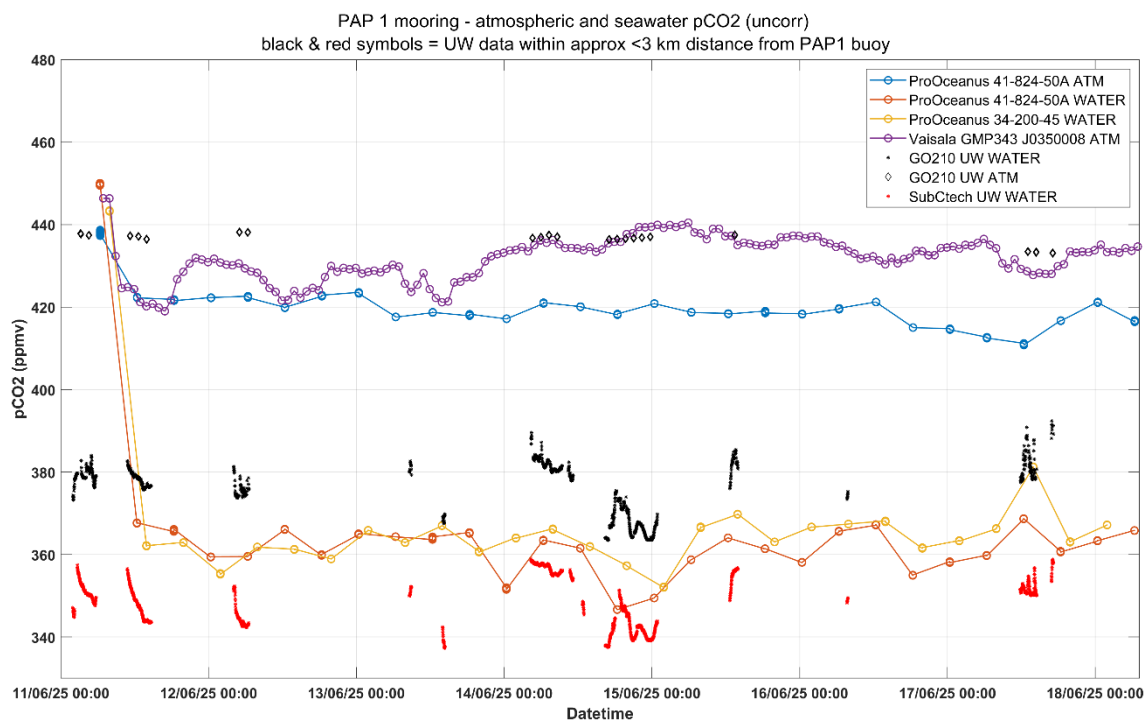


Figure 8.7: Early PAP1 near real time CO₂ data from surface ocean and atmosphere until 18th June 2025. Includes data from underway systems when the James Cook was within 3 km of PAP1.

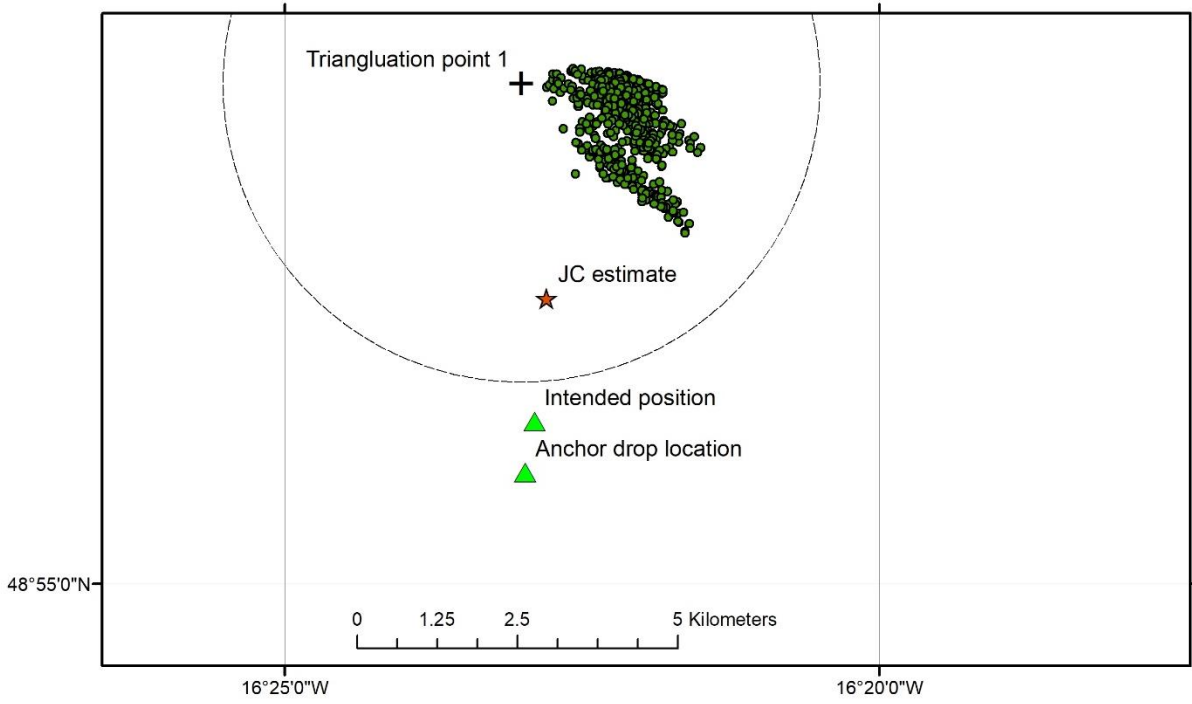


Figure 8.8: Early indications for an updated position for the PAP1 anchor (red triangle = early estimate of actual anchor position).

9. CTD casts and water sampling

Sue Hartman, Sophie Clayton, Dipin Ghosh, Socratis Loucaides, Christopher Feltham

9.1 CTD operations

On JC278 a total of 19 Conductivity Temperature Depth (CTD) casts (Table 9.1) were completed for various purposes:

- Discrete dissolved oxygen (DO) (section 9.2) and salt (Section 6.3) samples for validation of sensors on the CTD frame
- Discrete samples for carbonate chemistry – including total alkalinity (TA), dissolved inorganic carbon (DIC) and pH (Section 9.3) as well as dissolved inorganic nutrients (Section 9.4) for (i) continuation of the full depth timeseries and for (ii) validation of the pCO₂ and nutrient sensors deployed at the PAP1 mooring. ‘Science’ deep casts, including validation of the GEORGE project EGIM
- validation of deployed and recovered microCATs at PAP3 and Whittard Canyon (see Cal1-cal4 folders in Sensors and Mooring). These casts had long stops (5-10 min)
- Deep CTDs with acoustic release tests
- Validation casts for BGC ARGO float deployments (Section 12 and Section 16.3)
- Validation glider casts, with gliders attached by frames and 3x 1-hour stops (Section 16.2)

Maps with CTD locations is shown in Figure 9.1-9.3 and the CTD deck sampling logs with details of each cast, sample depths and samples taken are listed in Section 9.8.

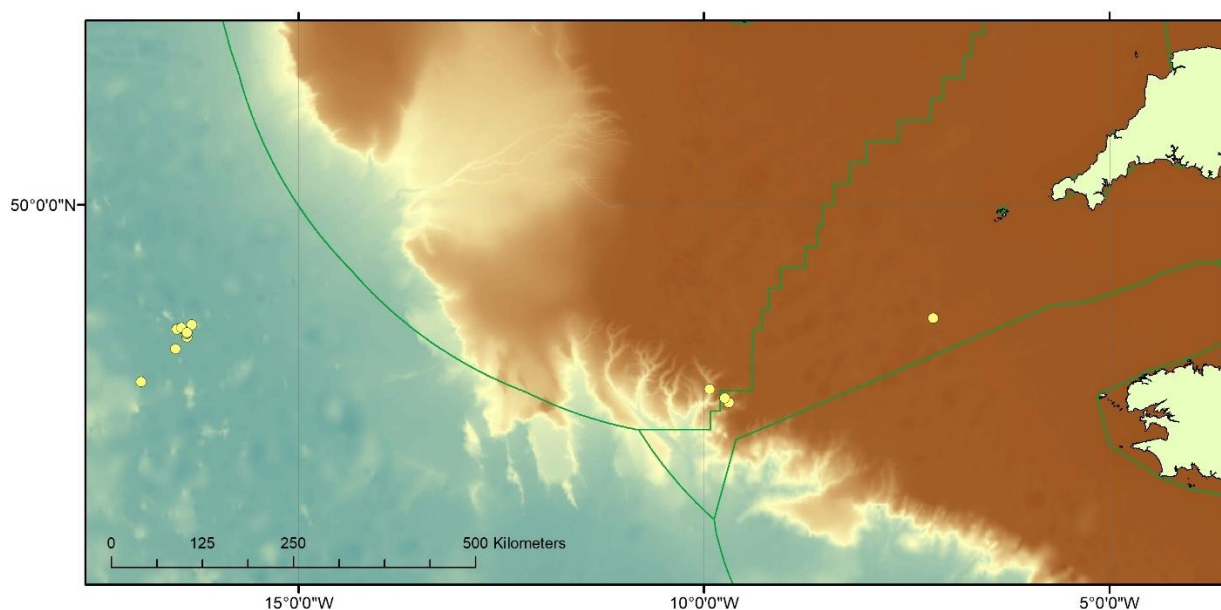


Figure 9.1: Location of all CTD casts on JC278

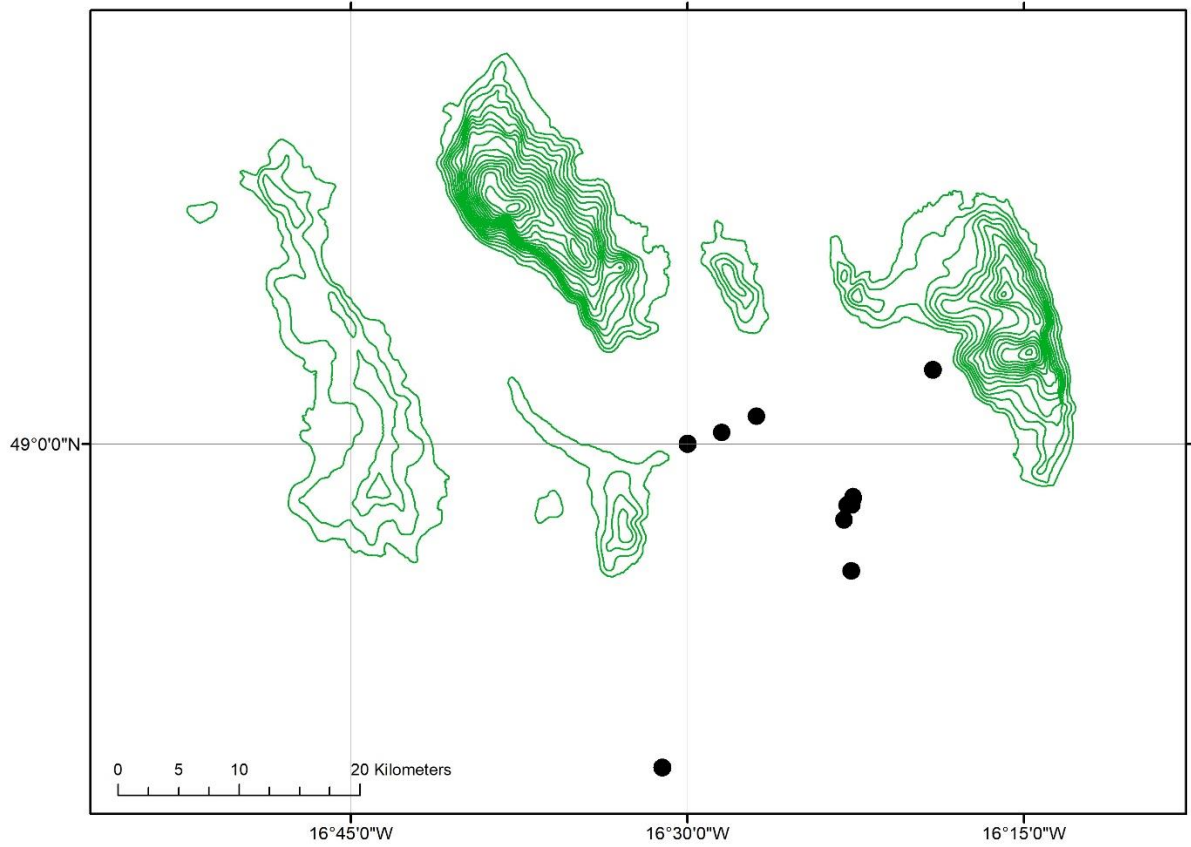


Figure 9.2: CTD stations in the PAP-SO area

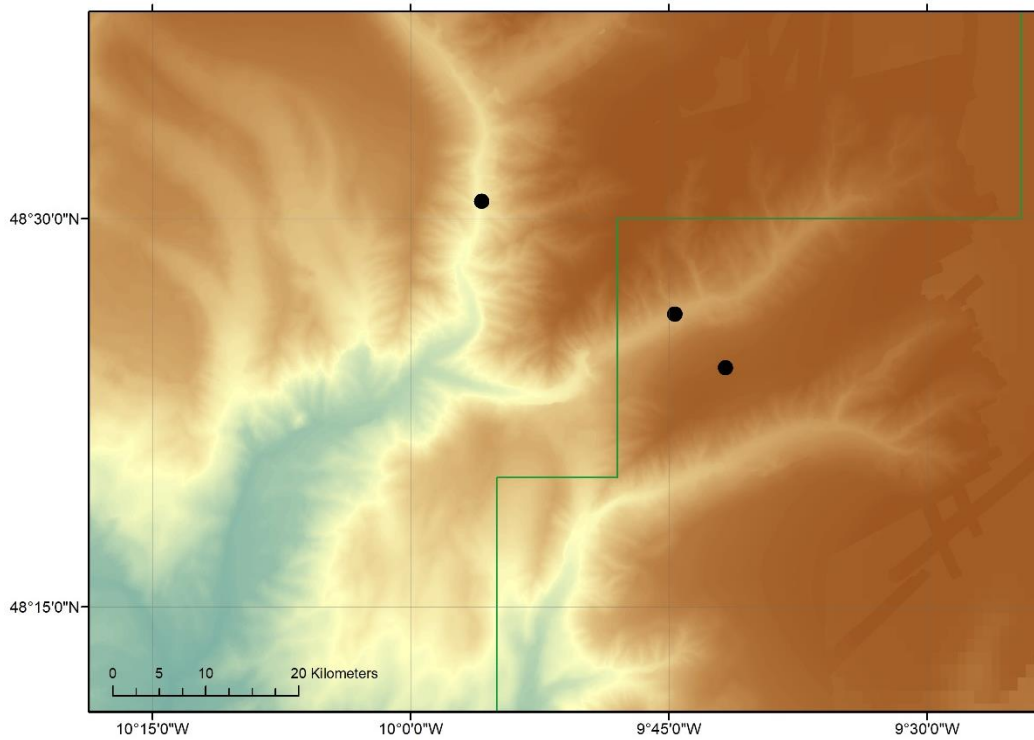


Figure 9.3: CTD stations in the Whittard Canyon area

CTD sampling

Once the CTD was back on deck, samples for dissolved oxygen (analysed onboard) were first in line and included bottle temperature to identify any misfires. The second sample was for carbonate chemistry (DIC, TA, pH), sampled into 250mL bottles, preserved with HgCl₂ for Vindta 3C analysis ashore. Note that on MicroCAT and glider validation casts the dissolved gas samples (DO, DIC) may be impacted by the long stop. Then inorganic nutrients were sampled (using non-nitrile gloves), followed by salinity samples for onboard analysis by NMF (Thank you Jade).

On most CTD casts, the 5L carboys were then filled (sometimes in duplicate) for all the chlorophyll and particulate related variables. Most of the chlorophyll (and SFC) samples were filtered and then frozen at -20C, before being batched up into groups of 20-60 samples for fluorometer analysis. This involved extraction into acetone with 'Trilogy' fluorometer analysis onboard (see details below).

Analyses of particulate inorganic carbon (PIC), particulate organic carbon (POC), High performance Liquid Chromatography (HPLC) and biogenic silica (BSi) will be carried out at NOC Southampton.

Table 9.1: CTD summary table for JC278, including depth, position and samples taken (further information in the main station log and CTD sampling logs)

stn no.	Cast	Date	start time	end time	Lat (N)	Lon (W)	cast depth (m)	Notes	Samples
JC278-001	1	31/05/2025	09:15	09:40	49° 5.466	7° 10.442	117	test CTD. O2 offset ~10uM, and no fluoro	O2, DIC, Nut, Salt
JC278-002	2	31/05/2025	20:06	20:26	48° 24.24	9° 41.7	331	Hybis svp / REDRESS CTD O2 offset still ~10uM	O2, DIC, Nut, Salt, Chl
JC278-004	3	01/06/2025	06:00	07:27	48° 26.309	9° 44.66	1295	release test for PISCES moorings Cal1-ucats 5 min stops, SN 6912,7289, 7294/95,7300 O2 offset still ~10uM	O2, DIC, Nut, Salt, Chl, SfC, Lugol, SEM
JC278-010	4	02/06/2025	06:00	08:30	48° 26.309	9° 44.662	2130	WCM CTD Cal-2 ucat 6907, 8081 O2 offset ~2uM (so is OK)	O2, DIC, Nut, pH, Salt, Chl, HPLC, PIC
JC278-013	5	05/06/2025	04:35	08:26	48° 59.993	16° 30.006	4827	Release test. Cal-3 ucat, 10 min stops, SN7297, 9386, 12463	O2, DIC, Nut, Salt, HPLC, chl, SfC, Lugol, benthic
JC278-014	6	05/06/2025	10:10	14:11	49° 0.329	16° 28.469	1000	Glider calibration (3 depths, 1000 m failed to fire, 1 hr stops)	O2, DIC, Nut, Salt, chl, Lugol
JC278-023	7	07/06/2025	04:55	08:52	49° 0	16° 30.002	4820	Full depth Science & PAP1 releases. PC issues (O2 recalculated, use CTD7-2)	O2, DIC, Nut, Salt, HPLC, Chl, SfC, POC, Lugol
JC278-027	8	11/06/2025	04:13	05:11	48° 55.901	16° 22.901	1000	Note O2 offset (block by arrow worm N5, O2 diff ~5uM)	O2, DIC, pH, Nut, Salt, HPLC, chl, SfC, PIC, POC, Bsi, Lugol
JC278-030	9	12/06/2025	05:01	06:12	48° 58.2	16° 22.871	1000	500 m from PAP1 (N5 leaks)	O2, DIC, pH, Nut, Salt, HPLC, Lugol
JC278-033	10	13/06/2025	04:08	05:16	48° 50.494	16° 31.123	1000	1000 m Argo validation (N5 and N7 leaks)	O2, DIC, pH, Nut, Salt, HPLC, Chl, SfC, Lugol,
JC278-038	11	13/06/2025	12:17	13:25	49° 2.178	16° 19.062	1000	glider area validation CTD midday cast (N7 leak, N11 not fired)	O2, DIC, pH, Nut, Salt, HPLC, Chl, Lugol
JC278-041	12	14/06/2025	04:56	06:05	48° 57.772	16° 23.011	1000	1000 m near PAP1 (N7 leak)	O2, DIC, pH, Nut, Salt, HPLC, Chl, SfC, PIC, POC, Bsi, Lugol
JC278-043	13	15/06/2025	04:11	08:09	49° 0.00	16° 29.999	4835	Science deep CTD (N7 leak, avoid from now)	O2, DIC, pH, Salt, Nut, HPLC, Chl, SfC, Lugol
JC278-044	14	15/06/2025	13:02	13:34	48° 58.213	16° 22.679	200	GEORGE Sampler 200m cast (2min stop at 200m). Odd O2 spike ~90m	O2, DIC, pH, Nut, Salt
JC278-050	15	17/06/2025	04:06	07:45	49° 0.005	16° 29.999	4830	Deep Science CTD.	O2, DIC, pH, Nut, Salt, HPLC, Chl, SfC, PIC, POC, Lugol, Bsi
JC278-052	16	17/06/2025	12:38	16:31	48° 58.384	16° 22.607	1000	1000 m glider calibration CTD (midday cast, PAR to 130m)	O2, DIC, pH, Nut, Salt, HPLC, Chl, SfC, Lugol, PIC, POC, Bsi
JC278-055	17	18/06/2025	04:13	07:54	49° 0.688	16° 27.106	4830	EGIM validation cast (7m above bottom), PAP3 ucat 1hour stops x3 (SN 24771 and 9385)	O2, DIC, pH, Nut, Salt, HPLC, PIC, POC, Lugol, Bsi
JC278-056	18	18/06/2025	13:45	14:16	48° 58.45	16° 22.621	200	PAP1 (~midday so PAR to ~120m), GEORGE sampler on, to 200m for 2 min stop	O2, DIC, pH, Nut, Salt, Chl
JC278-058	19	20/06/2025	18:06	19:42	48.5736	16.9447	2000	Argo cast	O2, DIC, pCO2

CTD profiles

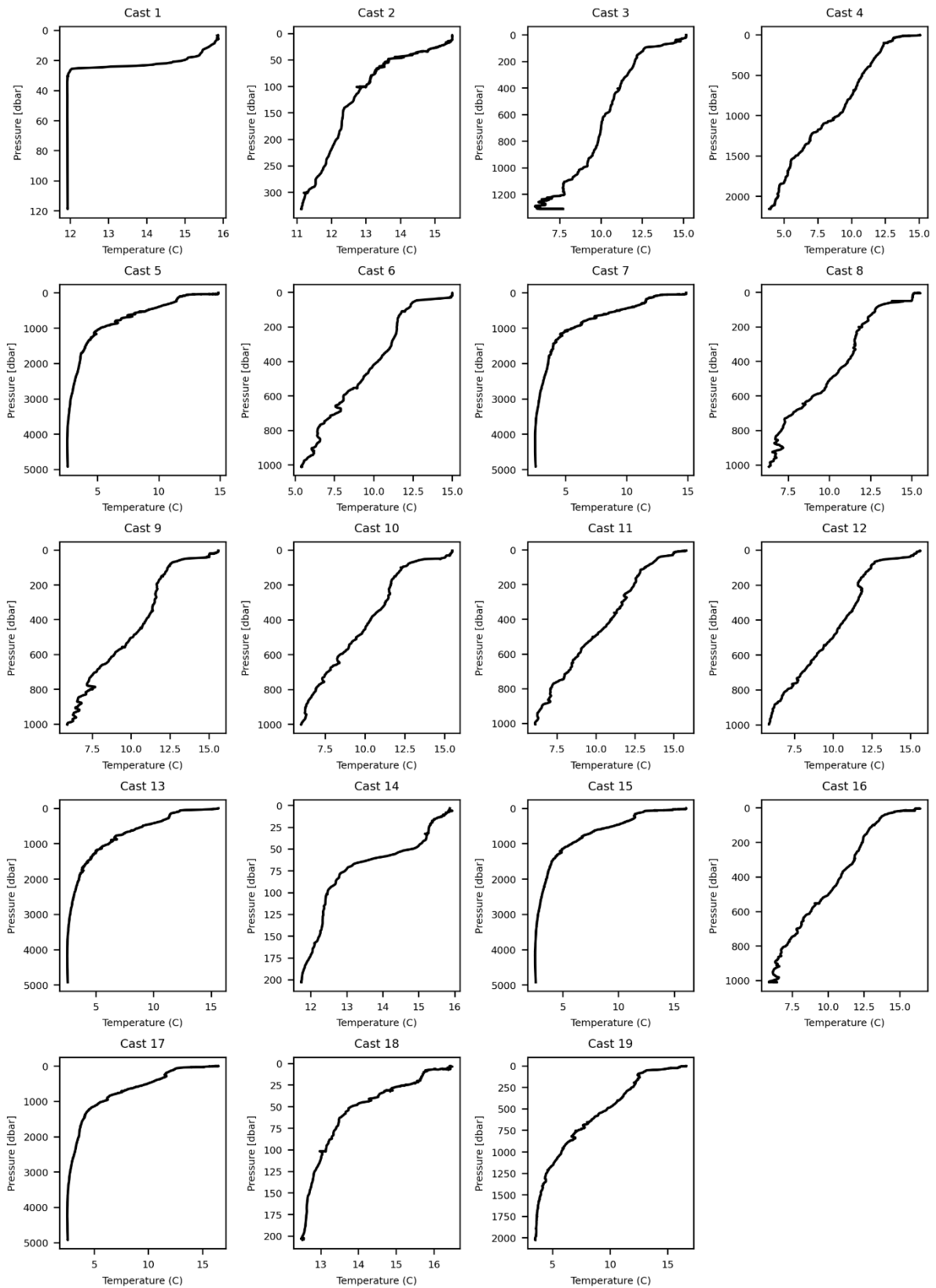


Figure 9.4: Full temperature profiles for all CTD casts on JC278. Note different y axes.

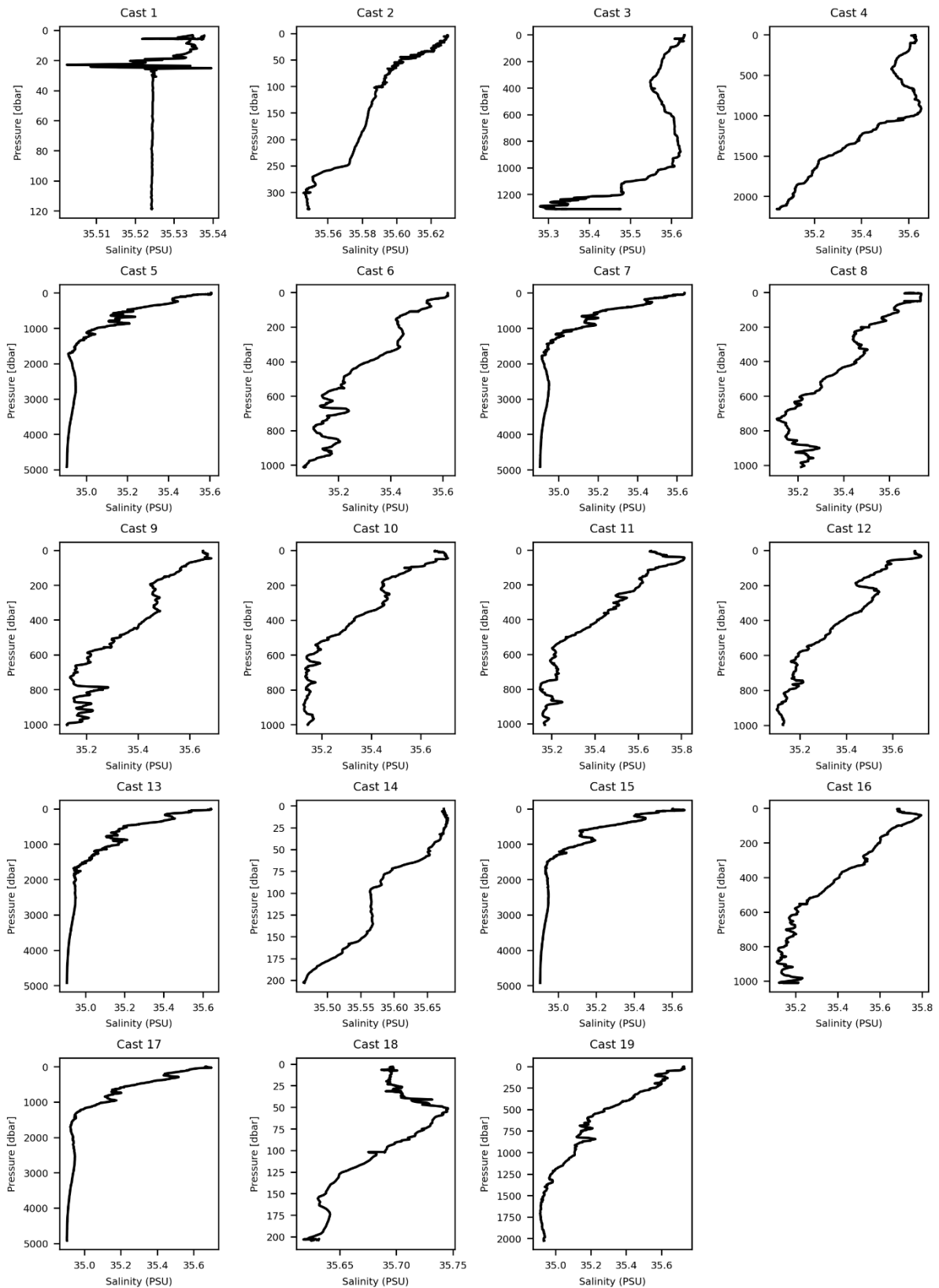


Figure 9.5: Full salinity profiles for all CTD casts on JC278. Note different y axes.

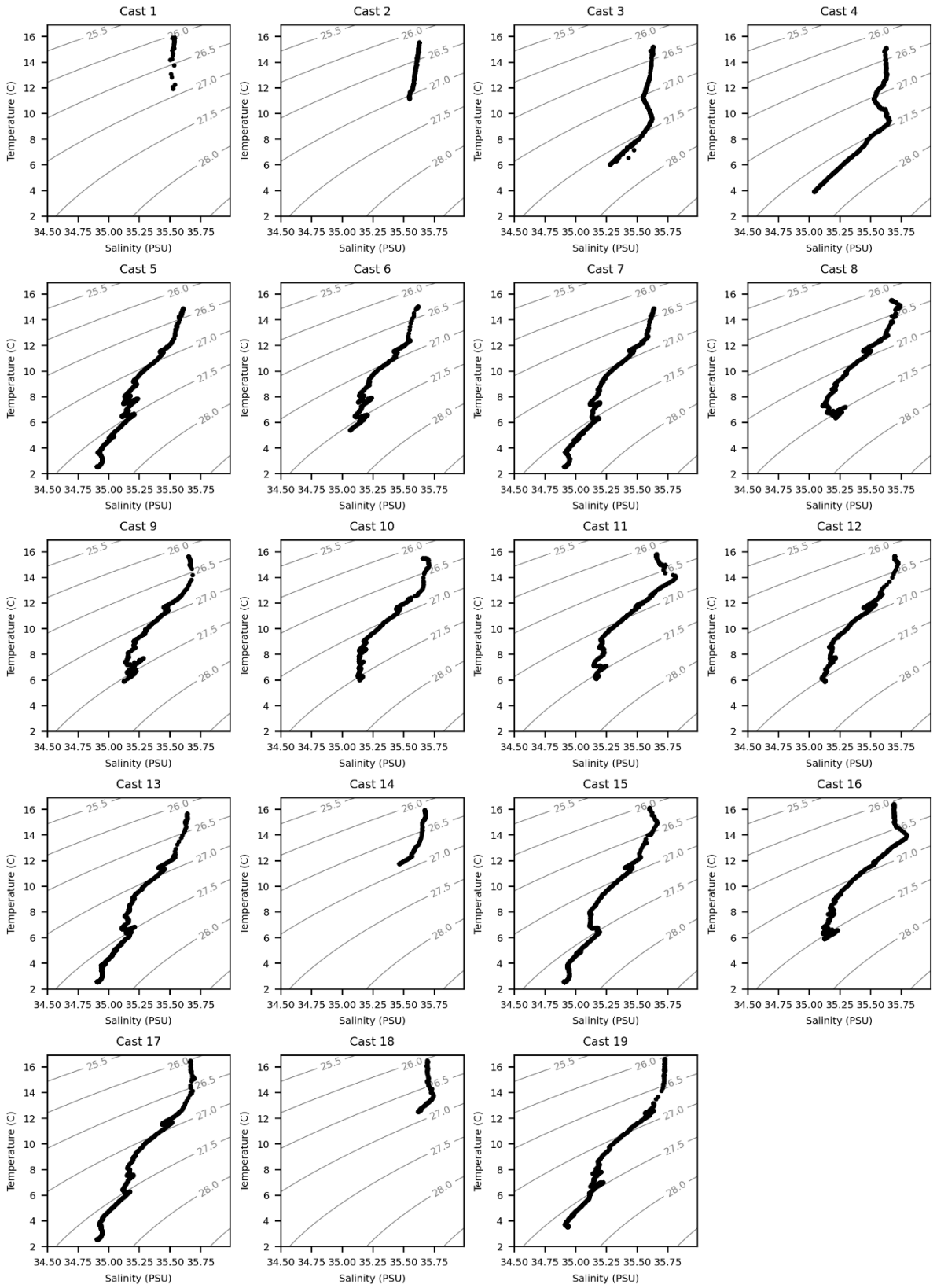


Figure 9.6: T/S plots with density for all CTD casts on JC278

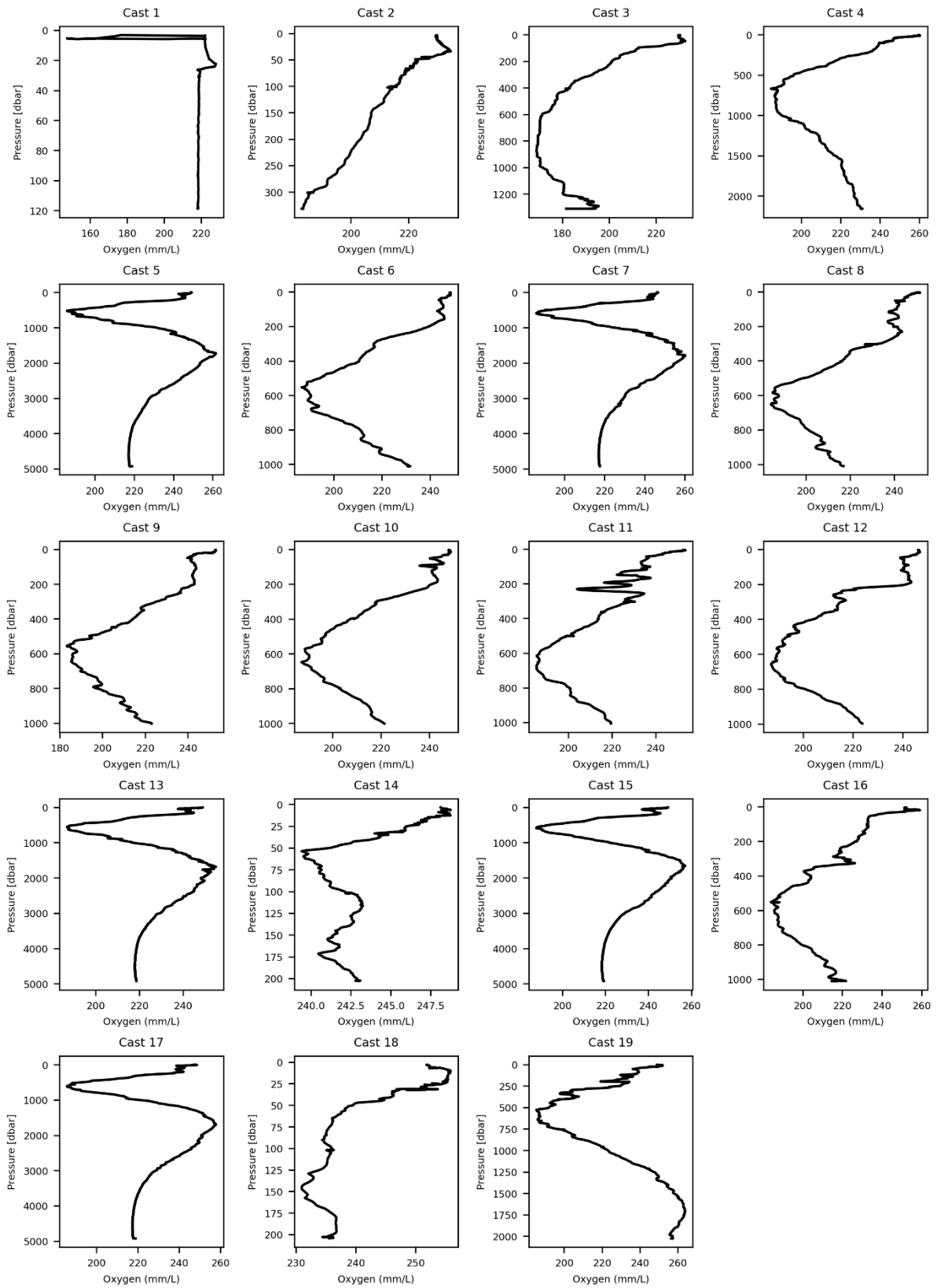


Figure 9.7: Full Oxygen (mmolL^{-1}) profiles for all CTD casts on JC278. Note different y axes.

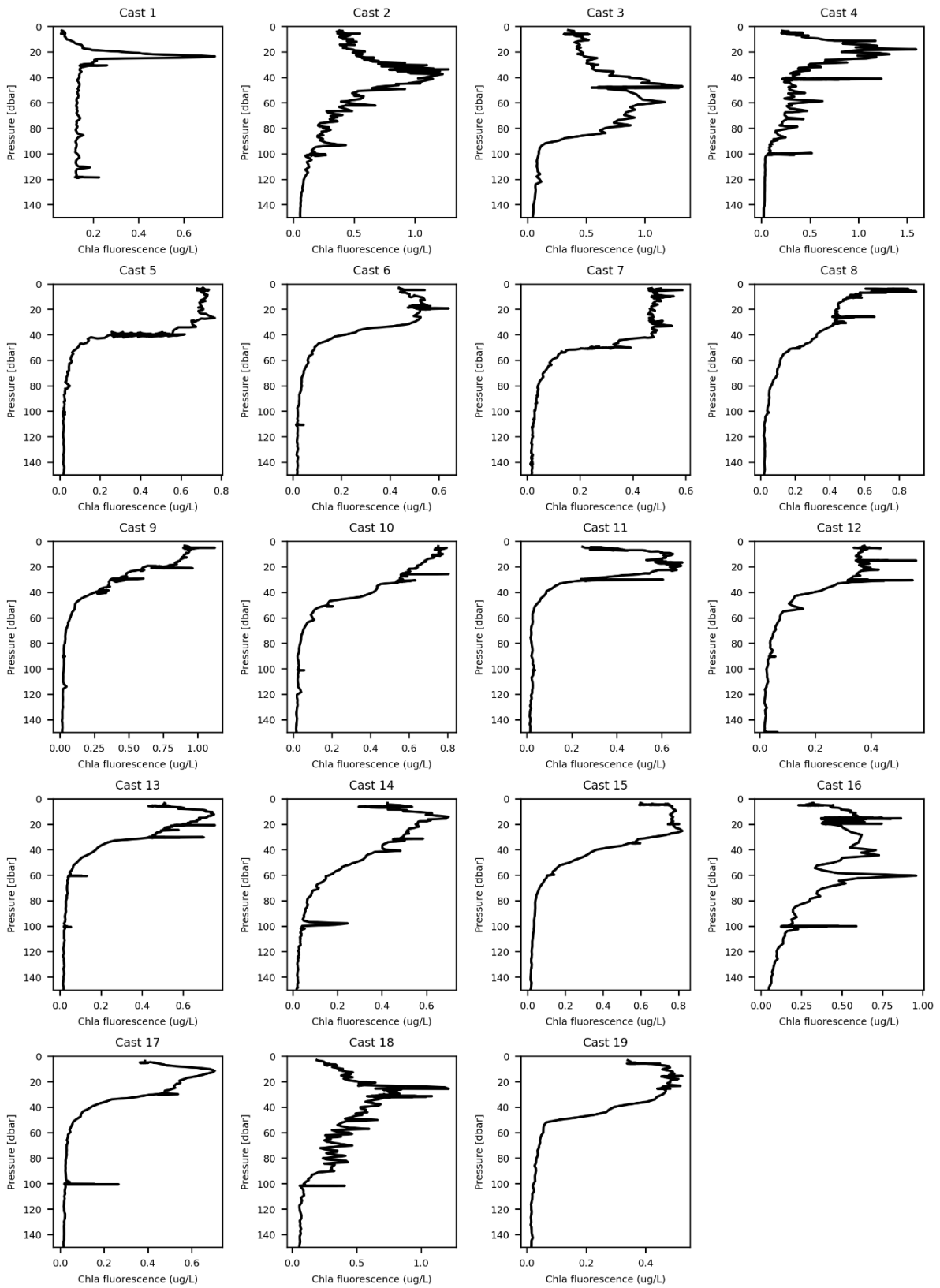


Figure 9.8: Chl-a fluorescence profiles to 140 m for all CTD casts on JC278. Note – consistent y axes.

9.2 CTD processing

Sue Hartman, Sophie Clayton, Anita Flohr (at NOC)

The configuration of the 24-way Stainless Steel CTD frame used on JC278 is described in detail in Section 6.3 with full lists of sensors, serial numbers and any changes during the cruise. A simplified sensor list is shown in Table 9.2.

Table 9.2: CTD configuration during JC278 (from CTD Cruise Report'). The following sensors were fitted to the Stainless Steel CTD frame. Note, Oxygen sensors swapped from cast 003

Instrument / Sensor	Manufacturer / Model
Stainless steel 24-way CTD frame	NOCS
Primary CTD deck unit	SBE 11plus
CTD Underwater Unit	SBE 9plus
24-way Carousel	SBE 32
Primary Temperature Sensor	SBE 3P
Primary Conductivity Sensor	SBE 4C
Digiquartz Pressure sensor	Paroscientific
Secondary Temperature Sensor	SBE 3P
Secondary Conductivity Sensor	SBE 4C
Primary Pump	SBE 5T
Secondary Pump	SBE 5T
Primary Dissolved Oxygen Sensor	SBE 43
Secondary Dissolved Oxygen Sensor	SBE 43
Altimeter	Valeport VA500
Light Scattering Sensor	WET Labs ECO BBRTd
Transmissometer	WET Labs C-Star DR
Fluorometer	CTG AquaTracka Mk3
PAR Down-looking UWIRR	Satlantic Cosine PAR-LOG
PAR Up-looking DWIRR	Satlantic Cosine PAR-LOG
20L Water Samplers	Ocean Test Equipment
Titanium EM CTD Swivel	MDS ST6003-2E2-Ti

The CTD sensor data were acquired through SeaBird SeaSave Vers. 7.26.7.121 generating the following files per each cast:

- JC278_CTD_nnn.bl
- JC278_CTD_nnn.hdr
- JC278_CTD_nnn.hex
- JC278_CTD_nnn.XMLCON.

The files were then processed using SBE Data Processing Vers. 7.26.7.1. The modules run and details on the settings are detailed in Table 9.3.

Table 9.3: Modules and settings used as part of the SBE Data Processing of the CTD files

Processing step	Input	Append	Output	Comment
1a. Data conversion	*.xmlcon, *.hex	c	*c.cnv	On downcast Scan range offset: -2.5 sec ⁽¹⁾ Scan range duration: 5 sec ⁽¹⁾ Tau correction and hysteresis correction applied ⁽²⁾
1b. Data conversion	*.xmlcon, *.hex		*c.ros	On up and downcast Scan range offset: -2.5 sec ⁽¹⁾ Scan range duration: 5 sec ⁽¹⁾ Tau correction and hysteresis correction applied ⁽²⁾
2. Bottle summary	*c.ros, *.bl, *.xmlcon		*c.btl	
3. Wild Edit	*c.cnv	w	*cw.cnv	WildEdit run on pressure only and before FILTER ⁽¹⁾
4. Filter	*cw.cnv	f	*cwf.cnv	FILTER run on the pressure channel ⁽¹⁾ For the SBE911 <i>plus</i> pressure sensor this is 0.15 sec ^(1,2)
5. Align	*cwf.cnv	a	*cwfa.cnv	Conductivity and temp advanced automatically, for oxygen advance of 6 sec ⁽¹⁾
6. Cell Thermal Mass	*cwfa.cnv	t	*cwfat.cnv	alpha=0.03; 1/beta=7 ⁽¹⁾
7. Loop Edit	*cwfat.cnv	l	*cwfatl.cnv	Fixed velocity, min CTD velocity = 0 m/s, remove surface soak ⁽¹⁾
8. Derive	*cwfatl.cnv, *.xlmcon	d	*cwfatld.cnv	
9. Bin average	*cwfatld.cnv	b	*cwfatldb.cnv	1 db intervals

References: (1) Moncoiffé (2010), Recommended steps for basic processing of SBE-911 CTD data, Document version: 1.0 October 2010; (2) Seasoft V2: SBE Data Processing CTD Data Processing & Plotting Software for Windows Software Manual, 2017

The processed files will be used to calibrate the CTD profiles using bottle salinity and oxygen bottle data back at NOC Southampton. Initial basic linear regression of the dissolved oxygen analysis from Dipin onboard, against the sensors for oxygen on the CTD casts identified some issues with the oxygen sensors, especially on the first two casts, and with cast 7 (when the PC crashed).

- Cast 001 – 002 – Primary Oxygen 43-0363 & Secondary Oxygen 43-0862
- Cast 003 – 018 - Primary Oxygen 43-0862 & Secondary Oxygen 43-0709

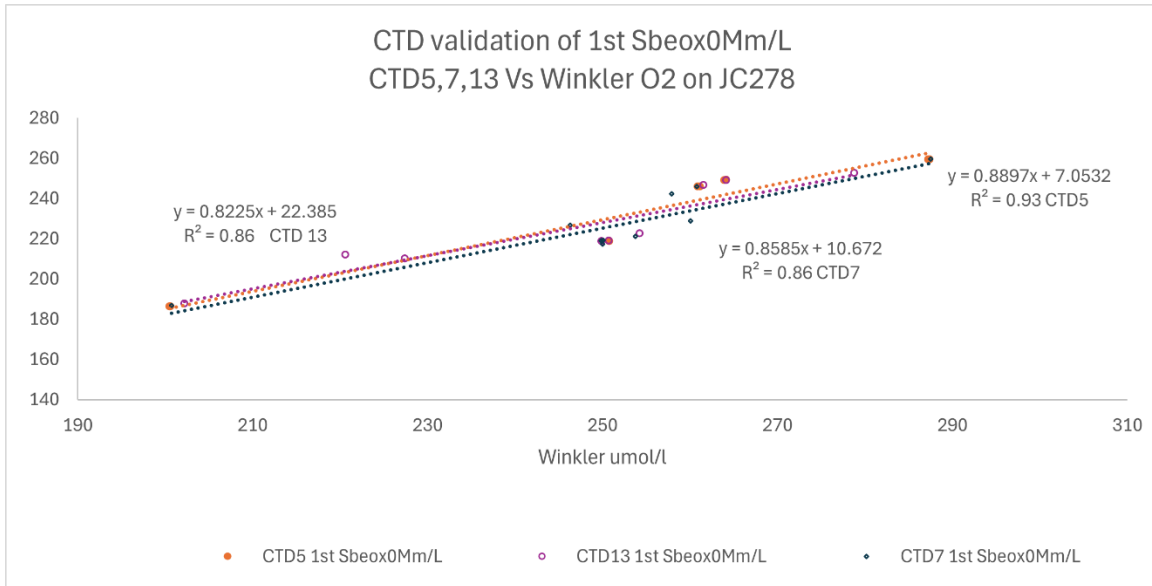


Figure 9.9: Initial validation of CTD Oxygen on JC278

A similar regression of the chlorophyll samples (Figure 10.10) with the CTD fluorescence sensor did not result in a sensible Chl: Fluoro relationship, and we will discuss with Stuart Painter ashore.

Acknowledgements

Many thanks to Jade, for support and willingness to operate the CTD at any time of the day. Also thanks to Allison for the CTD position maps.

9.2 Dissolved oxygen sampling

Dipin Ghosh (NOC), Sue Hartman (NOC)

Dissolved oxygen (DO) is the gaseous form of oxygen that is mixed into water and available for use by aquatic organisms. It is a critical parameter in aquatic environments and serves as an indicator of water quality and ecosystem health. The levels of DO in an aquatic system are influenced by temperature, salinity, pressure, biological activity, and pollution. It is typically measured in milligrams per liter (mg/L) or as a percentage of saturation.

Dissolved oxygen samples were collected during the current JC278 PAP cruise. The primary purpose of the sample collection was to calibrate the CTD's dissolved oxygen sensor and for comparison with the underway optode onboard, and the PAP1 sensors on the buoy when we were close to PAP1. Also DO sensors from the PAP3 ODO microcat, as well as from the GEORGE sampler, EGIM, and glider, are also intended to be calibrated using these samples. The preparation of reagents, as well as the sampling and analysis of DO samples, followed standard operation procedures (Dickson, 1995; Langdon, 2010).

Reagents

The following reagents were prepared prior to the cruise at the National Oceanography Centre (NOC), Southampton:

- Manganous chloride ($\text{MnCl}_2 \cdot 5\text{H}_2\text{O}$, 3 M)- Winkler A
- Sodium hydroxide (NaOH, 8 M) / Sodium iodide (NaI, 4 M)- Winkler B
- Sulfuric acid (H_2SO_4 , 5 M)

These reagents were marked as Reagent 1, Reagent 2 and Reagent 3 respectively. This helps to avoid the confusion during blank determination and thiosulfate standardisation.

Sodium thiosulfate ($\text{Na}_2\text{S}_2\text{O}_3$, 0.11 M) was weighed into 27.4 g portions at NOC to prepare a 1 L solution. The $\text{Na}_2\text{S}_2\text{O}_3$ solution was made on board before the commencement of the cruise, allowing sufficient time (~2 days) for the solution to stabilise and become more consistent before use, and was stored in an amber glass jar. For thiosulfate standardisation, a certified potassium iodate (KIO_3 , 0.00167 M) standard from OSIL was used.

Sampling

With the help of thin-walled silicon tubing, seawater samples were collected directly into Pyrex iodine titration flasks with ground glass stoppers from the Niskin bottles of a CTD cast. Each flask and stopper were numbered and calibrated so that the exact internal volume was known to ± 0.01 mL (ideally ± 0.003 mL).



Figure 9.10: Calibrated Pyrex iodine titration flask (with ground glass stopper)

Both Manganous Chloride (Reagent 1) and Sodium Hydroxide/Sodium Iodide (Reagent 2) reagents were kept nearby during sampling. Any air bubbles trapped inside the silicon tubing were removed by gently squeezing the tubing before collecting the sample. The bottle was flushed several times before the final sample was drawn. Storing the tubing in underway seawater helped prevent bubble accumulation. Care was taken to avoid the formation of air bubbles, and the sample was allowed to overflow by more than three times the bottle volume. Overflowing ensures that any air initially present in the bottle or tubing is completely flushed out and is a critical step in ensuring the accuracy and reliability of DO measurements. The temperature of the seawater (fixing temperature) was recorded using a handheld thermometer (HANNA Instruments, S/N: TA05310249) during the overflow. The sample was immediately fixed by carefully immersing the tip of the dispenser into the sample and slowly adding 1 mL of Reagent 1, followed by 1 mL of Reagent 2 solution. Both reagents were dispensed using calibrated bottle-top dispensers capable of repeatedly delivering 1.0 mL (± 0.02 mL). After carefully placing the stopper, the sample was thoroughly shaken for 30–60 seconds and stored in the dark to allow the precipitate to settle and the sample to warm to room temperature. All samples were shaken again after approximately 20–30 minutes to ensure the reaction was complete. To prevent air ingress, the flared necks were sealed with ultrapure (Milli-Q) water. Analyses were conducted within 2 to 24 hours of sample collection, with a minimum wait time of two hours post-sampling. Below is an example of the CTD deck sampling log used during sample collection, e.g. CTD Cast number 001.

For DO sample titration, the ultrapure water (Milli-Q) seal was poured off, and the stopper of the flask was carefully removed. A 1 mL aliquot of Reagent 3 was dispensed into the flask, along with a clean Teflon-coated magnetic stir bar. The flask was then placed on the stir plate, and the electrode and burette tip were carefully inserted. The initial volume of $\text{Na}_2\text{S}_2\text{O}_3$ titrant for each sample was 0.3 mL, after which titration continued in 0.0005 mL intervals using an electrode with amperometric end-point detection (Culberson and Huang, 1987), with an end current of 0.1×10^{-6} A. Once the titration was complete, the final volume of $\text{Na}_2\text{S}_2\text{O}_3$ titrant was recorded manually, digitally, and logged on the Metrohm Ti-Touch 916.



Figure 9.12: The Metrohm Ti-touch 916

Results:

A total of 142 samples were analysed. Samples from the first three casts (CTD 1 [TEST CTD], CTD 2, and CTD 3) were analysed using a Metrohm Ti-Touch 916 instrument (S/N: 32285). From cast 4 (CTD 4) onwards, a different unit of the same model (S/N: 24169) was used, as the former unit exhibited unstable values due to bubbles forming in the iodate dispenser. Efforts were made to resolve the issue. Assistance was sought from Ed Mawji, and their suggestions-such as shaking the thiosulfate and iodate standard solutions and checking the connections were implemented. However, no improvement was observed, and the decision was made to replace the former unit. Errors are expected in the results from the first three casts.

After replacing the titration unit, several dummy analyses were performed to ensure that no bubbles were entering the system. The reagent blank was calculated by subtracting the volume of the first blank from the average of the second and third blanks, i.e., Reagent blank = $V_1 - [(V_2 + V_3)/2]$. Small positive values are anticipated, as any trace contaminants (e.g., redox species or dissolved oxygen

from the Milli-Q water) should be accounted for in the first reagent blank titration. The reagent blank measured using the Ti-Touch 32285 unit was 0.0014 ± 0.0009 mL. For the Ti-Touch 24169, the average reagent blank was 0.0020 ± 0.0009 mL (Figure 9.13 and Table 9.4), with values ranging from 0.0018 to 0.0026 mL (median: 0.0020 mL, n = 84).

The standardisation of sodium thiosulfate was determined by titrating it against 5 mL of iodate standard. The standardisation volumes of $\text{Na}_2\text{S}_2\text{O}_3$ ranged from 0.4564 to 0.4577 mL (n = 44), with an average of 0.4570 ± 0.0002 mL (RSD = 0.17%) (see Figure 9.14 and Table 9.5). The molarity of the thiosulphate solution was calculated using the equation $M_{\text{thio}} = V_{\text{KIO}_3} * N_{\text{KIO}_3} / (V_{\text{std}} - V_{\text{blk}})$, where V_{KIO_3} = volume of KIO₃ standard added (mL), N_{KIO_3} is the molarity of standard KIO₃ (mol/L), V_{std} is the volume of thiosulfate (mL) and V_{blk} is the volume of the reagent blank (mL). The molarity of the thiosulfate solution ranged from 0.01832 to 0.01837 M (Table 9.5 and Figure 9.15). Slight variation in molarity was anticipated, as thiosulfate concentration can change with temperature.

Standard deviations of duplicate samples (same Niskin, same depth) ranged from ± 0.0 to $\pm 5.0 \mu\text{mol L}^{-1}$ (median: $\pm 0.158 \mu\text{mol L}^{-1}$, n = 36). Standard deviations of replicate samples (different Niskin, same depth) ranged from ± 0.044 to $\pm 0.66 \mu\text{mol L}^{-1}$ (median: $0.211 \mu\text{mol L}^{-1}$, n = 11). The higher standard deviation was caused by volume measurement errors in two bottles (A004 and A054). The average volume errors for A004 and A054 were $-4.72 \pm 0.50 \mu\text{mol L}^{-1}$ and $7.60 \pm 0.64 \mu\text{mol L}^{-1}$, respectively. It is recommended that samples be collected into all bottles during the test CTD to verify volume calibration. Although these bottles introduced volume errors, the dissolved oxygen profiles plotted from various deep casts generally fall within the expected range, with one outlier corresponding to the sample collected from A054 (Figure 9.15). Samples collected from the same location and depth ($\sim 5000\text{m}$) have an average concentration of $250.19 \pm 0.218 \mu\text{mol L}^{-1}$ (RSD = 0.087 %) (Table 9.6). The DO results will be used to calibrate the CTD's dissolved oxygen sensors after the cruise.

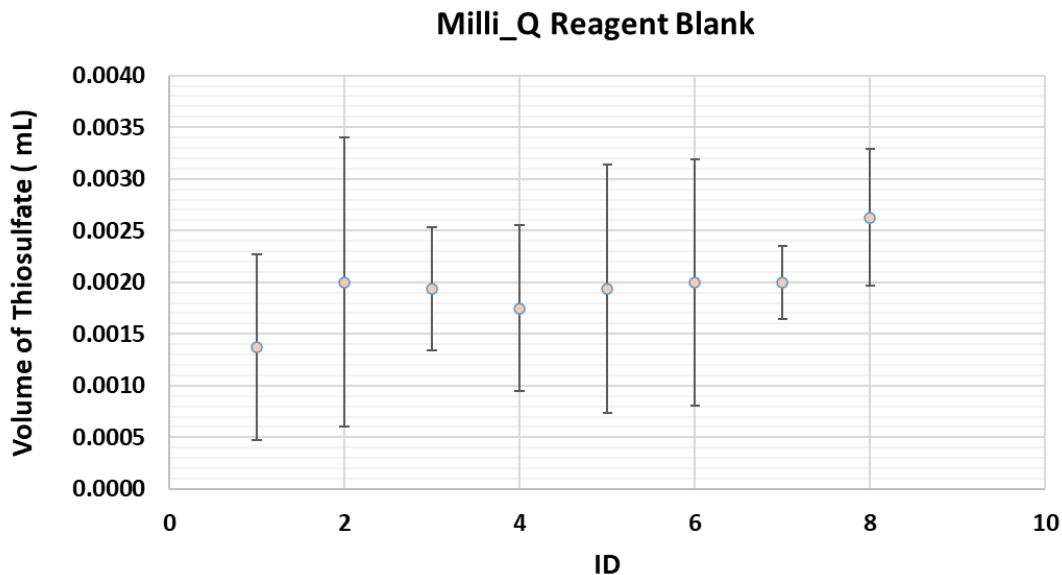


Figure 9.13: Results of reagent blank measurements in Milli-Q water.

Table 9.4. Results of blank measurements in Milli-Q water.

Date	Cast	ID	Reagent Blank Volume (mL)	Std Dev (mL)
01/06/2025	CTD 1(TEST), CTD2/3	1	0.0014	0.0009
02/06/2025	CTD 4	2	0.0020	0.0014
06/06/2025	CTD 5/6	3	0.0019	0.0006
08/06/2025	CTD 7	4	0.0018	0.0008
12/06/2025	CTD 8/ 9	5	0.0019	0.0012
13/06/2025	CTD 10/ 11	6	0.0020	0.0011
15/06/2025	CTD 12/ 13/ 14	7	0.0020	0.0003
18/06/2025	CTD 15/16/ 17/18	8	0.0026	0.0007
			0.0020	0.0009

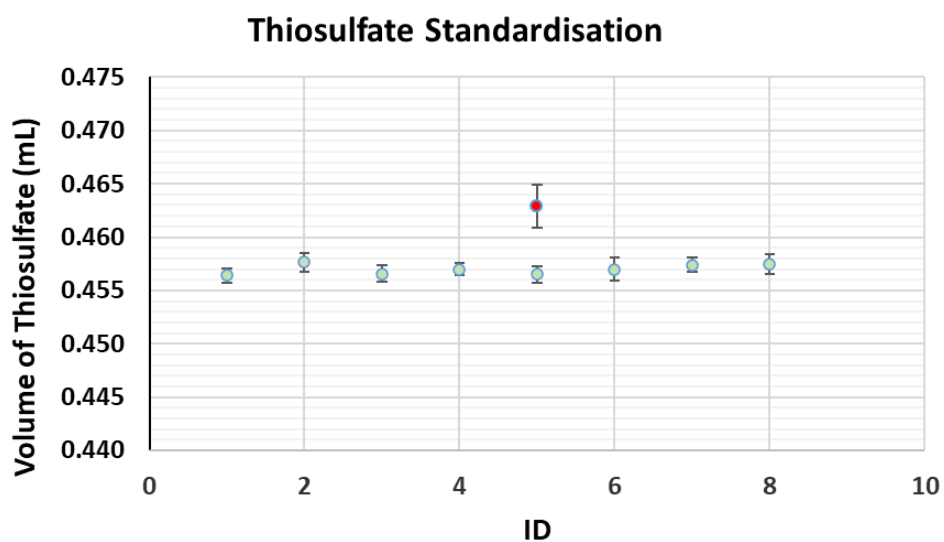


Figure 9.14: Results of sodium thiosulfate standardisation. The red circle data point is a value from a previous research cruise for reference.

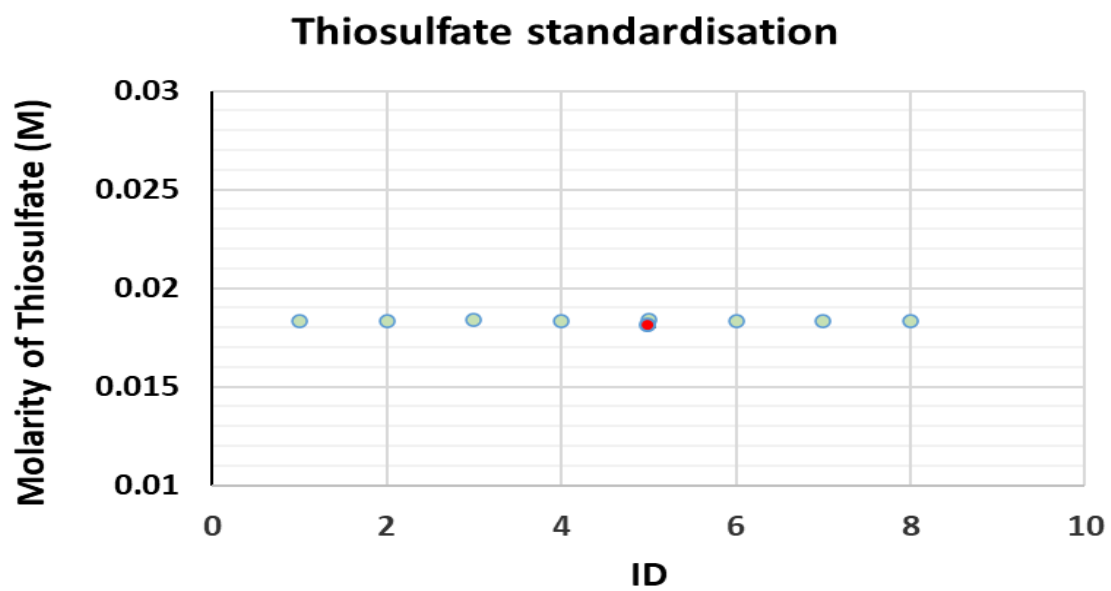


Figure 9.15: Results of sodium thiosulfate standardisation. The red circle data point is a value from a previous research cruise for reference.

Table 9.5: Results of sodium thiosulfate standardisation.

Date	CTD	ID	Volume of Sodium Thiosulphate (mL)						Average (mL)	Std Dev (±mL)	RSD (%)	Molarity of Thiosulfate (M)
01/06/2025	1/2/3	1	0.4560	0.4570	0.4570	0.4555	0.4565		0.4564	0.0007	0.14	0.01835
02/06/2025	4	2	0.4590	0.4585	0.4570	0.4570	0.4575	0.4570	0.4577	0.0009	0.19	0.01832
06/06/2025	5/6	3	0.4580	0.4560	0.4565	0.4565	0.4565	0.4560	0.4566	0.0007	0.16	0.01836
08/06/2025	7	4	0.4575	0.4570	0.4560	0.4570	0.4575	0.4570	0.4570	0.0005	0.12	0.01834
12/06/2025	8/9	5	0.4580	0.4560	0.4560	0.4565	0.4560	0.4565	0.4565	0.0008	0.17	0.01836
13/06/2025	10/11	6	0.4590	0.4565	0.4565	0.4565	0.4565		0.4570	0.0011	0.24	0.01835
15/06/2025	12/13 /14	7	0.4585	0.4570	0.4570	0.4570	0.4575		0.4574	0.0007	0.14	0.01833
18/06/2025	15/16 /17/18	8	0.4590	0.4575	0.4565	0.4570	0.4570		0.4575	0.0009	0.20	0.01835
Mean values									0.4570	0.0002	0.17	0.01834

Table 9.6: DO (umol/L) for samples collected at the same location and depth (~4830m)

Location (lat/long)	CAST	DEPTH	DO (umol/L)
49°0N/16°30.002W	7	4820	249.9518
49° 000N/ 16°29.999W	13	4840	250.2784
49°0.005N/16°29.999W	15	4830	250.3673
Mean			250.199

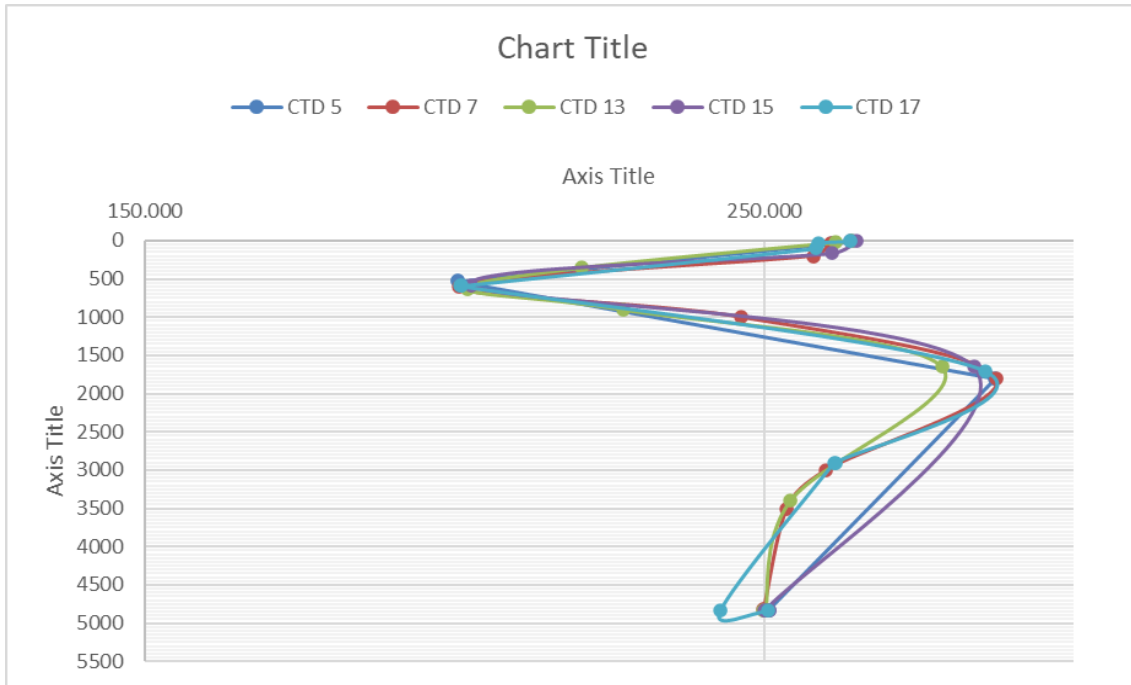


Figure 9.15. JC278 deep CTD profiles – to identify outlier bottle volumes

Acknowledgements

I convey my gratitude to Ed Mawji (NOC) for running the induction on DO analyses at NOC. Many thanks to Sam for help in shaking all the DO bottles and for inspection of the Thiosulphate unit.

References

- Culberson, C. H., and Huang, S.: Automated amperometric oxygen titration, *Deep-Sea Research Part I*, 34, 875-880, 10.1016/0198-0149(87)90042-2, 1987.
- Dickson, A. G.: Determination of dissolved oxygen in seawater by Winkler titration. WOCE Operations Manual, Part 3.1.3 Operations & Methods, WHP Office Report WHPO 91-1., 1995.
- Langdon, C.: Determination of dissolved oxygen in seawater by Winkler titration using the amperometric technique. IOCCP Report No. 14, ICPO Publication Series No. 134, Version 1, 2010.

9.3 Carbonate chemistry sampling

Dipin Ghosh, Socratis Loucaides, Anita Flohr (@NOC)

For CTD and underway Total alkalinity (TA) and dissolved inorganic carbon (DIC) samples were collected in 250 mL borosilicate glass bottles following Dickson et al. (2007); after a 1% by-volume headspace was created the sample was poisoned by addition of 50 μ L of saturated mercuric chloride solution (HgCl_2) and made air-tight by sealing with greased (Apiezon L) ground-glass stoppers secured with a clip and rubber band (and with electrical tape towards the end of JC278). The samples were stored in the dark at room temperature. Samples will be analysed at the National Oceanography Centre, Southampton, UK. Additional samples were taken for pH, especially at the surface and at 1000 m for comparison with LoC systems on the gliders. Further pH samples will go to Norway for analysis by ICOS. Stations and depths sampled for TA, DIC and pH are shown in Table 9.1, on the CTD sampling logs (Section 9.8) and underway sampling log (Table 10.3).

9.4 Dissolved nutrient sampling

Dipin Ghosh

CTD and Underway Nutrient samples were filled into 60 ml HDPE Nalgene bottles (acid-washed and rinsed with MilliQ). The sample bottle and cap were rinsed 3 times with sample before taking the final sample. Non-nitrile gloves (Semperguard) were used during sampling. The samples were then immediately frozen ($-20\text{ }^\circ\text{C}$) upright and will be analysed back at NOC for dissolved nitrate, nitrite, phosphate and silicate using an autoanalyzer.

9.5 Chlorophyll, HPLC pigment, Lugol's taxonomy and particulate sampling

Sue Hartman, Chris Feltham, Sophie Clayton

Objective

CTD and Underway samples were collected for total or bulk chlorophyll (using GF/F filters) and size fractionated chlorophyll (using 2, 10, 20 μm filters). Additional samples were filtered for particulate organic carbon (POC), particulate inorganic carbon (PIC), biogenic silica (BSi), particulate inorganic carbon (PIC), phytoplankton pigments (HPLC) and phytoplankton taxonomy (Lugol's). The purpose was to i) provide particulate concentration data to validate the PAP-1 mooring sensors, ii) provide insight into the makeup of the phytoplankton community.

Approach

Samples for all parameters were mostly collected on early morning CTD casts, with some additional underway sampling. Water samples for filtering were collected from the CTD in the top 30m for chlorophyll variables and within top 400m for PIC, POC and BSi. From each depth, one to two 5-liter carboys of water were sampled from the rosette. These carboys were then transferred to the chemical laboratory, where they were covered with dark plastic bags to prevent light exposure during the filtering process. To ensure thorough mixing before filtering, the samples were gently shaken by slowly inverting the carboy in a circular motion, repeating this action up to three times to achieve a homogeneous mixture. At this stage, the samples undergo filtration for various analyses, including

total chlorophyll, size-fractionated chlorophyll, particulate inorganic carbon (PIC), particulate organic carbon (POC), biogenic silica (bSi), and phytoplankton pigments (HPLC). Water samples were also collected for phytoplankton taxonomy (Lugol's) and SEM (microscopy).



Figure 9.16: Filtration unit used on JC278

Total Chlorophyll

Samples for total chlorophyll analysis were collected from the 5-liter carboy that was used during the sampling process. A volume of 250 ml (and 500ml later in when the fluorescence values dipped), was measured out and filtered through a 25 mm diameter, 0.7 μm pore size GFF filter using a low-pressure pump set to a maximum of -20 kPa. After completing the filtration process, the filters were folded, wrapped in foil, labelled and placed in the -20°C freezer.

Alongside the samples from the CTD, underway water samples were analysed for chlorophyll content following the same protocol. The samples were taken frequently (including a night sample, thanks to Jethro). One to two 500ml wide neck dark HDPE bottles were filled from the underway flow through system. The night samples were stored in the fridge and other samples filtered immediately.

Size-Fractionated Chlorophyll

Samples for the size-fractionated Chlorophyll analysis were collected from 5-liter carbuoys. Triplicate 250 ml volumes of seawater were measured out and filtered through 3 different pore size filter using a low-pressure pump (max -20 kPa):

25 mm, 20 μm nylon net filter

25 mm, 10 µm polycarbonate filter

25 mm, 2 µm polycarbonate filter

Once finished filtering, the filters were folded and wrapped in foil. They were transferred to the -20°C freezer until the batches of analysis were done. At that time, they were put into glass vials with 6 ml of 90% acetone and stored at 4°C in a fridge for 20-24 hours.

Chlorophyll analysis onboard

When batched up for analysis (on 5 occasions during JC278) the filters for bulk/total chlorophyll, and the Size fractionated chlorophyll, were put into glass vials containing 6 ml of 90% acetone, making sure that the filters were submerged into the acetone.

The vials were stored in a fridge at 4°C for 20-24 hours. After 20-24 hours, the samples were removed from the freezer and the filters were transferred into vials of 6ml 90% acetone transferred into a glass tube Fluorescence readings were obtained using a bench-top laboratory fluorometers (Turner Trilogy 816).



Figure 9.17: Benchtop Trilogy Fluorometer used on JC278

To ensure instrument accuracy and check for drift, three solid standard readings were performed, followed by one blank sample containing only 90% acetone. An H-factor must be used, which is specific to each Trilogy instrument and to each calibration. It is a measure of the solid standard at the point of calibration. Any difference between the daily measured value of the solid standard and the reference value (the h-factor) is used to modify the response factor from the calibration so that the calibration is maintained if the instrument drifts (assuming the chlorophyll-a module has not been removed as this will impact the calibration). The response factor (calibration slope) and the h-factor (solid standard reading) is specific for the instrument. You can't reuse information from previous spreadsheets. For Unit 816 the response factor (slope) is 0.1886 and the H-factor is 204.36 (based on the last calibration in April 2024).

The solid standard value should be ~ 204 for this unit (by measuring the standard with the raised edge at the back of the standard pointing away from you). Note that if it was significantly different from ~ 204 then we would need to contact whoever last used the Trilogy on recent cruises to check they did not adjust the standard (if they have then the calibration is unknown - or that the module

was not removed). As the values Chris obtained were ~200 we would expect sensible chlorophyll concentrations, however we could not get a sensible correlation between the samples and the CTD sensor, which will require investigation ashore.

A total of 250 samples were analysed for chlorophyll from the CTD and underway samples (including size fractionated chlorophyll). Chris did additional tests on the impact of the gloves, and any contamination from pen ink. After overnight 24-hour soaking (of part of the nitrile glove), the blank increased from 0.09 to 1.0, the cryo pen to 0.17 and permanent marker to 1.85. We changed the sample labelling from using pen to be 'stick on' labels early in JC278. The gloves only contacted the acetone briefly (not for 24 hours), but it was an interesting experiment nonetheless.

Phytoplankton Pigments HPLC

Samples intended for phytoplankton pigment analysis via High Performance Liquid Chromatography (HPLC) were also collected from many of the CTD casts. A volume of 1000 ml (to 2000ml) was measured out and filtered through a combusted 25 mm diameter, 0.7 μm glass microfiber filter (GFF) using a low-pressure pump (max -20 kPa). During the filtering process, the 2L Nalgene bottle were covered with dark plastic to prevent light exposure during the filtering process. Due to high biomass and/or time constraints, some samples were terminated with less than 2000 ml filtered (but with always more than 1000 ml), as the high particulate content caused significant clogging of the filter. Once finished, the filters were gently folded in half, wrapped in aluminium foil pouches and immediately flash frozen in liquid nitrogen to be stored at -80 °C in a freezer for later analysis. The filtration volumes were noted on a filtering log, especially to capture any changes in volumes (which have also been written on the foil packaging). A total of 41 HPLC samples were collected, from CTD and underway.

Particulate Organic Carbon/Nitrogen (POC/N)

Samples for particulate organic carbon were collected from 5-liter carboy that were preserved from CTD. A volume of 2000 ml was measured out and filtered through a combusted 25 mm diameter, 0.7 μm glass microfiber filter (GFF) using a low-pressure pump (max -20 kPa). For some samples the final filtered volume was less than 2000 ml (but more than 1000 ml), as high particulate biomass caused significant clogging of the filter. Once finished, the filtration tower was rinsed with about 10 ml of 0.2 μm filtered seawater. The filters were subsequently placed in individual petri slides, labelled, and oven dried at 40°C overnight. After being removed from the oven, the petri slides were sealed with tape and stored in a plastic bag in a dry, dark box in the chemistry lab for subsequent analysis on land. A total of 21 POC samples were collected from the CTD.

Biogenic Silica (bSi)

Samples for biogenic silica were collected via CTD from the top 400m. A volume of 500 ml was measured out and filtered through a 25 mm diameter, 0.8 μm membrane polycarbonate filter using a low-pressure pump (max -20 kPa). Once finished, the filtration tower was rinsed with about 10 ml of filtered seawater, which was then passed through the samples to eliminate any salt residue. The filters were subsequently placed in 15 ml individual plastic centrifuge tube, labelled, and oven dried at 40°C overnight. After being removed from the oven, the tubes were sealed and stored in a plastic bag in a

dry, dark box in the chemistry lab for subsequent analysis on land. A total of 14 filter samples for biogenic silica analysis were sampled from CTD casts.

Particulate Inorganic Carbon (PIC)

Samples for particulate inorganic carbon (PIC) analysis were collected via CTD. A volume of 500 ml was measured out from each sampled depth and filtered through a 25 mm diameter, 0.8 µm membrane polycarbonate filter using a low-pressure pump (max -20 kPa). Once finished filtering, the filtration tower was rinsed with approximately 10 ml of borax pH adjusted MilliQ water and filtered through the samples to remove any residue on the sides of the filtration tower. The filters were then placed into individual 15 ml centrifuge tubes, labelled, and oven-dried at 40 °C overnight. Samples were then removed from the dry oven, sealed, and stored in a plastic bag in a dry, dark box in the chemistry lab for later analysis back on land. A total of 19 samples for particulate inorganic carbon analysis were sampled, from the CTD casts.

Scanning Electron Microscope (SEM) samples for plankton analysis

Samples for Scanning Electron Microscope (SEM) analysis were collected via CTD. A volume of 500 ml was measured out from each sampled depth and filtered through a 25 mm diameter, 0.4 µm membrane polycarbonate filter using a low-pressure pump (max -20 kPa). Once finished filtering, the filtration tower was rinsed with approximately 10 ml of borax pH adjusted MilliQ water and filtered through the samples to remove any residue on the sides of the filtration tower. The filters were then placed into individual 15 ml centrifuge tubes, labelled, and oven-dried at 40 °C overnight. Samples were then removed from the dry oven, sealed, and stored in a plastic bag in a dry, dark box in the chemistry lab for later analysis back on land. A total of 23 samples for particulate inorganic carbon analysis were sampled from the CTD and underway.

Lugol samples for plankton community analysis

During JC263 water samples preserved with Lugol's solution (100ml samples, with 2ml Lugol, in brown glass bottles, stored in the fridge) were also collected and will be analysed using FlowCam when samples are returned to NOC. These preserved samples should provide more quantitative insight into the plankton community. A total of 45 samples were taken from the CTD and underway.

9.6 Satellite data

Sue Hartman and Anita Flohr (ashore)

The UK was under heat wave conditions prior to and throughout JC278, as this map shows (Thanks to Zoe Jacobs at NOC and the UK Met Office, https://ghrsst-pp.metoffice.gov.uk/ostia-website/marine_HW_category_map_regionnum_4_20250604.png).

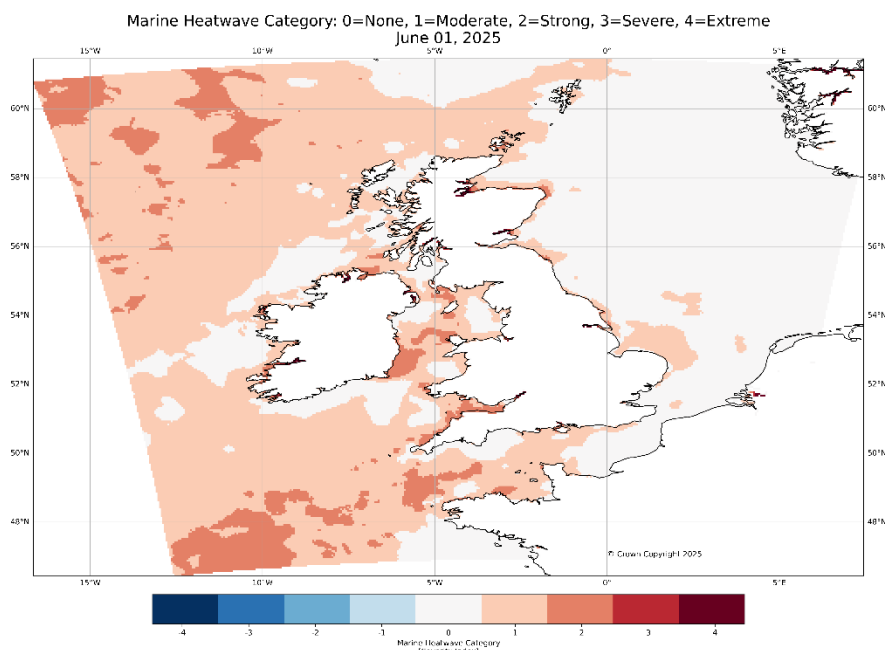


Figure 9.18: Shows heat wave categories around the UK at the start of June

However, satellite coverage at PAP was quite poor due to the many cloudy days. We continued to receive daily updates and maps, including Chlorophyll estimates from various satellite that tended to pass over PAP between midday and 14:00. Maps and data are available from NEODAAS, (for example: https://data.neodaas.ac.uk/files/24_19/2025/06/17 and from the FTP site: <ftp://neodaas4:Reikeengaht3quut4aico@ftp.rsg.pml.ac.uk/2025/06/17>). The weekly composites of chlorophyll, SSH, ocean temperature and ocean colour were especially useful.

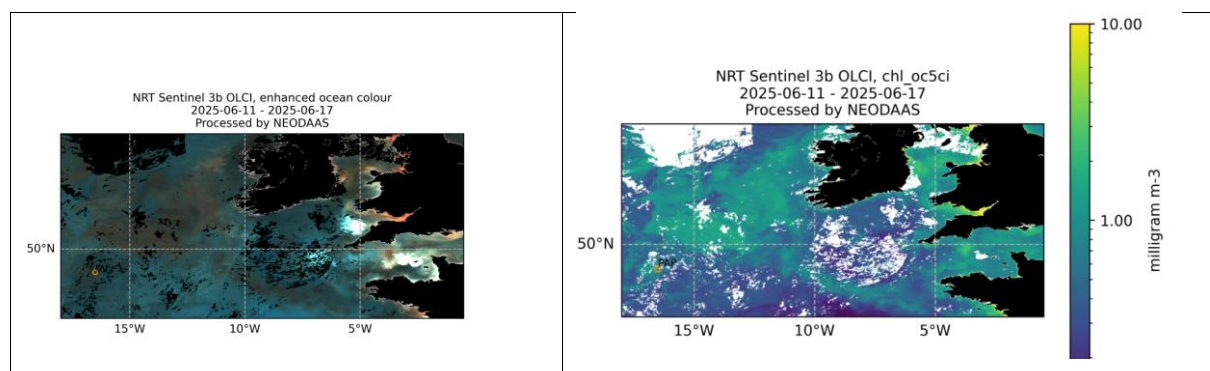


Figure 9.19: Examples of weekly composites of Ocean colour and surface chlorophyll NEODAAS maps

Anita, ashore, processed the satellite data and provided useful images such as Figure 9.20, showing a weekly composite of Chla NEODAAS data, with the glider and Argo float tracks overlaid (along with the areas of focus around PAP (explained in the legend). A prominent cyclonic/upwelling eddy

stayed to the west of us throughout JC278 and explains the northward currents that we experienced.

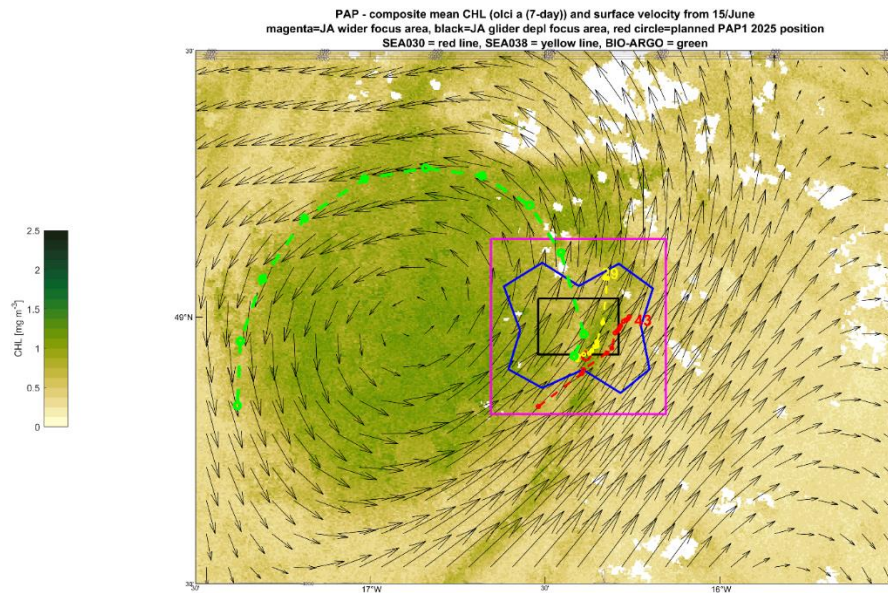


Figure 9.20: Composite image of NEODAAS chl data, showing the persistent eddy, currents with various tracks and positions of interest around PAP-SO area

Acknowledgements:

Many thanks to the team from NEODAAS for providing daily satellite data updates during the cruise. NEODAAS is hosted at Plymouth Marine Laboratory, overseen by the National Centre for Earth Observation (NCEO) and funded by the Natural Environment Research Council (NERC).

9.8 CTD deck sampling log sheets

CTD deck sampling log

(List parameters sampling from CTD in header and tick relevant box if bottle sampled)

SITE	TEST
Comments	test of GEORGE sampler. 2nd O2 on CTD is noisy, but primary O2 is the odd one replaced Cast 4 (and odd range for fluoro)

Cruise number	JC278
Station ID	001
Cast number	001
Sea floor depth (m)	125
Cast depth (m)	117
Event number	

Date (UTC)	31/05/2025
Time in (UTC)	09:15
Time out (UTC)	09:45
Latitude	49° 5.466N
Longitude	7° 10.442
Stainless steel cast	yes <input type="checkbox"/>

Niskin No	Depth (m)	O2 bottle No.	O2 bottle Rep 1	O2 bottle Rep 2	O2 Temp.	DIC/TA	DIC/TA Rep 1	DIC/TA Rep 2	pH	pH Rep 1	Nut PAP	SALTS Crate-bottle	PP/MP Stuart	5 L carboy								benthic Leonard	Comments		
														HPLC	CHL	SFC	PIC	POC /PON	B&B	Lugol					
1	117	A037/54	v	v	12.1	v					v	31-764												1.	
2	117	A0370	v		12.1	v					v	31-765													2.
3	117																								3.
4	117																								4.
5	117																								5.
6	117																								6.
7	117																								7.
8	117																								8.
9	117																								9.
10	117																								10.
11	117																								11.
12	117																								12.
13	5	A036	v		15.9	v					v	31-766													13.
14	5	A053	v		15.9	v					v	31-767													14.
15	5																								15.
16	5																								16.
17	5																								17.
18	5																								18.
19	5																								19.
20	5																								20.
21	5																								21.
22	5																								22.
23	5																								23.
24	not fired																								24.
Sampling	Dipin					Sue	Socratis					Sue													
Notes	O2 offset 10% (2nd on vane noisy), MLD ~20m, PAR to 90m																								

CTD deck sampling log

(List parameters sampling from CTD in header and tick relevant box if bottle sampled)

SITE	Whittard area
Comments	N3,4,7,8,11,12 removed. Aim deep carbonate (corals). SVP and pre HyBis. Use 2nd O2 sensor for calcs (until cast 4)

Cruise number	JC278
Station ID	002
Cast number	002
Sea floor depth (m)	337
Cast depth (m)	327
Event number	

Date (UTC)	31/05/2025
Time in (UTC)	20:06
Time out (UTC)	20:47
Latitude	48° 24.24N
Longitude	9° 41.7 W
Stainless steel cast	yes <input type="checkbox"/>

Niskin No	Depth (m)	O2 bottle No.	O2 bottle Rep 1	O2 bottle Rep 2	O2 Temp.	DIC/TA	DIC/TA Rep 1	DIC/TA Rep 2	pH	pH Rep 1	Nut PAP	SALTS Crate-bottle	PP/MP Stuart	5 L carboy								benthic Leonard	Comments			
														HPLC	CHL	SFC	PIC	POC /PON	B&B	Lugol						
1	327	A008	v	v	11.3	A012	v	v	v		v	31-768														1.
2	327	A047	v		11.3																					2.
3																										3.
4																										4.
5	327																									5.
6	327																									6.
7																										7.
8																										8.
9	327	Not shut																								9.
10	327																									10.
11																										11.
12																										12.
13	327																									13.
14	327																									14.
15	327																									15.
16	327																									16.
17	33											769						v								17.
18	33																									18.
19	33																									19.
20	33																									20.
21	5																									21.
22	5																									22.
23	5	A018	v		15.4		v		v		v	770														23.
24	5	A013	v		15.4																					24.
Sampling	Dipin					Sue	Socratis					Sue														
Notes	O2 offset ~9% (2nd on vane noisy despite rise). DCM ~33m																									

CTD deck sampling log

(List parameters sampling from CTD in header and tick relevant box if bottle sampled)

SITE	Pisces mooring
Comments	N3,4,7,8, 11,12, removed. 6x Microcats CAL-1 for PISCES (SNs: 6912, 7289, 7294, 7295, 7300, 8081). Use 2nd O2

Cruise number	JC278
Station ID	004
Cast number	003
Sea floor depth (m)	1300
Cast depth (m)	1295
Event number	

Date (UTC)	01/06/2025
Time in (UTC)	06:05
Time out (UTC)	07:27
Latitude	48° 26.309N
Longitude	9° 44.66 W
Stainless steel cast	yes

Niskin No	Depth (m)	O2 bottle No.	O2 bottle Rep 1	O2 bottle Rep 2	O2 Temp.	DIC/TA	DIC/TA Rep 1	DIC/TA Rep 2	pH	pH Rep 1	Nut PAP	SALTS Crate-bottle	PP/NP Stuart	5 L carboy								benthic Leonard	Comments			
														HPLC	CHL	SFC	PIC	POC /PON	Bsi	Lugol						
1	1295	A019 A026	✓	✓	8.8		✓	✓			✓	31-771													1.	
2	1295	A004	✓																							2.
3																										3.
4																										4.
5	1295																									5.
6	1295																									6.
7																										7.
8	✓																									8.
9	400	A043	✓		11.6						✓	772														9.
10	400																									10.
11	400																									11.
12	400																									12.
13	400																									13.
14	47	A051	✓		14.8						✓	773					✓					✓				SLOW SEM & PIC
15	47																									15.
16	47																									16.
17	47																									17.
18	47																									18.
19	47																									19.
20	47																									20.
21	5																									21.
22	5																									22.
23	5																									23.
24	5	A034	✓		15.1	✓					✓	774					✓					✓				SEM
Sampling	Dipin					Sue	Socratis					Sue														
Notes	O2 offset ~9% (2nd on vane offset despite replacement - now likely primary is the issue as differs from Winkler). DCM 47m, O2 max 39m																									

CTD deck sampling log

(List parameters sampling from CTD in header and tick relevant box if bottle sampled)

SITE	Whittard
Comments	N3,4,7,8, 11,12, removed. 2x Microcats CAL-2 for W/C. ~2uM difference O2 (can use primary now) *10 min stops x4

Cruise number	JC278
Station ID	010
Cast number	004
Sea floor depth (m)	2147
Cast depth (m)	2130
Event number	

Date (UTC)	02/06/2025
Time in (UTC)	06:00
Time out (UTC)	08:30
Latitude	48° 30.66N
Longitude	9° 55.88W
Stainless steel cast	yes

Niskin No	Depth (m)	O2 bottle No.	O2 bottle Rep 1	O2 bottle Rep 2	O2 Temp.	DIC/TA	DIC/TA Rep 1	DIC/TA Rep 2	pH	pH Rep 1	Nut PAP	SALTS Crate-bottle	PP/NP Stuart	5 L carboy								benthic Leonard	Comments				
														HPLC	CHL	SFC	PIC	POC /PON	Bsi	Lugol							
1	2130	35/A0	✓	✓	7.6		✓				✓	31-775														1.	
2	2130	50	✓		7.3																						leak at Tap?
3																											3.
4																											4.
5	680	48/39	✓	✓	11.4						✓	31-776															5.
6	680																										6.
7																											7.
8																											8.
9	680																										9.
10	680																										10.
11																											11.
12																											12.
13	41	24/28	✓	✓	14.1						✓	31-777		✓	✓												13.
14	41																										14.
15	41																										15.
16	41																										16.
17	41																										17.
18	41																										18.
19	41																										19.
20	41																										20.
21	5																										21.
22	5																										22.
23	5																										23.
24	5	49/5	✓	✓	15.3		✓				✓	31-778		✓	✓		✓										SEM
Sampling	Dipin					Sue	Socratis					Sue		Chris and Victoria													
Notes	DCM 41m PAR to 60 (down cast, then 90m by 8:30 - very sunny sampling especially bottle 13)																										

CTD deck sampling log										Cruise number		Date (UTC)												
<small>(List parameters sampling from CTD in header and tick relevant box if bottle sampled)</small>										Station ID		Time in (UTC)												
SITE		PAP								Cast number		Time out (UTC)												
Comments		N3,4,7,8, 11,12,removed, release test. 2x Microcats CAL-3 PAP3. ~1uM diff O2 (noise on secondary) *10 min stops x3 (*N1,9,19)								Sea floor depth (m)		Latitude												
										Cast depth (m)		Longitude												
										Event number		Stainless steel cast												
Niskin No	Depth (m)	O2 bottle No.	O2 bottle Rep 1	O2 bottle Rep 2	O2 Temp.	DIC/TA	DIC/TA Rep 1	DIC/TA Rep 2	pH	pH Rep 1	Nut PAP	SALT'S Crite-bottle	PP/NP Stuart	5 L carboy								Comments		
														HPLC	CHL	SFC	PIC	POC /PON	Bsi	Lugol	benthic Leonor			
1	4827	1/55	✓	✓	3.9		✓	✓			✓	31-779										✓	1.	
2	4827																							2.
3																								3.
4																								4.
5	4827	bulk for DIC																						5.
6	4827																							6.
7																								7.
8																								8.
9	1800	32 /43	✓	✓	4.9						✓	31-780												9.
10	1800																							10.
11																								11.
12																								12.
13	530	34/18	✓	✓	9.3						✓	31-781												13.
14	530																							14.
15	530																							15.
16	530																							16.
17	530																							17.
18	530																							18.
19	41	12 /49	✓	✓	14.4						✓	31-782												19.
20	41																							20.
21	41																							21.
22	5	5 /35	✓	✓	14.7		✓				✓	31-783												22.
23	5																							23.
24	5													✓	✓	✓						✓		24.
Sampling		Dipin			Sue		Socratis				Victoria		Chris and Victoria											
Notes		mix to ~40m, no clear DCM. 530 O2 min, 1800 O2 max 5am sunrise																						

CTD deck sampling log										Cruise number		Date (UTC)												
<small>(List parameters sampling from CTD in header and tick relevant box if bottle sampled)</small>										Station ID		Time in (UTC)												
SITE		PAP								Cast number		Time out (UTC)												
Comments		N1-4,7,8, 11-14,removed. Glider cal cast, 1hr stops N5,9,17 (but N5+6 not fired in error--use next 1000m cast?)								Sea floor depth (m)		Latitude												
										Cast depth (m)		Longitude												
										Event number		Stainless steel cast												
Niskin No	Depth (m)	O2 bottle No.	O2 bottle Rep 1	O2 bottle Rep 2	O2 Temp.	DIC/TA	DIC/TA Rep 1	DIC/TA Rep 2	pH	pH Rep 1	Nut PAP	SALT'S Crite-bottle	PP/NP Stuart	5 L carboy								Comments		
														HPLC	CHL	SFC	PIC	POC /PON	Bsi	Lugol	benthic Leonor			
1																								1.
2																								2.
3																								3.
4																								4.
5	1000	not fired in error																						5. 1 hour (bottle not fired)
6	1000	not fired in error																						6.
7																								7.
8																								8.
9	550	48	✓		10.1		✓	✓			✓	784+787												9. 1 hour
10	550																							10.
11																								11.
12																								12.
13																								13.
14																								14.
15	550																							15.
16	550																							16.
17	110	39	✓		12		✓	✓			✓	785												17. 1 hour
18	110																							18.
19	110																							19.
20	110																							20.
21	110																							21.
22	110																							22.
23	20	54	✓		14.8		✓	✓			✓	786							✓					23. 2 min
24	20																							24.
Sampling		Sue			Chris		Socratis OTEG bottles				sophie		Chris											
Notes		Light to 100m																						

CTD deck sampling log

(List parameters sampling from CTD in header and tick relevant box if bottle sampled)

SITE	PAP
Comments	Deep Science cast plus PAP releases x 6. PC fail so process as 'A' down and 'B' up-Cast

Cruise number	JC278
Station ID	023
Cast number	007
Sea floor depth (m)	4829
Cast depth (m)	4820
Event number	

Date (UTC)	07/06/2025
Time in (UTC)	04:55
Time out (UTC)	08:52
Latitude	49° 0N
Longitude	16° 30.002W
Stainless steel cast	yes

Niskin No	Depth (m)	O2 bottle No.	O2 bottle Rep 1	O2 bottle Rep 2	O2 Temp.	DIC/TA	DIC/TA Rep 1	DIC/TA Rep 2	pH	pH Rep 1	Nut PAP	SALTS C-rate-bottle	Bulk SL	5 L carboy								benthic Leonor	Comments
														HPIC	CHL	SFC	PIC	POC	Bsi	Lugol			
1	4820	22 /28	✓	✓	3.8	✓	✓				✓	28-692									✓	1.	
2	4820	36	✓		3.9	✓					✓											bulk dic	2.
3	4500					✓					✓												3.
4	4000					✓					✓												4.
5	3500	53	✓		4.1	✓					✓	693											5.
6	3000					✓					✓												6.
7	3000	19	✓		4.4	✓					✓												7.
8	2000					✓					✓												8.
9	2000					✓					✓												9.
10	1800	7	✓		5.2	✓					✓												10. O2 max
11	1800					✓					✓												11.
12	1200					✓					✓												12.
13	1000	24	✓		6.6	✓	(✓)				✓												13.
14	900					✓					✓	694											14.
15	600	26	✓		9	✓					✓	695											15. O2 min
16	500					✓					✓												16.
17	400					✓					✓												17.
18	300					✓					✓												18.
19	200	51	✓		11.7	✓					✓												19.
20	140					✓					✓		✓	✓	✓								20.
21	50					✓					✓												21.
22	30	47	✓		14.6	✓					✓	696	✓	✓	✓								22.
23	10					✓					✓												23.
24	5					✓					✓												24.
Sampling	Dipin				Sue		Socratis				sophie	Sam		Chris + Victoria									
Notes	4455m Pause PC Issues + modular error at restart (7A and 7B processed files)																						

CTD deck sampling log

(List parameters sampling from CTD in header and tick relevant box if bottle sampled)

SITE	PAP
Comments	pre-PAP1 cast (also 1000m for GEORGE). O2 offset from ~700m (chaetognath in sample)

Cruise number	JC278
Station ID	027
Cast number	008
Sea floor depth (m)	4511
Cast depth (m)	1000
Event number	

Date (UTC)	11/06/2025
Time in (UTC)	04:13
Time out (UTC)	05:11
Latitude	48° 55.9N
Longitude	16° 22.901W
Stainless steel cast	yes

Niskin No	Depth (m)	O2 bottle No.	O2 bottle Rep 1	O2 bottle Rep 2	O2 Temp.	DIC/TA	DIC/TA Rep 1	DIC/TA Rep 2	pH	pH Rep 1	Nut PAP	SALTS C-rate-bottle	Bulk SL	5 L carboy								benthic Leonor	Comments	
														HPIC	CHL	SFC	PIC	POC	Bsi	Lugol				
1	1000	Aoo8	4		7	✓	✓		✓		✓	697											✓	1.
2	1000										✓													2.
3	1000										✓													3.
4	1000										✓													4.
5	640	a004b			9	✓					✓	698	x1				✓	✓	✓					5. chaetognath
6	640										✓													6.
7	400										✓	699												7.
8	400										✓													8.
9	300										✓													9.
10	300										✓													10.
11	200	a037			12.1	✓					✓		x1				✓	✓	✓					11.
12	200										✓													12.
13	100										✓													13.
14	100										✓													14.
15	50	a01			14.7	✓					✓													15.
16	50	a055			14.7						✓													16.
17	30										✓													17.
18	30										✓													18.
19	25										✓		x2	✓	✓	✓	✓	✓	✓	✓	✓	✓		19.
20	25										✓													20.
21	10	a032			15						✓													21.
22	10										✓													22.
23	5	a019			15.2	✓	✓		✓		✓	700	x2	✓	✓	✓						✓		23.
24	5										✓													24.
Sampling	Dipin				Sue		Socratis				sophie	Sam		Chris + Victoria										
Notes	Cast 8 odd secondary O2 due to blockage. Cast 7 now reprocessed too																							

CTD deck sampling log										Cruise number		Date (UTC)													
<small>(List parameters sampling from CTD in header and tick relevant box if bottle sampled)</small>										Station ID		Time in (UTC)													
SITE		PAP								Cast number		Time out (UTC)													
Comments		post-PAP1 cast (also 1000m for GEORGE).								Sea floor depth (m)		Latitude													
										Cast depth (m)		Longitude													
										Event number		Stainless steel cast													
										JC278		12/06/2025													
										030		05:01													
										009		06:12													
										4605		48° 58.2N													
										1000		16° 22.871W													
												yes													
Niskin No	Depth (m)	O2 bottle No.	O2 bottle Rep 1	O2 bottle Rep 2	O2 Temp.	DIC/TA	DIC/TA Rep 1	DIC/TA Rep 2	org pH	pH Rep 1	Nut PAP	SALTS Crite-bottle	Bulk SL	5 L carboy							benthic Leonor	Comments			
1	1000		a051	a047	7	v	v		v	v	701			HPLC	CHL	SFC	PIC	POC	Bsi	Lugol			v		
2	1000																							2.	
3	800									v														3	
4	800																							4.	
5	560		leak		10.4							x1												5.	
6	560		22		9.9	v				v														O2 min	
7	450		leak?		12.2					v	702														7.
8	450																								8.
9	350									v															9.
10	350																								10.
11	250		28		11.7	v				v	703														11.
12	250																								12.
13	150		36		12.1					v															13.
14	150																								14.
15	90		53		12.6	v				v															15.
16	90																								16.
17	40									v															17.
18	40																								18.
19	30									v															19.
20	30																								20.
21	20		26		15.1	v				v		x1		v	v						v				21.
22	20																								22.
23	5		24		15.4	v			v	v	704	x1		v	v						v				23.
24	5																								24.
Sampling		Dipin			Sue		Socratis			sophie	Sam		Chris + Victoria												
Notes		Cast 8 odd secondary O2 due to blockage. Cast 7 now reprocessed too																							

CTD deck sampling log										Cruise number		Date (UTC)													
<small>(List parameters sampling from CTD in header and tick relevant box if bottle sampled)</small>										Station ID		Time in (UTC)													
SITE		HyBIS								Cast number		Time out (UTC)													
Comments		pre and cal NOC BGC-Argo float								Sea floor depth (m)		Latitude													
										Cast depth (m)		Longitude													
										Event number		Stainless steel cast													
										JC278		13/06/2025													
										033		04:08													
										010		05:16													
										4849		48° 50.494N													
										1000		16° 31.124W													
												yes													
Niskin No	Depth (m)	O2 bottle No.	O2 bottle Rep 1	O2 bottle Rep 2	O2 Temp.	DIC/TA	DIC/TA Rep 1	DIC/TA Rep 2	org pH	pH Rep 1	Nut PAP	2:1-SALTS Crite-bottle	Bulk SL	5 L carboy							benthic Leonor	Comments			
1	1000	a08	a04	a047	6	v	v		v	v	705			HPLC	CHL	SFC	PIC	POC	Bsi	Lugol				Allisons sample	
2	1000	a48			6.9																				2.
3	800									v															3
4	800																								4.
5	650		leak																						5. LEAK
6	650	a37	22		9	v				v	706														O2 min
7	400		leak?							v															7. LEAK
8	400																								8.
9	300									v															9.
10	300																								10.
11	150	a55			12	v				v															11.
12	150	a32																							12.
13	100	a19	a51		12.3					v	707														13.
14	100																								14.
15	50	a47	a22		14.5	v				v															15.
16	50																								16.
17	30									v															17.
18	30																								18.
19	25									v		x1		v	v	v					v				19.
20	25																								20.
21	10	a28	a36		15.3	v				v															21.
22	10																								22.
23	5	a53	a26		15.3	v			v	v	708	x1		v	v	v									23. salt not analysed, no stopper
24	5																								24.
Sampling		Dipin			Socratis				Socratis	sophie	Sam		Chris + Victoria												
Notes																									

CTD deck sampling log

(List parameters sampling from CTD in header and tick relevant box if bottle sampled)

SITE	Glider
Comments	glider cal mid day light to 140m

Cruise number	JC278
Station ID	038
Cast number	011
Sea floor depth (m)	4812
Cast depth (m)	1000
Event number	

Date (UTC)	13/06/2025
Time in (UTC)	12:17
Time out (UTC)	13:25
Latitude	49° 2.178N
Longitude	16° 19.062W
Stainless steel cast	yes

Niskin No	Depth (m)	O2 bottle No.	O2 bottle Rep 1	O2 bottle Rep 2	O2 Temp.	DIC/TA	DIC/TA Rep 1	DIC/TA Rep 2	oreg pH	pH Rep 1	Nut PAP	28-SALTS Crite-bottle	Bulk SL	5 L carboy								benthic Leonor	Comments	
														HPLC	CHL	SFC	PIC	POC	Bsi	Lugol	SEM			
1	1000			50	7.2	✓	✓			✓		709												reagent 2 bubbles
2	1000																							2.
3	800					✓				✓														3
4	800																							4.
5	650																							5. don't uae
6	650									✓		710												
7	500																							7. LEAK after new Oring
8	500		43	18	9.1	✓				✓														8.
9	400																							9.
10	400		38	12	11.2	✓				✓														10.
11	360																							didn't fire
12	360		49		11.6					✓														very long,bubbles
13	300																							13.
14	300		40		12					✓		711												14
15	150																							15.
16	150									✓														16.
17	100																							17.
18	100					✓				✓														18.
19	30																							19.
20	30		34		14.9					✓														20.
21	15																							21.
22	15									✓			x1		✓	✓					✓			22.
23	5																							23.
24	5		13	5	15.6	✓			✓	✓		712	x1		✓	✓					✓			24.
Sampling	Dipin			Socratis					Socratis	sophie	Sam		Chris + Victoria											
Notes																								

CTD deck sampling log

(List parameters sampling from CTD in header and tick relevant box if bottle sampled)

SITE	pap
Comments	Pre PAP ropes

Cruise number	JC278
Station ID	041
Cast number	012
Sea floor depth (m)	4815
Cast depth (m)	1000
Event number	

Date (UTC)	14/06/2025
Time in (UTC)	04:56
Time out (UTC)	06:05
Latitude	48° 57.772N
Longitude	16° 23.011W
Stainless steel cast	yes

Niskin No	Depth (m)	O2 bottle No.	O2 bottle Rep 1	O2 bottle Rep 2	O2 Temp.	DIC/TA	DIC/TA Rep 1	DIC/TA Rep 2	oreg pH	pH Rep 1	Nut PAP	28-SALTS Crite-bottle	Bulk SL	5 L carboy								SEM	Comments		
														HPLC	CHL	SFC	PIC	POC	Bsi	Lugol	SEM				
1	1000		5	13	6.9		✓	✓		✓		713												✓	
2	1000		48		7																				2.
3	750									✓															3
4	750																								4.
5	650																								5
6	650		37		9.2		✓			✓		714													6 O2 Min
7	550	leaks																							7. LEAKs
8	550									✓															8.
9	450																								9.
10	450	1		10.7						✓			x1			✓	✓	✓							10.
11	350																								didn't fire
12	350	55		11.6						✓															very long,bubbles
13	250																								13.
14	250	32		12						✓															14
15	150																								15.
16	150									✓															16.
17	90												x1				✓	✓	✓						17.
18	90																								18.
19	30	19		15		✓				✓			x2	✓	✓	✓				✓	✓			19. Life? +Chl spike?	
20	30																								20.
21	15									✓															21.
22	15																								22.
23	5	51		15.5		✓				✓		715	x2	✓	✓	✓					✓	✓		23. Pink - jelly	
24	5																								24. Pink - jelly
Sampling	Dipin			Socratis					Socratis	sophie	Sam		Chris + Victoria												
Notes																									

CTD deck sampling log

(List parameters sampling from CTD in header and tick relevant box if bottle sampled)

SITE	pap
Comments	Science full depth and pre dawn cast

Cruise number	JC278
Station ID	043
Cast number	013
Sea floor depth (m)	4836*
Cast depth (m)	4840
Event number	

Date (UTC)	15/06/2025
Time in (UTC)	04:11
Time out (UTC)	08:09
Latitude	49° 000N
Longitude	16° 29.999W
Stainless steel cast	yes

Niskin No	Depth (m)	O2 bottle No.	O2 bottle Rep 1	O2 bottle Rep 2	O2 Temp.	DIC/TA	DIC/TA Rep 1	DIC/TA Rep 2	oteg pH	pH Rep 1	Nut PAP	33-SALTS Crate-bottle	Bulk SL	5 L carboy								SEM	Comments	
														HPLC	CHL	SFC	PIC	POC	Bi	Lugol				
1	4840	47	22		4.1	✓				✓		812											✓	
2	4840	8			4.3																			2.
3	4400					✓				✓														3.
4	3400	36			4.5	✓				✓														4.
5	3400																							5.
6	2500					✓				✓														6.
7	2000	leak																						7. LEAKs
8	1650	53			5.5	✓				✓		813												8.
9	1650																							9.
10	1200					✓				✓														10.
11	1000								✓	✓														11. late to sample pH
12	900	26			7.4	✓				✓														12.
13	800					✓				✓														13.
14	700					✓				✓														14.
15	630	24			8.8	✓				✓		814												15.
16	630																							16.
17	450					✓				✓			x1				✓	✓	✓					17.
18	350	54			11.2	✓				✓														18.
19	250					✓				✓														19.
20	100					✓				✓			x1				✓	✓	✓					20.
21	60					✓				✓														21.
22	30					✓				✓														22.
23	20	50			15.2	✓				✓			x2	✓	✓	✓					✓			23.
24	5	43			15.6	✓				✓		815	x2	✓	✓	✓					✓			24. late to sample pH
Sampling		Dipin			Socratis				Socratis	sophie	Sam		Chris + Victoria											
Notes																								

CTD deck sampling log

(List parameters sampling from CTD in header and tick relevant box if bottle sampled)

SITE	pap1
Comments	200m from buoy in Afternoon. GEORGE sampler between bottles 7 and 8. pH comp - ICOS, OTEG, OBG

Cruise number	JC278
Station ID	044
Cast number	014
Sea floor depth (m)	4813
Cast depth (m)	200
Event number	

Date (UTC)	15/06/2025
Time in (UTC)	13:02
Time out (UTC)	13:34
Latitude	48° 58.213N
Longitude	16° 22.679W
Stainless steel cast	yes

Niskin No	Depth (m)	O2 bottle No.	O2 bottle Rep 1	O2 bottle Rep 2	O2 Temp.	DIC/TA NOC	DIC/TA OTEG	pH NOC	oteg pH	pH ICOS	Nut PAP	33-SALTS Crate-bottle	Bulk SL	5 L carboy								SEM	Comments		
														HPLC	CHL	SFC	PIC	POC	Bi	Lugol					
1	200	✓	✓		11.8							816												✓	
2	200																								2.
3	200					✓		✓		9207/9208															3.
4	200																								4.
5	200																								5.
6	200						✓		✓																6.
7	200																								7. LEAK so avoid
8	100											817													8.
9	100																								9.
10	100																								10.
11	100										✓														11. avoid
12	100																								12.
13	30											818													13.
14	30																								14.
15	30																								15.
16	30										✓														16.
17	30																								17.
18	30																								18.
19	5	✓			15.8							819													19.
20	5																								20.
21	5					✓		✓		9209/9210															21.
22	5																								22.
23	5						✓		✓		✓														23.
24	5																								24.
Sampling		Dipin			Socratis				Socratis	sophie	Sam		Chris + Victoria												
Notes																									

CTD deck sampling log

(List parameters sampling from CTD in header and tick relevant box if bottle sampled)

SITE	pap
Comments	Science - deep cast no long stops

Cruise number	JC278
Station ID	050
Cast number	015
Sea floor depth (m)	4813 single beam
Cast depth (m)	4830
Event number	

Date (UTC)	17/06/2025
Time in (UTC)	04:06
Time out (UTC)	07:45
Latitude	49° 0.005N
Longitude	16° 29.999W
Stainless steel cast	yes

Niskin No	Depth (m)	O2 bottle No.	O2 bottle Rep 1	O2 bottle Rep 2	O2 Temp.	DIC/TA OBG	DIC/TA OBG	pH OBG	pH OBG	pH ICOS	Nut PAP	33-SALTS Crate-bottle	Carbuoy 5L	5 L carboy								SEM	Comments	
														HPLC	CHL	SFC	PIC	POC	Bi	Lugol				
1	4830	5	13		3.8	✓	✓	✓	✓			820											✓	
2	4830	48			4						✓													2.
3	4100					✓					✓													3.
4	4000					✓					✓													4.
5	3300					✓					✓													5.
6	3000					✓					✓													6.
7	3000																							7. LEAK so avoid
8	2200					✓					✓													8.
9	2000					✓					✓													9.
10	1650	37			5.2	✓					✓	821												10. O2 max
11	1650																							11. avoid
12	1000					✓		✓	✓	✓								✓	✓	✓				12.
13	1000																							13. rust on niskin
14	850					✓					✓	822												14 rust on niskin
15	580	a01			9	✓					✓	823						✓	✓	✓				15.O2 min
16	500																							16.
17	400					✓					✓													17.
18	320					✓					✓													18.
19	220					✓					✓							✓	✓	✓				19.
20	160	55			11.7	✓				✓x2	✓	824						✓	✓	✓				20. 9211/12 ICOS O2max
21	60					✓					✓													21.
22	35																	✓	✓	✓			✓	22.
23	20							✓	✓	✓x2	✓	825						✓	✓	✓			✓	23.
24	5	32			15.9	✓		✓	✓	✓x2	✓							✓	✓	✓			✓	24. 9213/14 ICOS
Sampling		Dipin			Socratis			Socratis	sophie	Sam		Chris + Victoria												
Notes																								

CTD deck sampling log

(List parameters sampling from CTD in header and tick relevant box if bottle sampled)

SITE	pap
Comments	1-3,13-15 removed for Gliders cal (5hr cast). 3x 1 hour stops at N4, 8, 19. PAR to 130m

Cruise number	JC278
Station ID	052
Cast number	016
Sea floor depth (m)	4813 single beam
Cast depth (m)	1000
Event number	

Date (UTC)	17/06/2025
Time in (UTC)	12:38
Time out (UTC)	16:31
Latitude	48° 58.384N
Longitude	16° 22.607W
Stainless steel cast	yes

Niskin No	Depth (m)	O2 bottle No.	O2 bottle Rep 1	O2 bottle Rep 2	O2 Temp.	DIC/TA OBG	DIC/TA OBG	pH OBG	pH OBG	pH ICOS	Nut PAP	33-SALTS Crate-bottle	Carbuoy 5L	5 L carboy								SEM	Comments		
														HPLC	CHL	SFC	PIC	POC	Bi	Lugol					
1																								✓	
2																									2.
3																									3.
4	1000	19	51		10.4	✓	✓	✓	✓		✓	826													4.O2 reagg bubbles
5	1000																								5.
6	1000																								6.
7	1000																								7. LEAK so avoid
8	550	47			11.7	✓		✓	✓																8.
9	550																								9.
10	550																								10.
11	200	22			13.6	✓					✓	827													11. avoid
12	200																								12.
13																									13.
14																									14.
15																									15.
16	100	28			14.2	✓					✓														16.
17	100																								17.
18	100																								18.
19	15	36			16.1	✓		✓	✓	✓								✓							19.
20	15																								20.
21	15																								21.
22	5																								22.
23	5	53	26		16.3	✓				✓	✓	828						✓							23.
24	5																								24.
Sampling		Dipin			Socratis			Socratis	sophie	Sam		Chris + Victoria													
Notes																									

CTD deck sampling log

(List parameters sampling from CTD in header and tick relevant box if bottle sampled)

SITE	Argo
Comments	2000m cast for Argo (back at PAP, see stn log details for stn 015 deployment). Mini pCO2 in 3 bottles (Paco). No Chl, Nuts, salt

Cruise number	JC278	Date (UTC)	20/06/2025
Station ID	058	Time in (UTC)	18:06
Cast number	019	Time out (UTC)	19:42
Sea floor depth (m)	4640	Latitude	48°34.416N
Cast depth (m)	2000	Longitude	16° 56.6831W
Event number		Stainless steel cast	yes

Niskin No	Depth (m)	pCO2 tests (Paco)	O2 bottle Rep 1	O2 bottle Rep 2	O2 Temp.	DIC/TA OBG	DIC/TA OBG	PH OBG	oteg pH	pH ICOS	Nut PAP	33-SALIS Crate-bottle	Carbuoy 5L	5 L carboy								SEM	Comments		
														HP/LC	CHL	SFC	PIC	POC	Bi	Lugol					
1																								√	
2	2000																								2.
3	2000							√																	3.
4	2000																								4.
5	1730		049, 34	04, 008	4.7																				5.
6	1730																								6.
7	1200																								7. LEAK* so avoid
8	1200							√																	8.
9	950							√																	9.
10	950	pCO2																							10.
11	750							√																	11.
12	750																								12.
13	650																								13.
14	650							√																	14.
15	650																								15.
16	400							√																	16.
17	400																								17.
18	200							√																	18.
19	200																								
20	15							√																	20.
21	15																								21.
22	5	pCO2																							22.
23	5							√																	23.
24	2	pCO2																							24.
Sampling		Paco	Dipin		sue				Secratis																
Notes																									

10. Underway Sensors and Sampling

Sophie Clayton, Dipin Ghosh, Allison Schaap, Sue Hartman, Anita Flohr (NOC)

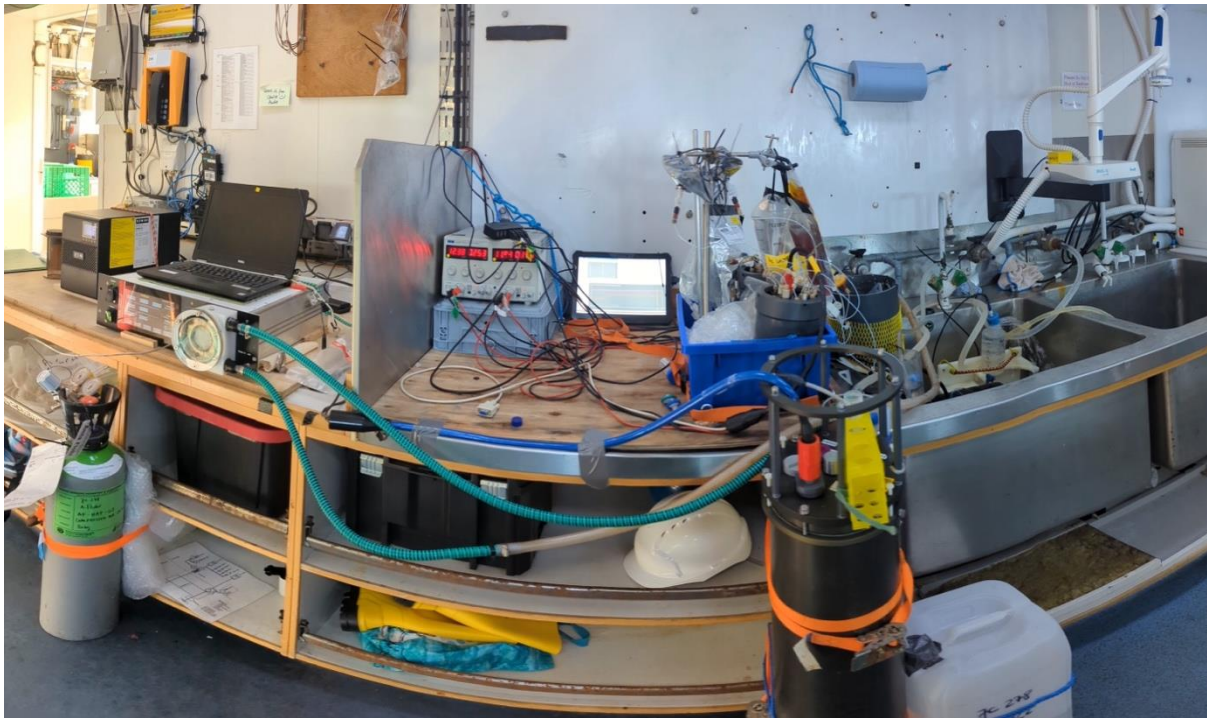


Figure 10.1 Panoramic photograph of the range of underway sensors and samplers set up to sample from the ship's seawater supply in the RRS James Cook's deck lab during JC278. From left to right: SubCTech pCO₂ sampler, a range of LoC sensors, IFCB (in front of sink).

10.1 Underway xCO₂

Dipin Ghosh (NOC, at sea), Anita Flohr (NOC, ashore)

The partial pressure of carbon dioxide (pCO₂) in the surface ocean was measured throughout the cruise track to capture cross-shelf variability, variability across fronts and for validation of deployed pCO₂ sensors at the PAP1 mooring site.

SubCtech

A SubCtech OceanPack MK2 Flow-Through Analyzer (SN: CO2-DLZEGAMK2-19-0-1803-01) was connected to the underway seawater supply in the deck lab for continuous xCO₂ measurements (Figure 10.2) (membrane-based equilibration, dual-wavelength NDIR detector LI-COR LI-850x). The system was installed and connected to the underway seawater supply on 30/05/2025 from ~16:00 UTC at ~10 L/min (Table 10.2). The system was switched off on 22/6/2025 at 20:00 UTC. The water temperature was measured and logged at the analysers' outflow at 1 min intervals (Tinytag TGP-4204 PT1000). The system was connected to a single standard gas (provided by BOC, 400 ppm, uncertainty ≤1%, traceable to BOC primary standards) via stainless steel tubing. The measurement schedule

included running a calibration (zero CO₂, span 1) twice a day and running the reference gas as a sample once a day (Table 10.1).

The data was streamed and logged to a laptop at 1 min intervals (using OceanView Software, SubCtech). Additionally, the data was logged and merged with the ship’s TechSAS data, which will be used to compute pCO₂. The data shown in Figure 10.3 are preliminary.



Figure 10.2: SubCtech in the deck lab on JC278

Table 10.1: SubCtech measurement schedule on JC278

Phase	Mode	Sensor state	Hrs	Phase duration UTC
1	operate	5	07:30:00	10:30-18:00
2	zero CO2	2	00:15:00	18:00-18:15
3	span 1	1	00:15:00	18:15-18:30
4	operate	5	07:45:00	18:30-02:15
5	ref gas	18	00:15:00	02:15-02:30
6	operate	5	07:30:00	02:30-10:00
7	zero CO2	2	00:15:00	10:00-10:15
8	span1	1	00:15:00	10:15-10:30

Table 10.2: UW sampling time windows outside of calibrations

Sensor state	Phase duration UTC
UW sampling	03:00 – 09:45
UW sampling	11:00 – 17:45
UW sampling	19:00 – 02:00

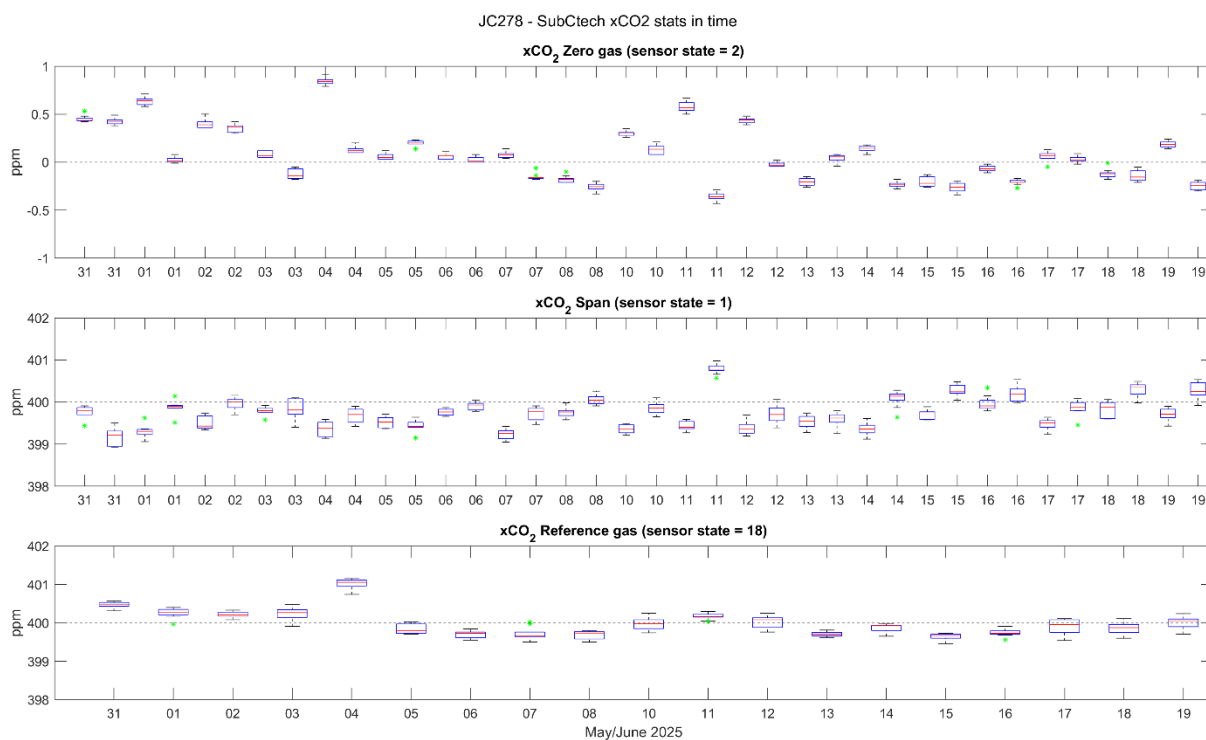


Figure 10.3 Results of zero and reference gas measurements (preliminary data) from SubCtech. Shown are boxplots of a) zero gas measurements and b) reference gas measurements for span during the calibration sequence and c) reference gas measurements between calibration sequences measured as sample (green=outliers, dashed line = certified value of reference gas of 400 ppm. Please also refer to Table 10.1, which shows the measurement schedule.

General Oceanics pCO₂

A General Oceanics pCO₂ 8060 analyser (SN: GO210) was connected to the underway seawater supply in the chemistry lab for continuous xCO₂ measurements (Figure 10.4) (equilibrator-based equilibration, NDIR detector LI-COR LI-7815). The system was connected to the underway seawater supply on 30/05/2025 from ~16:00 UTC at ~2.4 L/min (Table 10.2). The system was switched off on 22/06/2025 at 19:30 UTC. The analyser was running a zero gas and three non-zero reference gases once a day (250.7, 449.2 and 799.3 ppm gases provided by NPL, uncertainty ≤1%, traceable to NPL primary standards) (Figure 10.5).

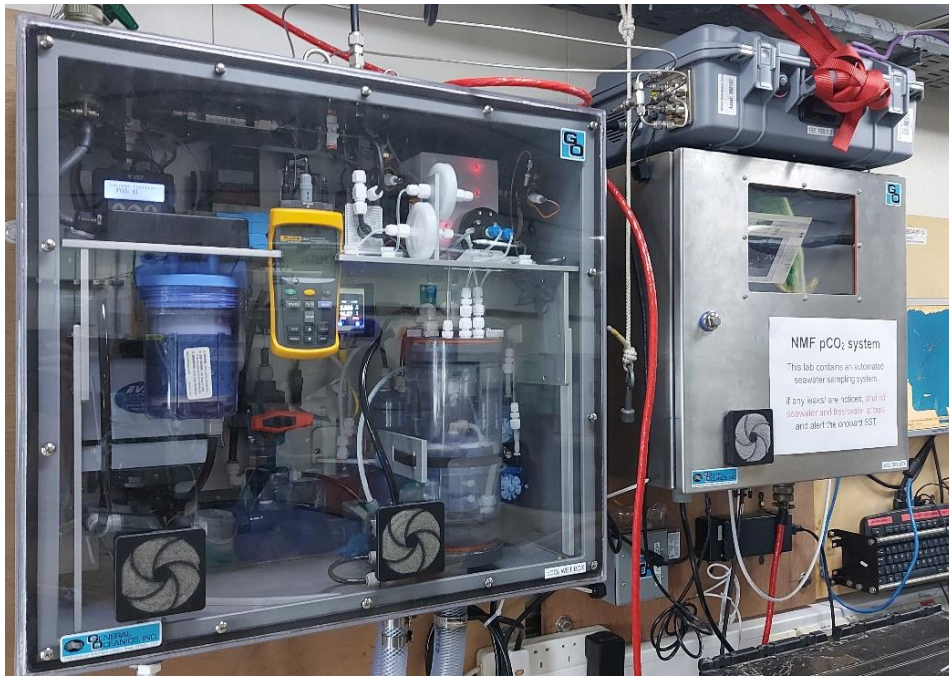


Figure 10.4 General Oceanics pCO₂ 8060 analyzer in chemistry lab on JC278

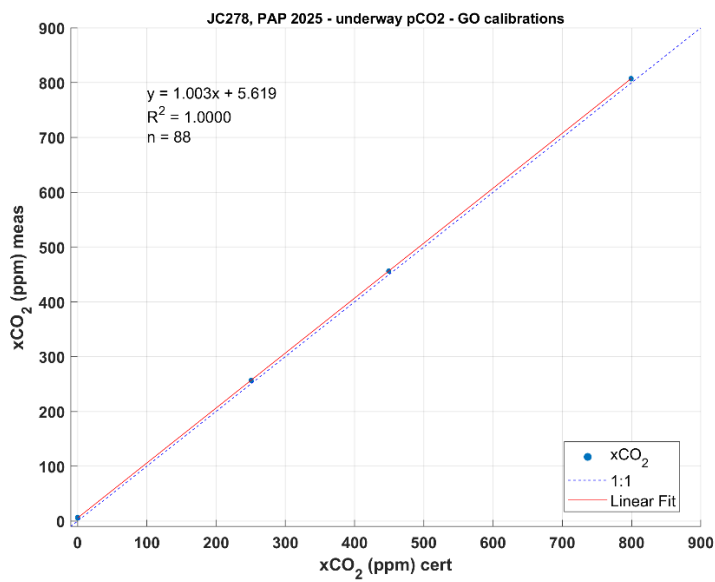


Figure 10.5: Results of daily reference gas measurements (preliminary data) from GO210.

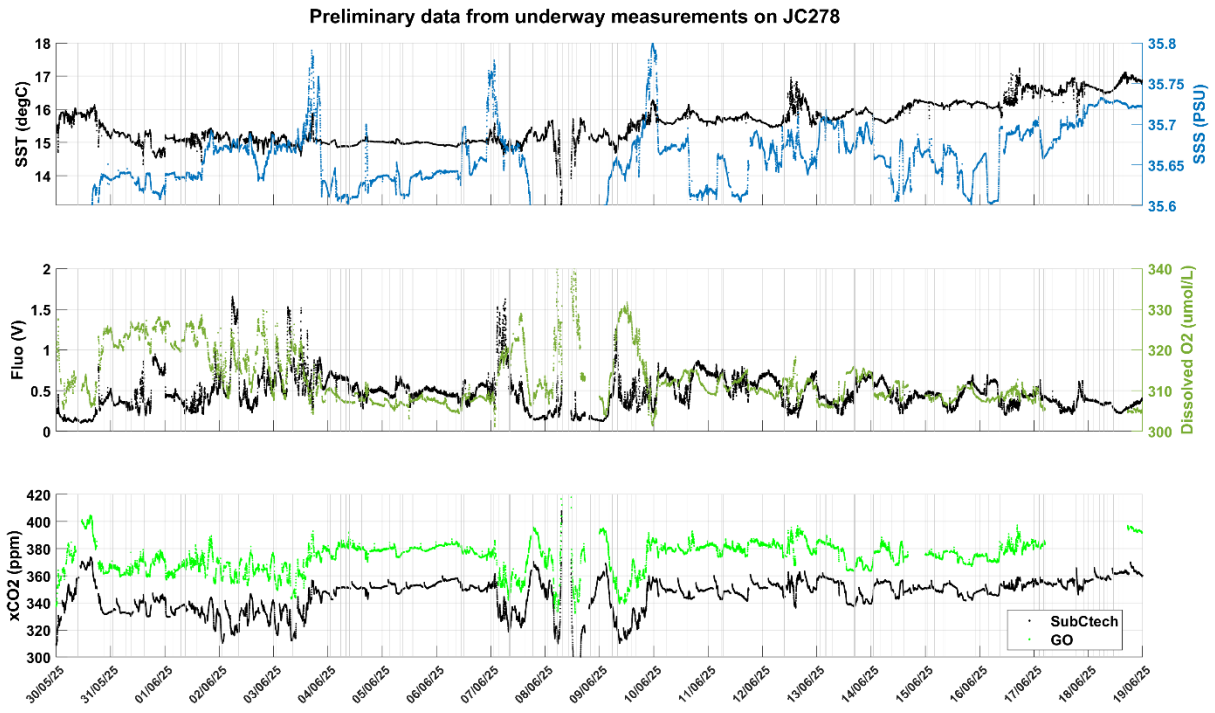


Figure 10.6: Timeseries of preliminary UW measurements. a) SST ($^{\circ}\text{C}$) (left y-axis) and SSS (PSU) (right y-axis), b) fluorescence (V) (left y-axis), dissolved oxygen ($\mu\text{mol/L}$) (right y-axis), c) xCO_2 from SubCtech (black) and GO210 (green) (ppm) over time. The vertical grey lines indicate times discrete water sampling from the UW water supply in the deck lab (includes sampling for TA, DIC, pH, Chl, nutrients).

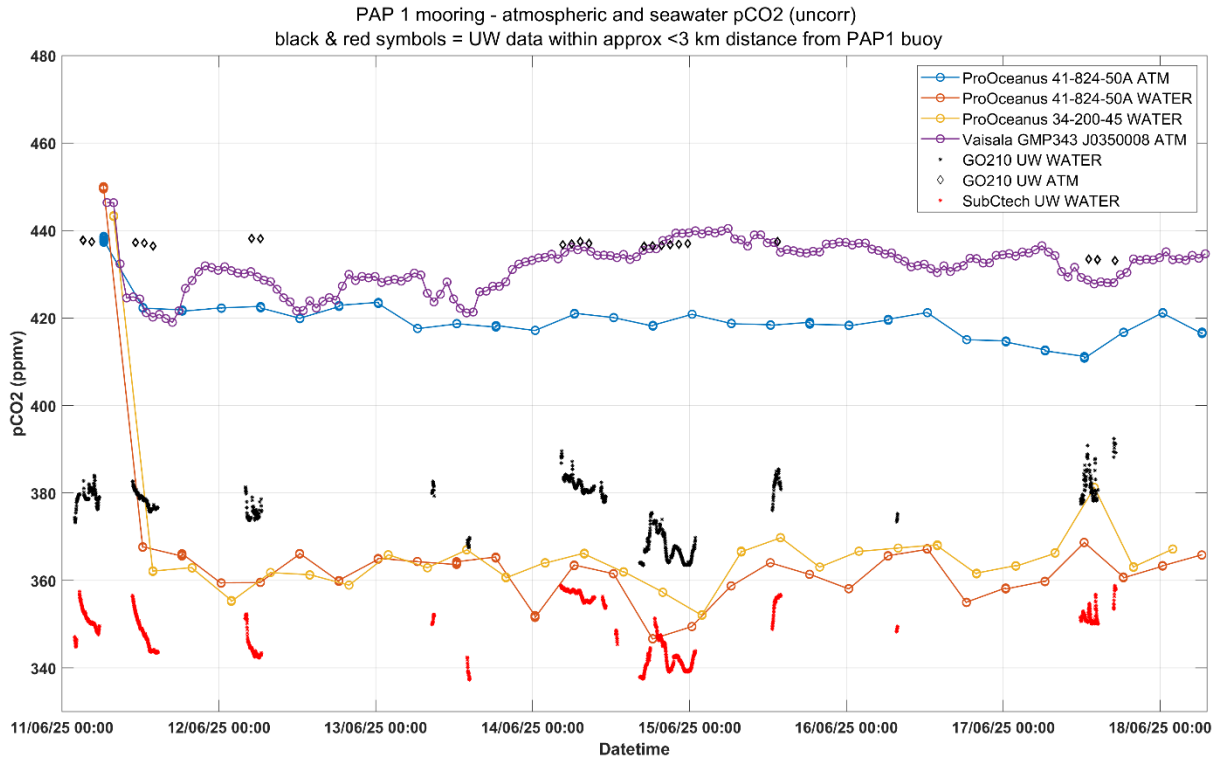


Figure 10.7: Comparison of data from UW pCO_2 data (GO210 and SubCtech) and pCO_2 sensors deployed on the keel of the PAP1 buoy (ProOceanus and Vaisala) (preliminary data) when the ship was within a radius of approx. <3 km from the PAP1 buoy.

Underway discrete water sampling

Discrete water samples were collected for analyses of dissolved inorganic carbon (DIC), total alkalinity (TA) and pH. When close to the PAP 1 mooring the underway sampling was timed to correspond with measurement times of the buoy and outside of calibration schedules. Usually two samples/day were taken for TA, DIC at the SubCtech underway water outflow (deck lab). The TA, DIC and pH samples were collected, as per CTD sampling, into 250 mL borosilicate glass bottles following Dickson et al. (2007); after a 1% by-volume headspace was created the sample was poisoned by addition of 50 μL of saturated mercuric chloride solution and made air-tight by sealing with greased (Apiezon L) ground-glass stoppers. The samples were stored in dark at room temperature. Samples will be analysed at the National Oceanography Centre, Southampton, UK.

In addition, samples for analysis of dissolved nutrient concentration, salinity and Chlorophyll related variables (covered in the CTD sampling chapter of the Pelagic report) were taken from the outlet water flow of the underway system (Table 10.2). This is except for salinity which was sampled from the black tygon outlet near the TSG/underway system in the CTD hangar. Salinity, bulk and size fractionated chlorophyll samples were measured onboard (see CTD sampling part of the re chapter in report). Additional samples (HPLC, SEM and Lugol preserved) were taken for analysis ashore. Types of samples and sampling times were recorded using the ship's event logger and reported in Table 10.3.

10.2 Underway lab-on-a-chip sensors

Allison Schaap (NOC)

Lab-on-chip sensors to analyse pH, total alkalinity (TA), and nitrate were added to the ship's underway system in the deck lab. The sensors were plumbed into the underway system via a de-bubbling tube, shown schematically in Figure 10.8.

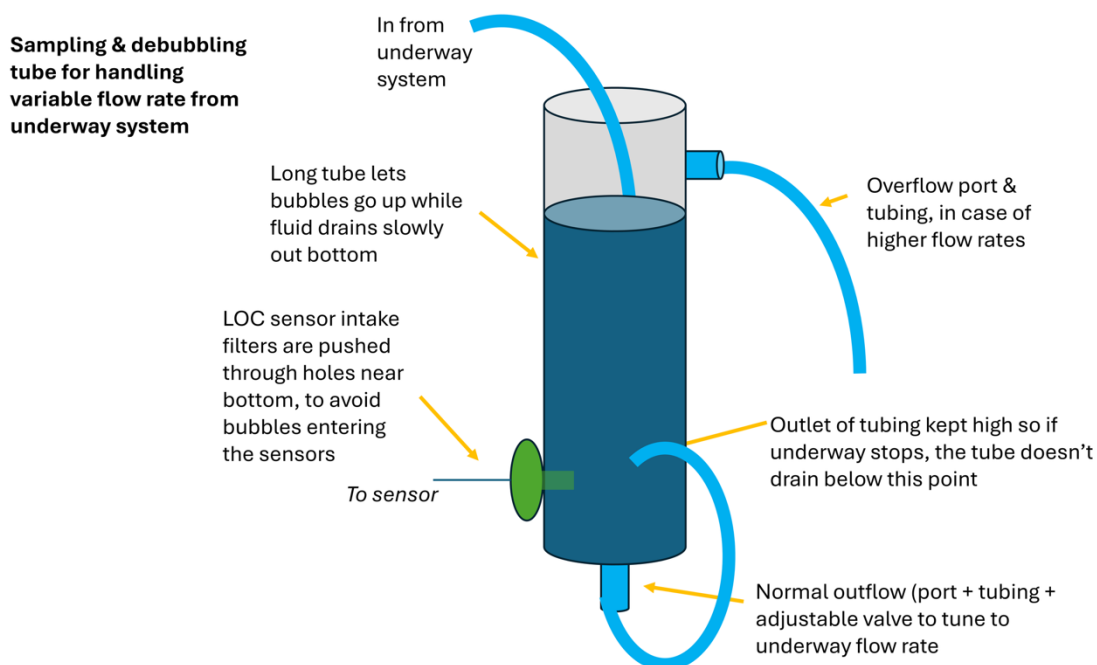


Figure 10.8: Schematic of the continuously draining de-bubbling tube used to bring water from the underway hose to the lab-on-chip sensors

The pH and TA sensors were set to run every 30 minutes, and the nitrate every hour.

The sensors were:

pH sensor: NOC pH sensor serial number 42

TA sensor: NOC TA sensor serial number 31

Nitrate sensor: CWS nitrate sensor serial number until 6th June, NOC nitrate sensor serial number 100 (from the 9th June – 16th June). Issues with the nitrate sensors meant that the coverage over the expedition was not continuous.

Preliminary pH data, from the 31st May – 16th June, is shown in Figure 10.9.

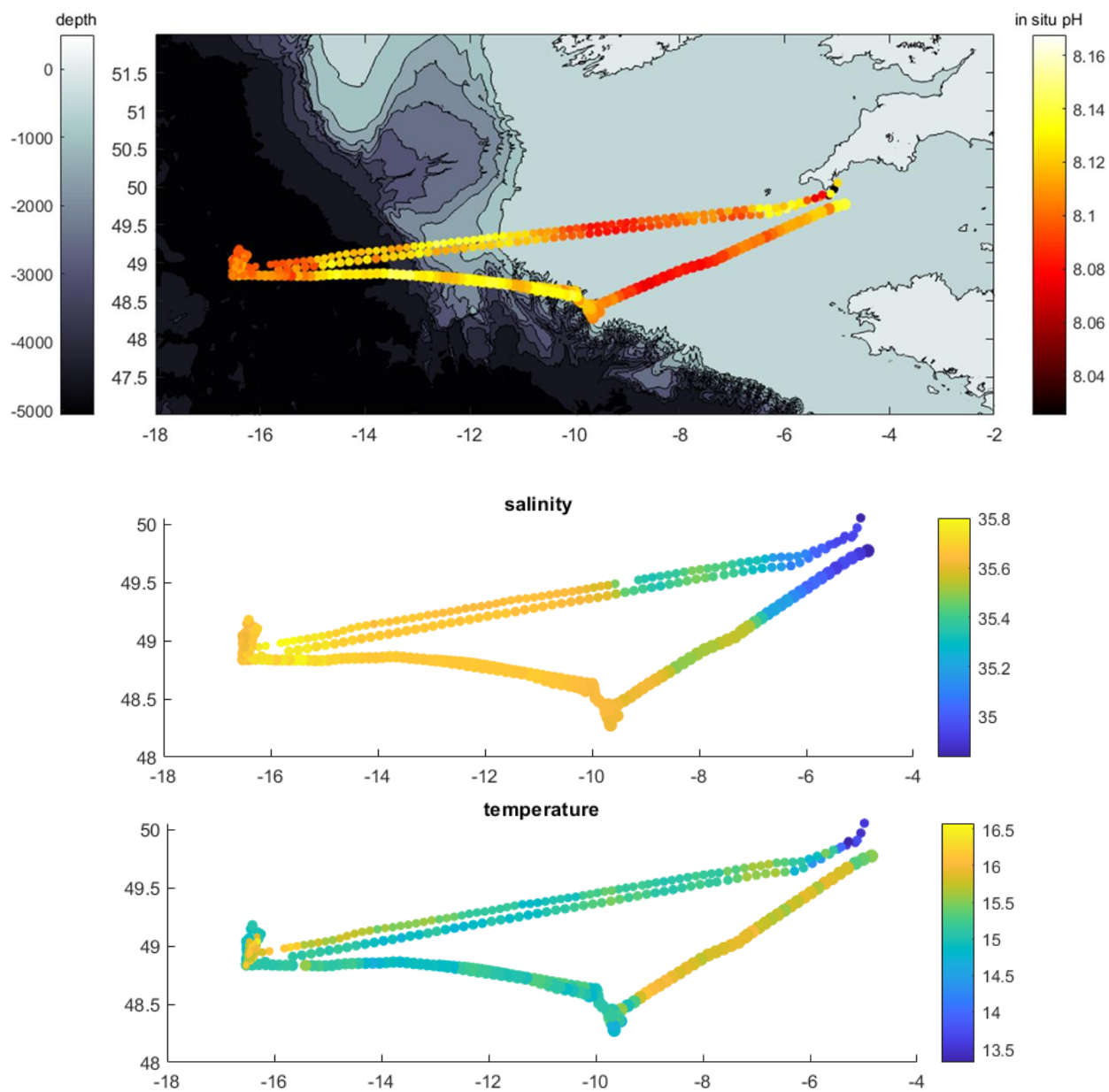


Figure 10.9: Sample of underway data from 31st May – 16th June, showing *in situ* pH, salinity, and temperature over the cruise track.

The pH sensor data shown above has been corrected to *in situ* temperature and salinity but not otherwise quality-checked.

10.3 Discrete biological sampling from underway

Discrete water samples were collected for the analysis of Chl a, size fractionated Chl a (SFC), HPLC pigments, Lugol's taxonomy and Scanning Electron Microscopy (SEM) at frequent intervals during the cruise (Table 10.3). Chl a samples in particular were collected at least twice a day, both at night and during the day, in order to calibrate the underway fluorescence data collected by the ship's inline WetLabs fluorometer. SFC, HPLC, Lugol's and SEM samples were collected less frequently, but an effort was made to collect samples every 2-3 hours during the transits from PAP-SO to Falmouth Bay and back in order to fully capture the biogeochemical variability along the track.

Underway biological samples were collected in 500mL amber Nalgene flasks and either filtered right away or stored in the fridge until they could be processed. Samples were not stored in the fridge for more than 5 hours before being processed. Full details of the processing steps for each of the sample types are given in the sampling section and were the same as those used for samples collected from the CTD casts.

10.4 Underway Chlorophyll a fluorescence and calibration

Sophie Clayton (NOC)

Discrete Chl a samples were matched up to underway position and sensor data using the 5-minute averaged METOCEAN data files produced by NMF at the end of each day. The individual match ups are given in Table 10.3 below. Underway fluorescence values were calibrated to Chl a concentrations using discrete samples collected between 21:00 and 05:00 UTC in order to avoid mismatches due to quenching of fluorescence during the day time. A total of 29 samples were used to produce the calibration curve shown in Figure 10.10. This calibration was applied to the full underway fluorescence dataset to produce the map of Chl a concentrations along the cruise track shown in Figure 10.11.

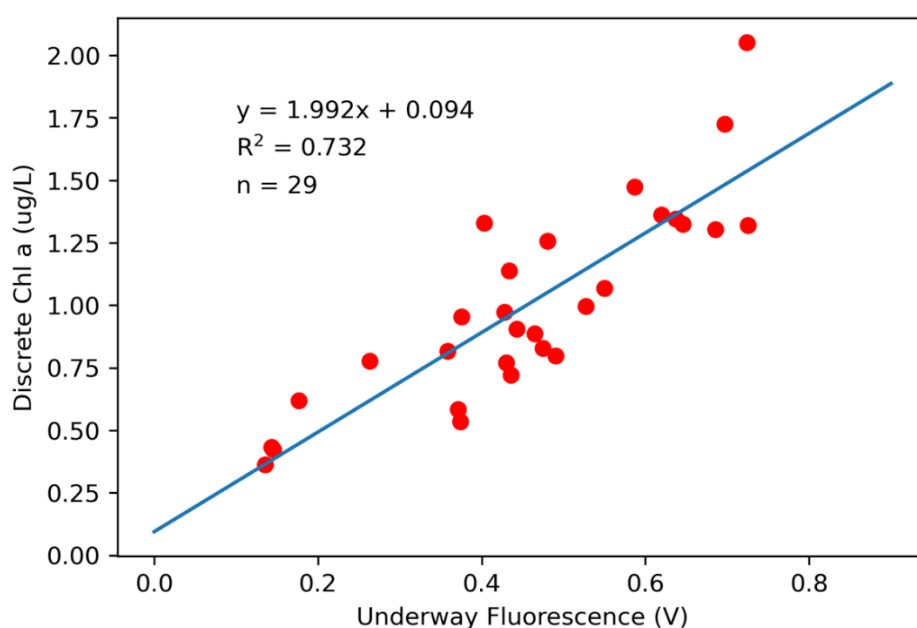


Figure 10.10: Calibration relationship to convert underway fluorescence data to Chlorophyll a concentration based on night-time (21:00 – 05:00 UTC) discrete Chlorophyll a samples matched to underway fluorescence.

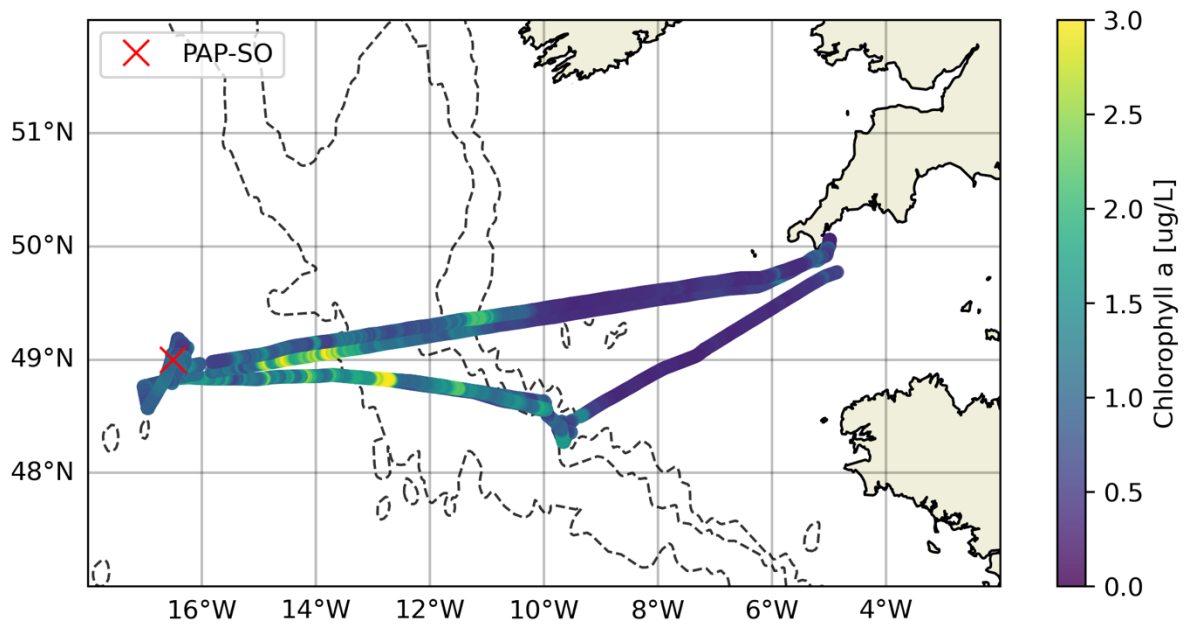


Figure 10.11: Underway chlorophyll a concentration (ug/L) along the JC278 cruise track based on underway fluorescence data converted to chlorophyll a concentrations based on the calibration curve shown in Figure 10.10 above. The location of PAP-SO is shown by a red cross. The dashed lines represent the 200m, 1000m, and 4000m bathycontours.

10.5. Underway sampling event log

Table 10.3: Log of JC278 sampling events showing all underway samples collected from the outflow of the SubCTech pCO₂ system (unless specified otherwise). Sample types listed here are: Bulk and size fractionated Chlorophyll a, Lugol's preserved samples, HPLC, pH, DIC, TA, dissolved inorganic nutrients.

DIC/TA# 1/2	DIC/TA# 2/2	pH	Chl	Nutrients	Comments	Datetime (UTC)	gps_time (UTC)	Latitude	Longitude	Temperature (C)	Salinity (PSU)	Fluorescence (V)
			uw1		on station ctd1 uw1 chla	2025-05-31 09:38:00+00:00	2025-05-31 09:40:00+00:00	49.091106	-7.17404	15.89247	35.546062	0.13938561
				nut1	uway nut	2025-05-31 12:30:00+00:00	2025-05-31 12:30:00+00:00	48.92258	-7.8971486	15.819794	35.519115	0.12613939
#25					uway DIC	2025-05-31 12:57:00+00:00	2025-05-31 12:55:00+00:00	48.891796	-8.012193	15.776384	35.518402	0.14103587
#26					uway DIC	2025-05-31 12:58:00+00:00	2025-05-31 13:00:00+00:00	48.88586	-8.035245	15.714179	35.517197	0.13800707
		#1pH			uway pH	2025-05-31 13:00:00+00:00	2025-05-31 13:00:00+00:00	48.88586	-8.035245	15.714179	35.517197	0.13800707
			uw2		on station ctd2 uw2 chla	2025-05-31 21:04:00+00:00	2025-05-31 21:05:00+00:00	48.401924	-9.692014	15.457097	35.63717	0.35832462
			uw3		uw3 chl night (HyBis site)	2025-06-01 01:01:00+00:00	2025-06-01 01:00:00+00:00	48.40394	-9.694724	15.322481	35.63303	0.37523174
			uw4		on station ctd3 uw4	2025-06-01 06:43:00+00:00	2025-06-01 06:45:00+00:00	48.438488	-9.744334	15.13759	35.63979	0.33155382
				nut2	uway nut	2025-06-01 09:00:00+00:00	2025-06-01 09:00:00+00:00	48.44756	-9.689821	15.070423	35.637314	0.2859518
#27					uway dic/ta	2025-06-01 09:01:00+00:00	2025-06-01 09:00:00+00:00	48.44756	-9.689821	15.070423	35.637314	0.2859518
#28		#pH2			uway dic/ta	2025-06-01 09:02:00+00:00	2025-06-01 09:00:00+00:00	48.44756	-9.689821	15.070423	35.637314	0.2859518

DIC/TA# 1/2	DIC/TA# 2/2	pH	Chl	Nutrients	Comments	Datetime (UTC)	gps_time (UTC)	Latitude	Longitude	Temperature (C)	Salinity (PSU)	Fluorescence (V)
					uway pH	2025-06-01 09:03:00+00:00	2025-06-01 09:05:00+00:00	48.448177	-9.687197	15.045066	35.636295	0.2820683
#29					uway dic/ta	2025-06-01 14:53:00+00:00	2025-06-01 14:55:00+00:00	48.359066	-9.548205	14.986906	35.619328	0.55753374
#30					uway dic/ta	2025-06-01 14:54:00+00:00	2025-06-01 14:55:00+00:00	48.359066	-9.548205	14.986906	35.619328	0.55753374
		#pH3			uway pH	2025-06-01 14:55:00+00:00	2025-06-01 14:55:00+00:00	48.359066	-9.548205	14.986906	35.619328	0.55753374
			uw5		uway chl	2025-06-01 18:12:00+00:00	2025-06-01 18:10:00+00:00	48.273907	-9.657674	14.841714	35.617115	0.74287313
#33	#34	#pH5			uway DIC	2025-06-02 00:14:24+00:00	2025-06-02 00:15:00+00:00	48.370487	-9.690005	15.192265	35.620377	0.6268903
			uw6		uway chl	2025-06-02 03:51:00+00:00	2025-06-02 03:50:00+00:00	48.419342	-9.732192	15.113649	35.639774	0.43366927
			uw7		on station chl	2025-06-02 07:05:00+00:00	2025-06-02 07:05:00+00:00	48.51099	-9.93134	15.039135	35.63498	0.4001621
				nut3	uway nut	2025-06-02 09:04:00+00:00	2025-06-02 09:05:00+00:00	48.58791	-9.97661	14.992253	35.63091	0.24626955
#31	#32				uway DIC	2025-06-02 09:07:00+00:00	2025-06-02 09:05:00+00:00	48.58791	-9.97661	14.992253	35.63091	0.24626955
		#pH4			uway pH	2025-06-02 09:08:00+00:00	2025-06-02 09:10:00+00:00	48.602985	-9.983308	14.936101	35.632492	0.2659336
			uw8		uway pH	2025-06-02 14:03:00+00:00	2025-06-02 14:05:00+00:00	48.613728	-9.990627	15.204235	35.6349	0.2701482
				nut4		2025-06-03 01:11:00+00:00	2025-06-03 01:10:00+00:00	48.780285	-11.946889	15.130802	35.66993	0.6952608
					uway nut	2025-06-03 08:00:00+00:00	2025-06-03 08:00:00+00:00	48.820625	-12.762817	14.933816	35.680588	1.4609008
#35					uway DIC	2025-06-03 08:30:00+00:00	2025-06-03 08:30:00+00:00	48.810146	-12.613807	14.824624	35.67263	1.2292691

DIC/TA# 1/2	DIC/TA# 2/2	pH	Chl	Nutrients	Comments	Datetime (UTC)	gps_time (UTC)	Latitude	Longitude	Temperature (C)	Salinity (PSU)	Fluorescence (V)
		#pH6			uway pH	2025-06-03 08:31:00+00:00	2025-06-03 08:30:00+00:00	48.810146	-12.613807	14.824624	35.67263	1.2292691
			uw9		uw9 chl + Sfc + SEM (diatom)	2025-06-03 08:49:00+00:00	2025-06-03 08:50:00+00:00	48.804077	-12.515171	15.041686	35.666527	0.5642175
			uw10		uw10 chl + Sfc + lugol3 (0.27 V)	2025-06-03 14:38:00+00:00	2025-06-03 14:40:00+00:00	48.650787	-10.820491	15.088541	35.663975	0.27484167
#36					uway DIC	2025-06-03 16:30:00+00:00	2025-06-03 16:30:00+00:00	48.598217	-10.268868	15.138936	35.65269	0.31752348
		pH#7			uway pH	2025-06-03 16:31:00+00:00	2025-06-03 16:30:00+00:00	48.598217	-10.268868	15.138936	35.65269	0.31752348
			uw11		chl night uway (rename uw11)	2025-06-04 01:04:00+00:00	2025-06-04 01:05:00+00:00	48.73974	-11.439859	15.056869	35.664986	0.6196514
			uw12		chl + sfc + lugol4 + HPLC + SEM (0.49V)	2025-06-04 05:36:00+00:00	2025-06-04 05:35:00+00:00	48.815075	-12.564117	15.150455	35.67227	0.4539548
			uw13		Chl ~ 1.5V fluo	2025-06-04 06:48:00+00:00	2025-06-04 06:50:00+00:00	48.830364	-12.864386	14.865491	35.67743	1.42472
				nut5	uway nut	2025-06-04 08:00:00+00:00	2025-06-04 08:00:00+00:00	48.839394	-13.147707	14.917962	35.666553	0.74500424
#37					uway DIC	2025-06-04 08:30:00+00:00	2025-06-04 08:30:00+00:00	48.845394	-13.2747135	14.896108	35.668526	0.8303166
		pH8			uway pH	2025-06-04 08:32:00+00:00	2025-06-04 08:30:00+00:00	48.845394	-13.2747135	14.896108	35.668526	0.8303166
			uw14		uway14 chl +lugol5 (fluoro~0.8)	2025-06-04 08:39:00+00:00	2025-06-04 08:40:00+00:00	48.846928	-13.316686	14.897407	35.66944	0.87494683
#38					uway dic/ta	2025-06-04 12:30:00+00:00	2025-06-04 12:30:00+00:00	48.851944	-14.294954	14.805332	35.67667	0.8393087
		pH#9			uway pH	2025-06-04 12:32:00+00:00	2025-06-04 12:30:00+00:00	48.851944	-14.294954	14.805332	35.67667	0.8393087

DIC/TA# 1/2	DIC/TA# 2/2	pH	Chl	Nutrients	Comments	Datetime (UTC)	gps_time (UTC)	Latitude	Longitude	Temperature (C)	Salinity (PSU)	Fluorescence (V)
			uw15		chl uway 15 + Lugol6 9flu=0.65)	2025-06-04 16:24:00+00:00	2025-06-04 16:25:00+00:00	48.831493	-15.269844	15.241421	35.711445	0.50557715
			uw16		uway 16 (dino?)	2025-06-05 01:02:00+00:00	2025-06-05 01:00:00+00:00	48.83706	-16.518528	14.9673395	35.61397	0.7237163
			uw17		on station chl 17 + lugol 7 (flu ~0.7)	2025-06-05 05:42:00+00:00	2025-06-05 05:40:00+00:00	49.001118	-16.500427	14.8742	35.60872	0.6704727
				nut6	uway nut	2025-06-05 08:00:00+00:00	2025-06-05 08:00:00+00:00	49.00111	-16.500431	14.884478	35.61191	0.6467811
#39	#40				uway dic/ta	2025-06-05 09:30:00+00:00	2025-06-05 09:30:00+00:00	49.005493	-16.47447	14.878209	35.607395	0.46227366
		#pH10/pH11			uway pH	2025-06-05 09:32:00+00:00	2025-06-05 09:30:00+00:00	49.005493	-16.47447	14.878209	35.607395	0.46227366
			uw18		uway chl at stn 6	2025-06-05 14:47:00+00:00	2025-06-05 14:45:00+00:00	49.007423	-16.45358	15.043562	35.62782	0.32241786
#41	#42				uway dic/ta	2025-06-05 15:00:00+00:00	2025-06-05 15:00:00+00:00	49.007458	-16.452415	15.052143	35.62721	0.44080672
		#pH12/13			uway pH	2025-06-05 15:02:00+00:00	2025-06-05 15:00:00+00:00	49.007458	-16.452415	15.052143	35.62721	0.44080672
			uw19			2025-06-06 03:20:00+00:00	2025-06-06 03:20:00+00:00	48.839245	-16.517233	14.996226	35.632942	0.427861
			uw20		lugol uway 20 (flu ~0.44)	2025-06-06 05:06:00+00:00	2025-06-06 05:05:00+00:00	48.83978	-16.519327	15.014915	35.630253	0.43640736
				nut7	uway nut	2025-06-06 08:00:00+00:00	2025-06-06 08:00:00+00:00	49.036766	-16.519629	14.980599	35.616234	0.6505091
#63	#64				uway dic/ta	2025-06-06 09:00:00+00:00	2025-06-06 09:00:00+00:00	49.038055	-16.521164	14.955446	35.613	0.5842323
		pH14/15			uway pH	2025-06-06 09:02:00+00:00	2025-06-06 09:00:00+00:00	49.038055	-16.521164	14.955446	35.613	0.5842323
#65	#66					2025-06-06 13:30:00+00:00	2025-06-06 13:30:00+00:00	48.97217	-16.47671	14.98649	35.635647	0.42306665

DIC/TA# 1/2	DIC/TA# 2/2	pH	Chl	Nutrients	Comments	Datetime (UTC)	gps_time (UTC)	Latitude	Longitude	Temperature (C)	Salinity (PSU)	Fluorescence (V)
		pH#16/17				2025-06-06 13:32:00+00:00	2025-06-06 13:30:00+00:00	48.97217	-16.47671	14.98649	35.635647	0.42306665
			uw21		at PAP3 stn	2025-06-06 13:36:00+00:00	2025-06-06 13:35:00+00:00	48.972187	-16.478716	14.99921	35.635708	0.44458023
			uw21 hplc		at PAP3 stn	2025-06-06 13:53:00+00:00	2025-06-06 13:55:00+00:00	48.972256	-16.486746	15.001772	35.636475	0.38349143
			uw22		chl	2025-06-07 01:02:00+00:00	2025-06-07 01:00:00+00:00	48.838978	-16.523352	14.925602	35.64177	0.48061866
			uw23		chl	2025-06-07 05:03:00+00:00	2025-06-07 05:05:00+00:00	49.000126	-16.500435	14.921641	35.641296	0.4413247
#67	#68				dic	2025-06-07 08:30:00+00:00	2025-06-07 08:30:00+00:00	49.000458	-16.501625	14.883556	35.64213	0.43828416
#18	#19				pH	2025-06-07 08:32:00+00:00	2025-06-07 08:30:00+00:00	49.000458	-16.501625	14.883556	35.64213	0.43828416
				nut8	nut	2025-06-07 11:00:00+00:00	2025-06-07 11:00:00+00:00	49.11889	-16.310253	15.007867	35.64258	0.2636498
#69					dic glider comp	2025-06-07 12:12:00+00:00	2025-06-07 12:10:00+00:00	49.096115	-16.260347	14.962413	35.696487	0.5856755
		#20			pH glider comp	2025-06-07 12:13:00+00:00	2025-06-07 12:15:00+00:00	49.096107	-16.260355	14.961581	35.69643	0.6028294
				nut9	uway nut	2025-06-07 12:15:00+00:00	2025-06-07 12:15:00+00:00	49.096107	-16.260355	14.961581	35.69643	0.6028294
			uw24		flu 0.62 chl + lugol	2025-06-07 12:18:00+00:00	2025-06-07 12:20:00+00:00	49.096104	-16.260344	14.960242	35.696457	0.60891694
			uw25			2025-06-08 01:18:00+00:00	2025-06-08 01:20:00+00:00	48.928616	-15.369984	15.428467	35.763775	0.4033194
			uw26		hplc/lugol/PIC/chl flu ~1.3	2025-06-08 03:42:00+00:00	2025-06-08 03:40:00+00:00	48.993217	-14.583373	15.0666485	35.698498	1.3372315
				nut10	uway nut	2025-06-08 08:00:00+00:00	2025-06-08 08:00:00+00:00	49.109875	-13.131482	15.037974	35.668713	0.76328266

DIC/TA# 1/2	DIC/TA# 2/2	pH	Chl	Nutrients	Comments	Datetime (UTC)	gps_time (UTC)	Latitude	Longitude	Temperature (C)	Salinity (PSU)	Fluorescence (V)
			uw27		uway chl lugol hplc PIC	2025-06-08 08:13:00+00:00	2025-06-08 08:15:00+00:00	49.11722	-13.049907	15.06295	35.668613	0.55208105
#70					uway dic	2025-06-08 08:31:00+00:00	2025-06-08 08:30:00+00:00	49.12573	-12.967814	15.105495	35.67034	0.4791253
		#25			uway pH	2025-06-08 08:32:00+00:00	2025-06-08 08:30:00+00:00	49.12573	-12.967814	15.105495	35.67034	0.4791253
			uw28		chl/lugol/hplc/PIC	2025-06-08 12:20:00+00:00	2025-06-08 12:20:00+00:00	49.23331	-11.659596	15.012207	35.67393	0.35000116
#71					uway dic	2025-06-08 15:00:00+00:00	2025-06-08 15:00:00+00:00	49.30832	-10.743252	15.116884	35.655956	0.26428187
		#26			uwaypH	2025-06-08 15:02:00+00:00	2025-06-08 15:00:00+00:00	49.30832	-10.743252	15.116884	35.655956	0.26428187
			uw29		chl/lugol/hplc/PIC	2025-06-08 18:36:00+00:00	2025-06-08 18:35:00+00:00	49.4046	-9.522149	15.364526	35.54478	0.14840277
			uw30		as above (x5 bottles)	2025-06-09 01:07:00+00:00	2025-06-09 01:05:00+00:00	49.583878	-7.3263183	15.380724	35.385773	0.17644426
			uw31		all chl x5	2025-06-09 04:00:00+00:00	2025-06-09 04:00:00+00:00	49.643227	-6.2900224	14.742954	35.09059	0.24404337
			uw32		all chl x5	2025-06-09 05:30:00+00:00	2025-06-09 05:30:00+00:00	49.7481	-5.7977076	14.410093	35.01335	0.5501689
				nut11	uway about to shutdown	2025-06-09 07:47:00+00:00	2025-06-09 07:45:00+00:00	49.92486	-5.094836	12.885465	34.932156	0.53368
#72						2025-06-09 07:52:00+00:00	2025-06-09 07:50:00+00:00	49.939693	-5.079222	12.839143	34.938747	0.44278726
		#27				2025-06-09 07:53:00+00:00	2025-06-09 07:55:00+00:00	49.954823	-5.0644293	12.769617	34.94392	0.504165
			uw33			2025-06-09 08:20:00+00:00	2025-06-09 08:20:00+00:00	50.030205	-4.9945793	13.235715	34.957355	0.5937684
					uway system shutdown	2025-06-09 08:30:00+00:00	2025-06-09 08:30:00+00:00	50.05442	-4.9858327	13.531254	34.835102	0.40280667

DIC/TA# 1/2	DIC/TA# 2/2	pH	Chl	Nutrients	Comments	Datetime (UTC)	gps_time (UTC)	Latitude	Longitude	Temperature (C)	Salinity (PSU)	Fluorescence (V)
					uway switch on	2025-06-09 09:36:00+00:00	2025-06-09 09:35:00+00:00	50.045532	-4.987676	13.3579445		0.10242969
					disconnect temp (bubble trapped)	2025-06-09 09:47:00+00:00	2025-06-09 09:45:00+00:00	50.015354	-4.9902587	13.353203		0.10180412
					subCtech flow set 10-12L/min and connect to temp	2025-06-09 10:04:00+00:00	2025-06-09 10:05:00+00:00	49.953884	-5.029407	13.772805	34.955566	0.2838726
			uw34		hplc hl sfc sem (0.18v)	2025-06-09 10:25:00+00:00	2025-06-09 10:25:00+00:00	49.91064	-5.091915	13.738261	34.939598	0.18069723
			uw35	nut12		2025-06-09 12:04:00+00:00	2025-06-09 12:05:00+00:00	49.819805	-5.589853	15.312769	34.97701	0.14833295
				nut13		2025-06-09 14:00:00+00:00	2025-06-09 14:00:00+00:00	49.724483	-6.1675906	15.097961	35.144684	0.18065703
			uw36		x5 chl sfc hplc sem lugol (0.18v)	2025-06-09 14:04:00+00:00	2025-06-09 14:05:00+00:00	49.721962	-6.1924696	15.1086	35.13561	0.20714785
#73					uway dic	2025-06-09 16:01:00+00:00	2025-06-09 16:00:00+00:00	49.70203	-6.770728	15.670207	35.26358	0.1710463
		#28				2025-06-09 16:02:00+00:00	2025-06-09 16:00:00+00:00	49.70203	-6.770728	15.670207	35.26358	0.1710463
			uw37		x5 chl sfc lugol sem hplc (0.2V)	2025-06-09 18:00:00+00:00	2025-06-09 18:00:00+00:00	49.65649	-7.382493	15.294213	35.385456	0.16896363
			uw38		chl sfc lugol sem hplc	2025-06-09 20:06:00+00:00	2025-06-09 20:05:00+00:00	49.60949	-8.01032	15.176474	35.46776	0.18159045
			uw39		as uw38	2025-06-09 22:03:00+00:00	2025-06-09 22:05:00+00:00	49.563084	-8.604575	15.067346	35.37329	0.14353047
			uw40		as uw38	2025-06-10 00:01:00+00:00	2025-06-10 00:00:00+00:00	49.521465	-9.13396	15.219245	35.365513	0.1357878
			uw40		as uw38	2025-06-10 00:01:00+00:00	2025-06-10 00:00:00+00:00	49.51937	-9.157497	15.216217		0.1368248

DIC/TA# 1/2	DIC/TA# 2/2	pH	Chl	Nutrients	Comments	Datetime (UTC)	gps_time (UTC)	Latitude	Longitude	Temperature (C)	Salinity (PSU)	Fluorescence (V)
			uw41	nut41	as uw38 now collecting nutrient at same time (change uw and nut name to be consistent)	2025-06-10 02:07:00+00:00	2025-06-10 02:05:00+00:00	49.475216	-9.7242155	15.413018	35.59234	0.14531615
			uw42	nut42	as uw38 0.25V	2025-06-10 04:00:00+00:00	2025-06-10 04:00:00+00:00	49.433678	-10.239266	15.203284	35.623867	0.26297677
			uw43	nut43	as uw38 0.5V	2025-06-10 05:40:00+00:00	2025-06-10 05:40:00+00:00	49.40058	-10.698866	15.02939	35.643654	0.4269576
			uw44	nut44	as uw38 1.16V	2025-06-10 08:00:00+00:00	2025-06-10 08:00:00+00:00	49.35719	-11.370164	14.830714	35.649254	0.9177993
#74						2025-06-10 08:31:00+00:00	2025-06-10 08:30:00+00:00	49.346146	-11.514704	15.132372	35.653625	0.43362767
		#29				2025-06-10 08:32:00+00:00	2025-06-10 08:30:00+00:00	49.346146	-11.514704	15.132372	35.653625	0.43362767
			uw45	nut45		2025-06-10 12:10:00+00:00	2025-06-10 12:10:00+00:00	49.25806	-12.546491	15.1385765	35.647118	0.33083454
			uw46			2025-06-10 14:03:00+00:00	2025-06-10 14:05:00+00:00	49.218742	-13.088001	15.627559	35.659714	0.3031261
#75						2025-06-10 16:00:00+00:00	2025-06-10 16:00:00+00:00	49.17228	-13.6428995	15.496371	35.672558	0.6361088
						2025-06-10 16:01:00+00:00	2025-06-10 16:00:00+00:00	49.17228	-13.6428995	15.496371	35.672558	0.6361088
#76						2025-06-11 05:44:00+00:00	2025-06-11 05:45:00+00:00	48.98878	-16.363197	15.588185	35.667854	0.6802748
		#30				2025-06-11 05:46:00+00:00	2025-06-11 05:45:00+00:00	48.98878	-16.363197	15.588185	35.667854	0.6802748
#77	#78					2025-06-11 15:00:00+00:00	2025-06-11 15:00:00+00:00	48.922386	-16.384274	15.947842	35.683605	0.53381544

DIC/TA# 1/2	DIC/TA# 2/2	pH	Chl	Nutrients	Comments	Datetime (UTC)	gps_time (UTC)	Latitude	Longitude	Temperature (C)	Salinity (PSU)	Fluorescence (V)
						2025-06-11 15:03:00+00:00	2025-06-11 15:05:00+00:00	48.917618	-16.391346	16.009367	35.684177	0.50971115
			uw47			2025-06-12 03:00:00+00:00	2025-06-12 03:00:00+00:00	48.84262	-16.52096	15.578578	35.614975	0.69695866
			uw48	nut48	chk buoy	2025-06-12 05:50:00+00:00	2025-06-12 05:50:00+00:00	48.97	-16.381178	15.647301	35.658146	0.70847976
#79					on stn	2025-06-12 06:48:00+00:00	2025-06-12 06:50:00+00:00	49.00373	-16.449306	15.729703	35.655636	0.6524539
		#31			on stn	2025-06-12 06:49:00+00:00	2025-06-12 06:50:00+00:00	49.00373	-16.449306	15.729703	35.655636	0.6524539
#80						2025-06-12 16:30:00+00:00	2025-06-12 16:30:00+00:00	49.01965	-16.455477	15.853494	35.614437	0.60332215
	#113					2025-06-12 16:31:00+00:00	2025-06-12 16:30:00+00:00	49.01965	-16.455477	15.853494	35.614437	0.60332215
						2025-06-12 16:36:00+00:00	2025-06-12 16:35:00+00:00	49.023964	-16.456781	15.870301	35.613934	0.5333734
			uw49			2025-06-13 01:02:00+00:00	2025-06-13 01:00:00+00:00	48.83927	-16.518627	15.581502	35.664715	0.6852
#114						2025-06-13 06:30:00+00:00	2025-06-13 06:30:00+00:00	48.92259	-16.500816	15.496301	35.658176	0.589161
		#32				2025-06-13 06:32:00+00:00	2025-06-13 06:30:00+00:00	48.92259	-16.500816	15.496301	35.658176	0.589161
			uw50		oteg pH too/gliders drift	2025-06-13 09:45:00+00:00	2025-06-13 09:45:00+00:00	49.00935	-16.31195	15.67843	35.672222	0.30560037
#115	#116					2025-06-13 14:30:00+00:00	2025-06-13 14:30:00+00:00	48.903103	-16.370548	16.024849	35.66203	0.26070538
			uw51			2025-06-13 23:47:00+00:00	2025-06-13 23:45:00+00:00	48.8399	-16.522385	15.561174	35.64995	0.72508
						2025-06-14 01:36:00+00:00	2025-06-14 01:35:00+00:00	48.83045	-16.522768	15.827576	35.703537	0.41770324

DIC/TA# 1/2	DIC/TA# 2/2	pH	Chl	Nutrients	Comments	Datetime (UTC)	gps_time (UTC)	Latitude	Longitude	Temperature (C)	Salinity (PSU)	Fluorescence (V)
						2025-06-14 03:52:00+00:00	2025-06-14 03:50:00+00:00	48.85523	-16.493767	15.660614	35.68331	0.43011132
						2025-06-14 04:19:00+00:00	2025-06-14 04:20:00+00:00	48.932602	-16.418333	15.651302	35.708313	0.3938275
#117						2025-06-14 07:02:00+00:00	2025-06-14 07:00:00+00:00	48.964565	-16.381386	15.683777	35.700394	0.34786245
		#33				2025-06-14 07:03:00+00:00	2025-06-14 07:05:00+00:00	48.96667	-16.378672	15.70609	35.699944	0.34404296
#118	#119					2025-06-14 16:30:00+00:00	2025-06-14 16:30:00+00:00	48.98065	-16.334217	16.020073	35.675316	0.40763766
				nut54		2025-06-14 17:00:00+00:00	2025-06-14 17:00:00+00:00	48.980743	-16.351038	15.939401	35.669086	0.59268326
			uw54			2025-06-14 22:03:00+00:00	2025-06-14 22:05:00+00:00	48.980946	-16.377832	16.01149	35.70137	0.637443
			uw55			2025-06-15 01:04:00+00:00	2025-06-15 01:05:00+00:00	48.99285	-16.44265	15.650909	35.704777	0.5272698
			uw56	nut56		2025-06-15 04:01:00+00:00	2025-06-15 04:00:00+00:00	49.000004	-16.499998	15.66296	35.661144	0.6461511
#120	#121					2025-06-15 09:01:00+00:00	2025-06-15 09:00:00+00:00	48.922203	-16.501604	15.667087	35.63138	0.4541921
#170	#171					2025-06-15 14:30:00+00:00	2025-06-15 14:30:00+00:00	48.923187	-16.478687	15.993572	35.622044	0.3275528
		#36				2025-06-15 14:32:00+00:00	2025-06-15 14:30:00+00:00	48.923187	-16.478687	15.993572	35.622044	0.3275528
			uw57			2025-06-16 01:03:00+00:00	2025-06-16 01:05:00+00:00	48.82885	-16.523312	16.202568	35.668854	0.47490463
#172	#173		uw58	nut58		2025-06-16 04:06:00+00:00	2025-06-16 04:05:00+00:00	48.837967	-16.514938	16.149214	35.652637	0.44272676
			uw59			2025-06-16 08:03:00+00:00	2025-06-16 08:05:00+00:00	49.005783	-16.376955	16.021544	35.672554	0.32338873

DIC/TA# 1/2	DIC/TA# 2/2	pH	Chl	Nutrients	Comments	Datetime (UTC)	gps_time (UTC)	Latitude	Longitude	Temperature (C)	Salinity (PSU)	Fluorescence (V)
			uw60			2025-06-16 08:46:00+00:00	2025-06-16 08:45:00+00:00	49.004704	-16.37707	16.087399	35.664364	0.32132748
#174	#175					2025-06-16 15:00:00+00:00	2025-06-16 15:00:00+00:00	49.01052	-16.410593	16.226183	35.640297	0.42369682
		#37		nut59		2025-06-16 15:02:00+00:00	2025-06-16 15:00:00+00:00	49.01052	-16.410593	16.226183	35.640297	0.42369682
			uw61		for chla	2025-06-16 22:04:00+00:00	2025-06-16 22:05:00+00:00	48.83549	-16.526588	16.186008	35.645077	0.5498953
			uw62			2025-06-17 01:05:00+00:00	2025-06-17 01:05:00+00:00	48.835503	-16.526583	16.1859	35.65804	0.4645551
			uw63			2025-06-17 03:52:00+00:00	2025-06-17 03:50:00+00:00	49.000072	-16.499983	16.082909	35.60439	0.58666617
#176	#177				uwdic glider	2025-06-17 09:05:00+00:00	2025-06-17 09:05:00+00:00	49.10576	-16.306547	15.962088	35.694973	0.3415254
		#38			uwpH glider cal	2025-06-17 09:07:00+00:00	2025-06-17 09:05:00+00:00	49.10576	-16.306547	15.962088	35.694973	0.3415254
				nut64	glider cal	2025-06-17 09:15:00+00:00	2025-06-17 09:15:00+00:00	49.108128	-16.305023	15.997523	35.69536	0.3073185
			uw64		glider cal	2025-06-17 09:15:00+00:00	2025-06-17 09:15:00+00:00	49.108128	-16.305023	15.997523	35.69536	0.3073185
#178			uw64			2025-06-17 17:00:00+00:00	2025-06-17 17:00:00+00:00	48.964317	-16.39564	16.796452	35.69437	0.25936025
			uw65			2025-06-17 22:02:00+00:00	2025-06-17 22:00:00+00:00	48.838657	-16.525135	16.662085	35.692043	0.43575874
			uw66			2025-06-18 02:22:00+00:00	2025-06-18 02:20:00+00:00	48.82394	-16.563955	16.427673	35.69082	0.49028733
			uw67		egim site	2025-06-18 04:15:00+00:00	2025-06-18 04:15:00+00:00	49.011456	-16.451752	16.590784	35.65851	0.42990622
					egim chl	2025-06-18 04:55:00+00:00	2025-06-18 04:55:00+00:00	49.013035	-16.449764	16.569582	35.660946	0.41803882

DIC/TA# 1/2	DIC/TA# 2/2	pH	Chl	Nutrients	Comments	Datetime (UTC)	gps_time (UTC)	Latitude	Longitude	Temperature (C)	Salinity (PSU)	Fluorescence (V)
#182					uway dic cast 17	2025-06-18 08:01:00+00:00	2025-06-18 08:00:00+00:00	49.014076	-16.445862	16.46813	35.670868	0.37017998
		#39			cast 17	2025-06-18 08:02:00+00:00	2025-06-18 08:00:00+00:00	49.014076	-16.445862	16.46813	35.670868	0.37017998
#183					uway dic cast 17	2025-06-18 14:30:00+00:00	2025-06-18 14:30:00+00:00	48.989933	-16.391548	16.665579	35.699005	0.2570782
			uw68		chl	2025-06-18 18:28:00+00:00	2025-06-18 18:30:00+00:00	49.03464	-16.374174	16.931604	35.697884	0.28279266
			uw69			2025-06-18 22:04:00+00:00	2025-06-18 22:05:00+00:00	48.856853	-16.49614	16.798578	35.72335	0.37097675
			uw70			2025-06-19 02:24:00+00:00	2025-06-19 02:25:00+00:00	48.837463	-16.525726	16.6532	35.722893	0.3737726
			uw71		black and clear tube sampling (near TSG and near SubCtech)	2025-06-19 05:00:00+00:00	2025-06-19 05:00:00+00:00	48.83746	-16.525726	16.603539	35.72959	0.34721723
			uw72		black and clear tube sampling (near TSG and near SubCtech)	2025-06-19 06:55:00+00:00	2025-06-19 06:55:00+00:00	48.837456	-16.525724	16.497787	35.7302	0.33511704
#184	#185				uway dic	2025-06-19 08:31:00+00:00	2025-06-19 08:30:00+00:00	48.83834	-16.513416	16.516804	35.72775	0.3436375
		#40			uway pH	2025-06-19 08:33:00+00:00	2025-06-19 08:35:00+00:00	48.838337	-16.513374	16.522655	35.727493	0.34105077
			uw73		chl	2025-06-19 11:09:00+00:00	2025-06-19 11:10:00+00:00	48.83745	-16.513332	16.592184	35.72708	0.2818845
			uw74		chl/lugol/sem	2025-06-19 13:36:00+00:00	2025-06-19 13:35:00+00:00	48.831844	-16.51239	16.83062	35.72824	0.22457948
#190	#191				uway dic	2025-06-19 15:31:00+00:00	2025-06-19 15:30:00+00:00		-16.512386	17.01421	35.725468	0.2548239

DIC/TA# 1/2	DIC/TA# 2/2	pH	Chl	Nutrients	Comments	Datetime (UTC)	gps_time (UTC)	Latitude	Longitude	Temperature (C)	Salinity (PSU)	Fluorescence (V)
			uw75		chl	2025-06-19 22:50:00+00:00	2025-06-19 22:50:00+00:00	48.836273	-16.512371	16.880547	35.722	0.35909292
					Seawater flow stopped and SubCtech switched off	2025-06-22 14:58:00		49.804765	-4.792228			

Acknowledgements

Many thanks to Joshua Pedder and Juan Ward (NMF) for setting up the data merger for the underway SubCtech pCO₂ and the ship's TechSAS data. Many thanks to Juan Ward and Daniel Phillips (NMF) for assistance with the GO underway pCO₂ system. Many thanks to Jethro Reading (NOC) from the benthic science team for taking the night-time underway Chlorophyll a samples.

References

Dickson, A. G., Sabine, C. L., and Christian, J. R.: Guide to Best Practices for Ocean CO₂ Measurements. PICES Special Publication 3, 191 pp., 2007.

11. Phytoplankton Community Survey from Underway Imaging Flow Cytometry

Sophie Clayton (NOC)

11.1 Objective

An Imaging Flow CytoBot (IFCB) was deployed on JC278 to provide continuous data on the phytoplankton community composition from samples automatically collected from the ship's underway seawater supply. The IFCB is an imaging flow cytometer designed to sample and image phytoplankton cells in the 5 – 150 μm size range (microphytoplankton) at roughly 30-minute intervals and can be run continuously for several weeks at a time. The goal of this deployment was primarily to determine how best to install the newly acquired IFCB on an NMF ship, develop NOC IFCB standard operating procedures, and collect a set of reference images for North Atlantic phytoplankton to start building an image library to support the development of automated taxonomic classification algorithms. A secondary goal was to provide detailed information on phytoplankton community composition and community changes along the ship's track, transiting from coastal to shelf and open ocean waters, as well as a short time series of phytoplankton community changes within the PAP-SO study area.

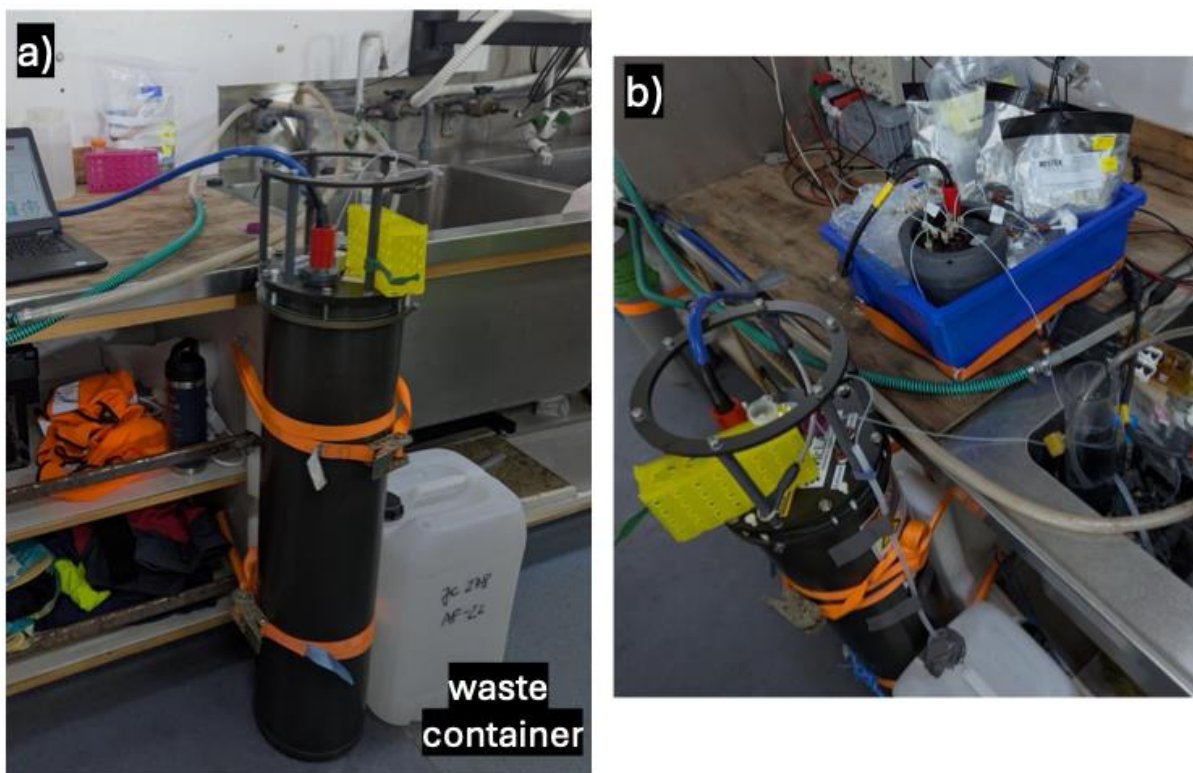


Figure 11.1: Photos of the IFCB installation in the RRS James Cook's deck lab from the side (a) and above (b). The IFCB intake was placed into a tubular receptacle that is filled by the underway system from below. The IFCB exhaust, which contains dilute sodium azide, is routed into a wider silicon tube that feeds into the waste container. The IFCB produces approximately 400mL of waste per day, generating a little under 10L of waste by the end of this cruise.

11.2 Approach

Installation

The IFCB was installed next to a sink with an underway seawater supply in the RRS James Cook's deck lab along with several other sensors sampling from the underway system (Figure 11.1). The IFCB sampled from the same water reservoir as a series of (Lab-on-Chip) LoC sensors, and the SubCTech pCO₂ sensor (see also Underway Sampling section of this report).

Once in its housing, the IFCB can only be controlled remotely, so it was necessary to assign the IFCB's onboard computer with a fixed IP address on the ship's network for remote access. This turned out to be a non-trivial issue but was resolved relatively quickly by the NMF IT staff. Unfortunately, we were not able to set the network connection up such that the IFCB could read position information from the ship's UDP broadcasts. GPS coordinates (along with underway temperature, salinity and fluorescence data) were matched based on the time of collection of the IFCB samples (which is captured as a datetime stamp in each sample's file name) and extracted from the ship's 5-minute averaged METOCEAN files to provide metadata for the IFCB samples. This may have introduced some offsets in the actual vs. recorded positions where each sample was collected but given the ship's speed of travel for the majority of the cruise, this error in position would be trivial. If necessary, the data can be reprocessed to extract position data from the 1-minute averaged METOCEAN data files to minimize location offsets.

Over the first couple of days of sampling, it became evident that small bubbles were being introduced into the IFCB from the reservoir. Bubbles cause the sample stream within the IFCB to deviate, this impacts particle alignment and focusing and can result in errors in the resulting data. To mitigate this, the option to 'debubble with sample' was enabled, which largely mitigated the introduction of bubbles.

To avoid fouling of the IFCB intake and internal fluidics, a cleaning cycle was performed every day, usually in the morning. This involved pausing sampling and removing the IFCB intake from the reservoir to avoid contaminating the supply that was also feeding other sensors, as a small amount of bleach is pushed back out through the intake during the cleaning cycle. Performing this daily cleaning cycle introduced a gap in sampling of an hour or less every day.

Data Dashboard and Data Management

The IFCB stores data on its internal hard drive, so scripts were set up to regularly copy data from the IFCB to the ship's shared 'science_public' drive and to my laptop every 12 hours and 30 minutes, respectively. This ensured that multiple copies of the data were captured in case of a failure of the IFCB's onboard computer.

Data from the IFCB was updated in near real time, with a roughly 30 minute delay, and displayed on a dashboard set up with code provided by the Sosik Lab (WHOI; <https://github.com/WHOIGit/ifcbdb>). The IFCB dashboard provided a view of all of the individual cells imaged in each sample, giving a relatively quick qualitative view of phytoplankton community shifts along the ship's track (Figure 11.2). The associated position metadata (latitude, longitude) was updated every day with a 1-day delay as the averaged METOCEAN data files are generated by NMF at the end of each day. It is highly recommended that all future underway IFCB deployments make use of this dashboard system to support adaptive sampling, or to monitor community shifts over time. Ideally it should be set up and made available to view on the ship's network.

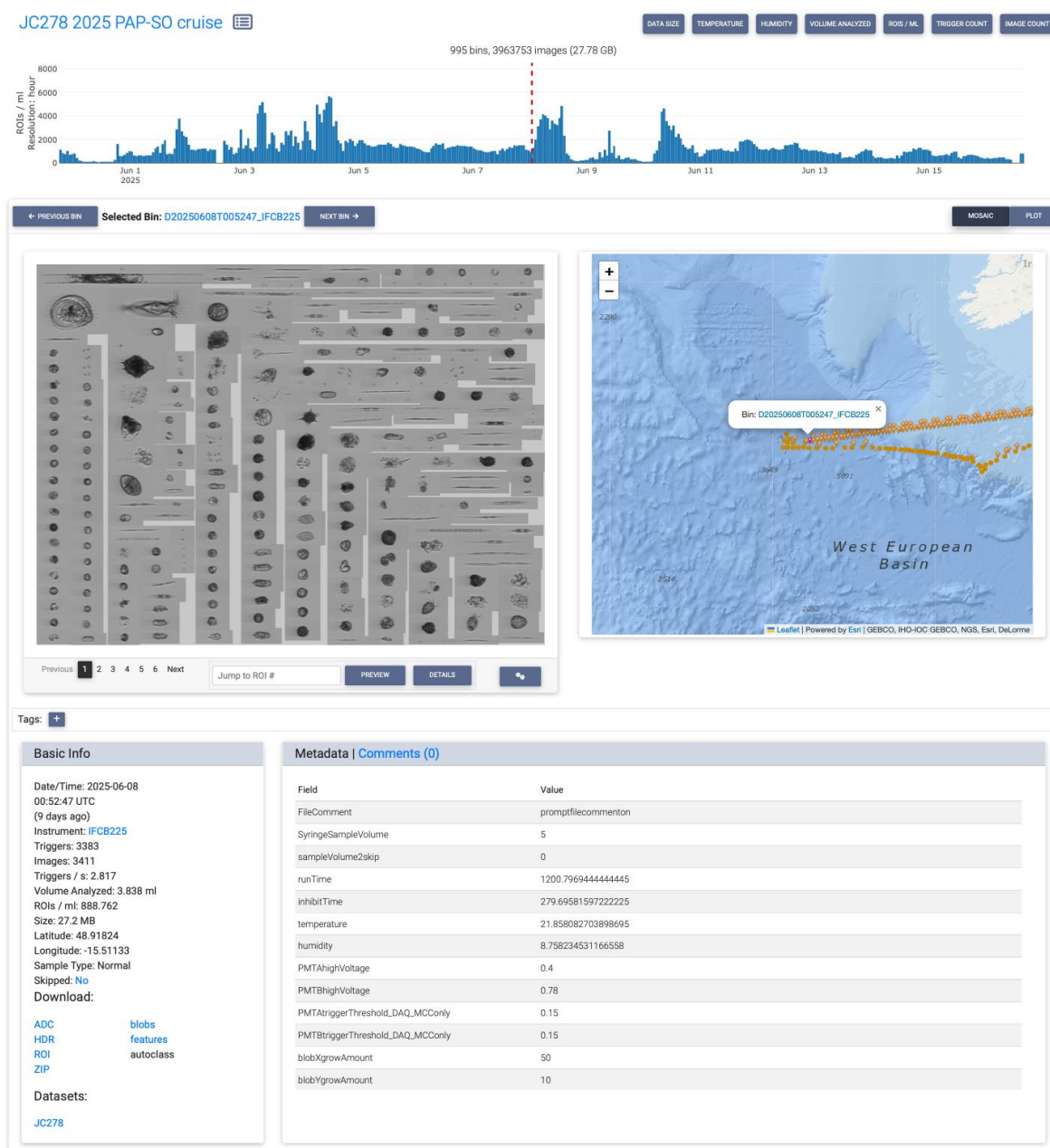


Figure 11.2: Screenshot of IFCB dashboard displaying IFCB images along with associated data collected during this cruise. The screenshot was captured on 16th June 2025, several days before sampling ended.

The IFCB performs some pre-processing of images, identifying Regions Of Interest (ROIs) within the frame to isolate images of individual cells and thereby reduce the volume of image data collected. After acquisition, the ROIs captured by the IFCB were processed with WHOI's MATLAB ifcb-analysis toolbox (<https://github.com/hsosik/ifcb-analysis>) to segment the images into 'blobs' and then extract features from each 'blob' (e.g. biovolume, major and minor axis length, etc...). Segmentation and feature extraction was performed manually on an ad hoc basis but should ideally be set up to run automatically on a set schedule following the regular data back-up process described above.

11.3 Impressions and Initial Results

Data Collected

Underway IFCB sampling commenced at approximately 18:30 UTC on 30/05/2025, and continued throughout the duration of the cruise until 15:00 UTC on 22/06/2025 with only minimal interruptions. By the end of the cruise, the IFCB had collected 1,351 individual samples, comprised of a total of 4,509,932 images, representing 32.43GB of data. Figure 11.3 shows the spatial distribution of the data collected with an indication of changes in the abundance of microphytoplankton along the track.

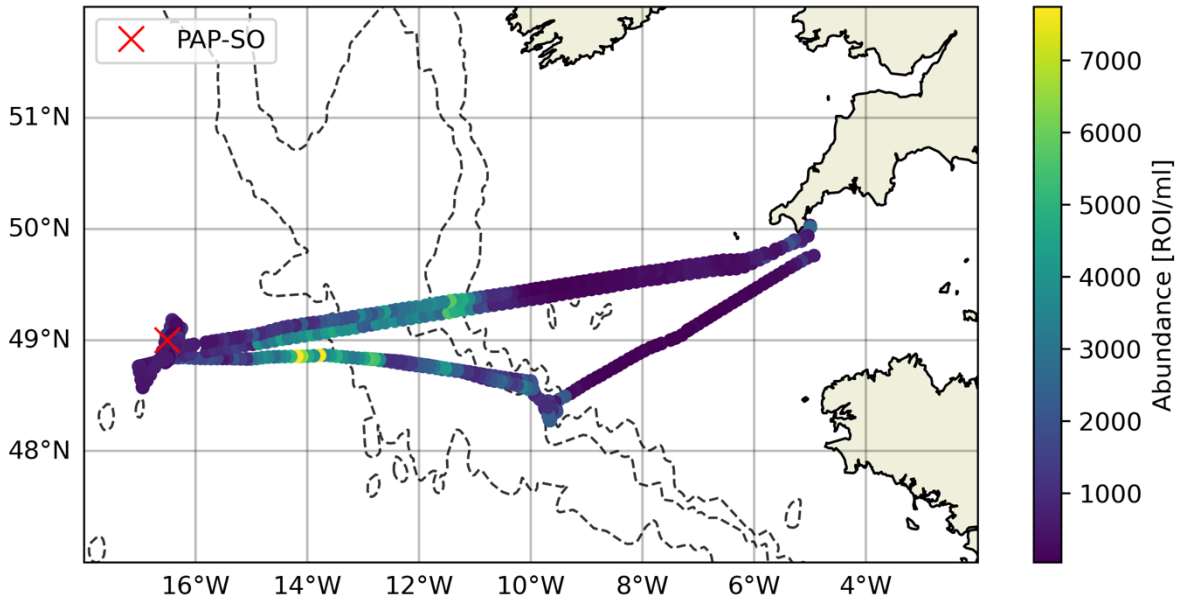


Figure 11.3: Map of IFCB data collected during JC278 (not including data collected after 23:59 UTC 20/06/2025), coloured to show ROI/ml, a proxy for microphytoplankton abundance, along the track. The location of PAP-SO is represented by a red cross and the dashed contours show the 200m, 1000m and 4000m depth contours.

Broadly, the data captured by the IFCB during JC278 can be used to assess phytoplankton community composition shifts:

1. along a strong environmental gradient from the coastal ocean to the open ocean, crossing the shelf break front at least 3 times; and,
2. over time at the PAP-SO site spanning a period of over 2 weeks, with 14 individual days of presence at the site.

Phytoplankton Community Shifts from Coastal to Open Ocean

The IFCB was able to capture marked community shifts that occurred along the ship's track as we transited from coastal waters, across the shelfbreak and into the deep open ocean. Figure 11.4 shows some examples of collections of images from the (a) English Channel, (b) Falmouth Bay, (c) the vicinity of Whittard Canyon,

and (d) PAP-SO at the beginning of the cruise. These collections highlight the larger cells images in the corresponding samples and hint at significantly different community composition and size structure in these 4 locations. This is a very superficial view of the data, which will be developed further once taxonomic identifications and quality control of the data can be undertaken.

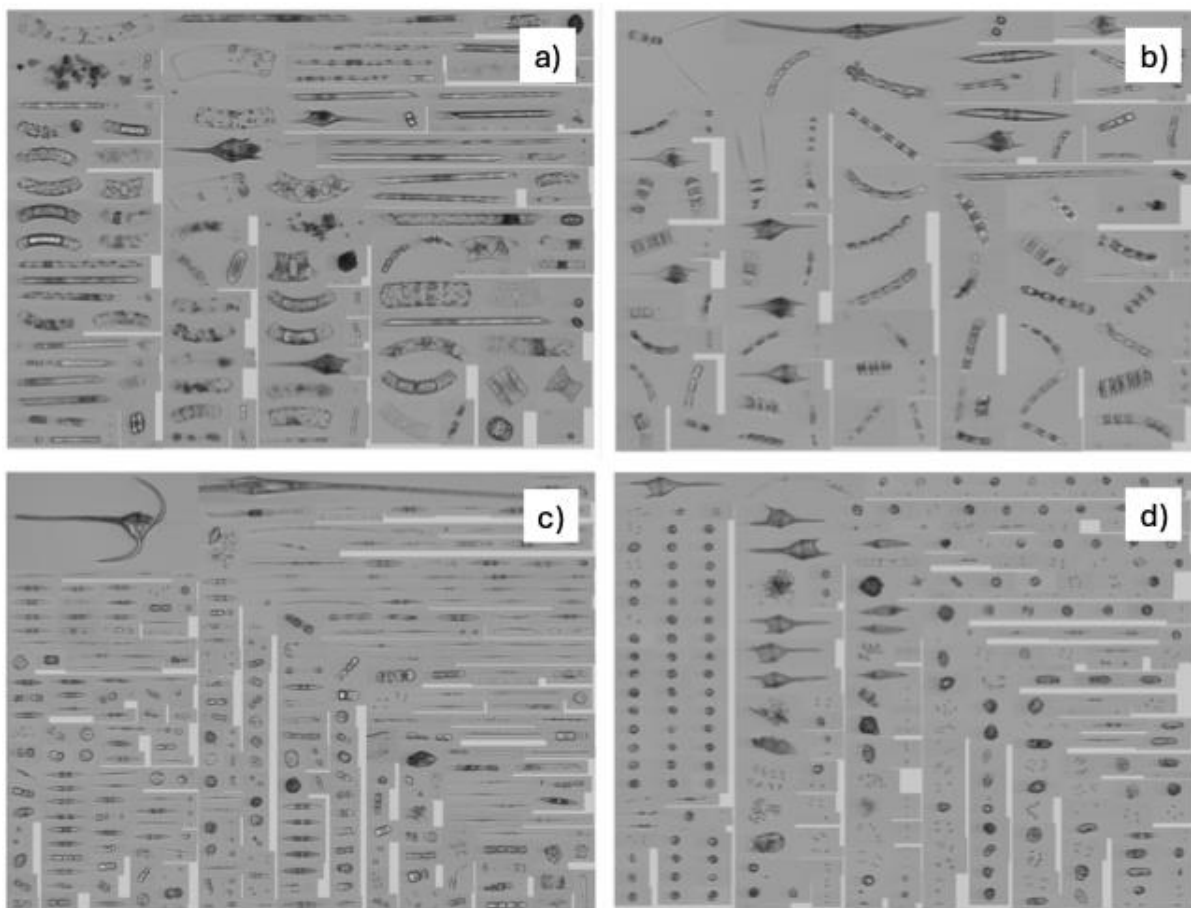


Figure 11.4: Example mosaics of IFCB images collected during JC278 from the (a) English Channel, (b) Falmouth Bay, (c) the vicinity of Whittard Canyon, and (d) PAP-SO at the beginning of the cruise. Note that these do not represent a full view of the phytoplankton cells imaged, rather they highlight the largest cells imaged in each sample.

An initial analysis of the abundance of IFCB ROIs compared to calibrated underway Chlorophyll a fluorescence data collected by the ship (see also Underway Measurements section) shows a good qualitative agreement along the coastal to open ocean gradient sampled (Figure 11.5). On average, the highest abundance of ROIs and the highest Chlorophyll a concentrations were both observed in the 12°W to 15°W longitudinal range, which broadly coincides with the locations where we crossed the shelfbreak front. Anecdotally, this region of high abundance was dominated largely by small pennate diatoms (e.g. Figure 11.4c) rather than the large microphytoplankton seen near the coast (e.g. Figure 11.4a, b).

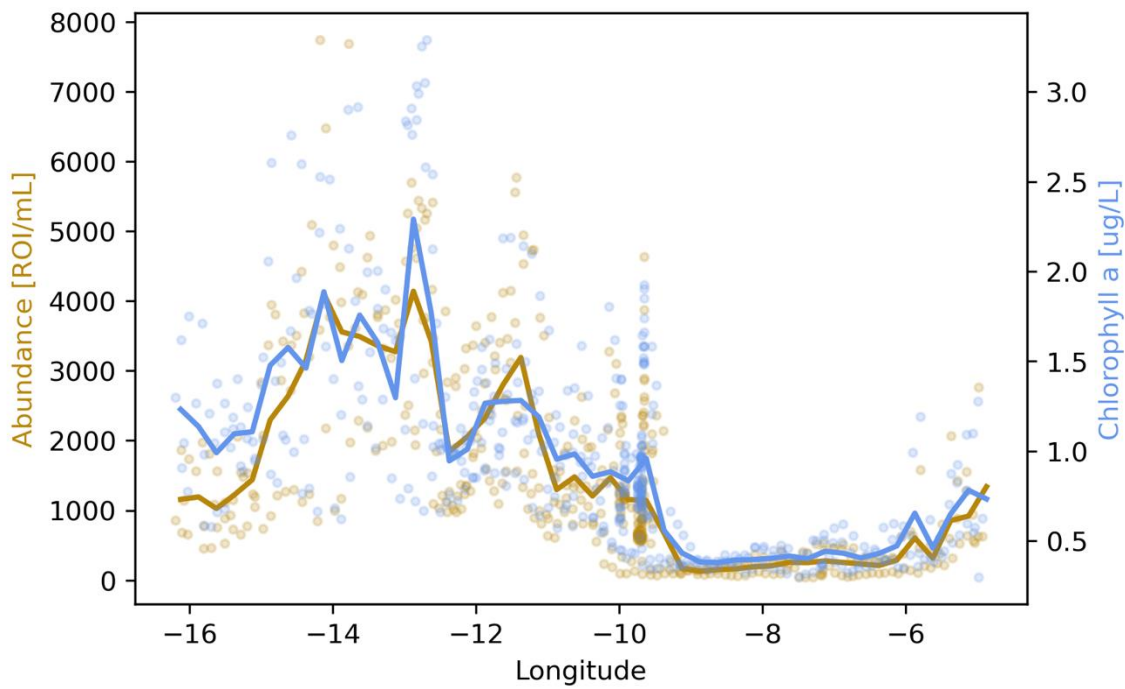


Figure 11.5: Abundance (ROI/mL; ochre) and Chlorophyll a (ug/L; blue) data collected between Falmouth Bay and PAP-SO. The small points represent each individual data file and the solid lines show the data averaged over 0.25° bins of longitude.

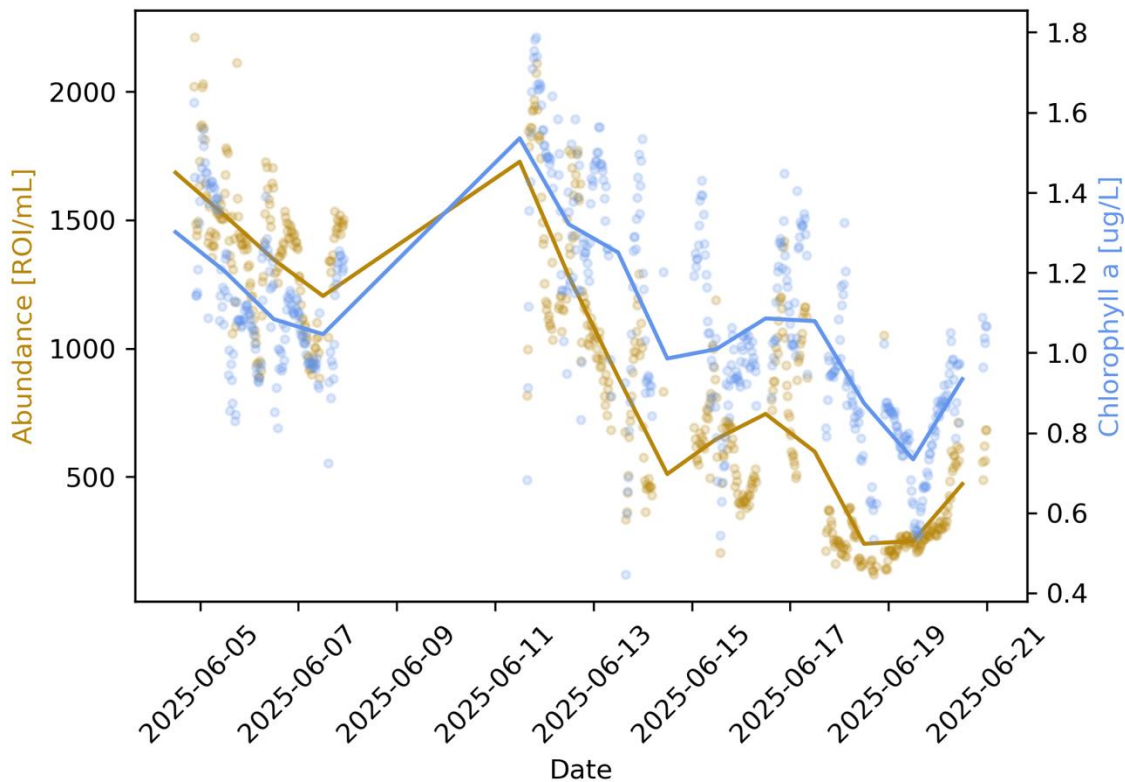


Figure 11.6: Abundance (ROI/mL; ochre) and Chlorophyll a (ug/L; blue) data collected within 0.1° of the PAP-SO site plotted against time. The small points represent each individual data file and the solid lines show the data averaged into daily bins.

Temporal Shifts in Phytoplankton Community at PAP-SO

A large proportion of time was spent in the vicinity of the PAP-SO time series site, and several days' worth of IFCB image data was accumulated in this area. A total of 577 individual IFCB samples were collected within 0.1° of the PAP-SO over 14 individual days. This synthetic time series of phytoplankton community composition data at PAP-SO captured an overall decrease in both Chlorophyll a concentration and microphytoplankton abundance (Figure 11.6). The community composition did not appear to change dramatically over this period (Figure 11.7), with the larger cells mostly represented by dinoflagellates (*Ceratium* spp.) and ciliates, with samples occasionally containing diatoms (*Chaetoceros* spp.) towards the latter part of the time series. These larger taxa comprised only a small number (< 10) of total cells imaged per sample, and so it is likely that samples will need to be pooled to obtain reliable data on their abundance.

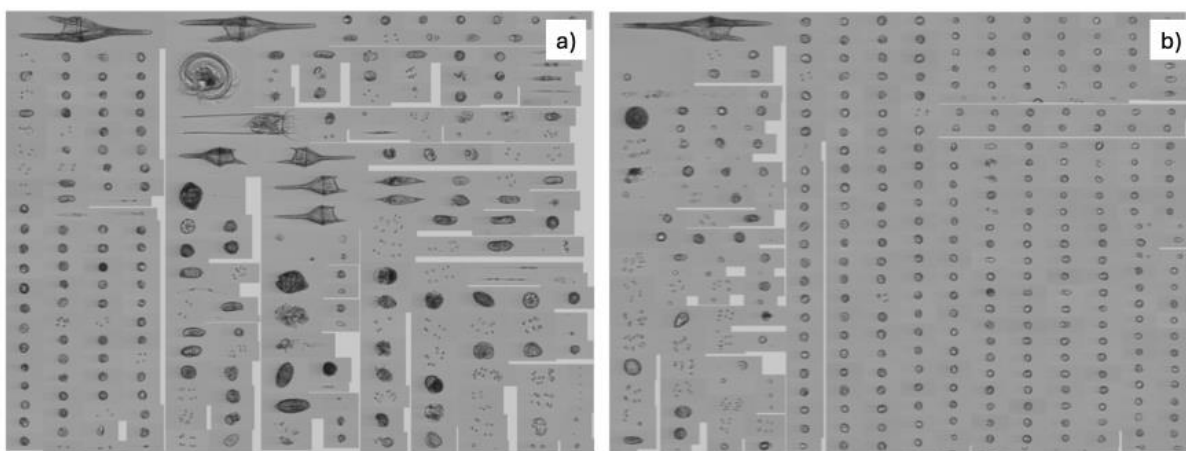


Figure 11.7: Example mosaics of IFCB images collected during JC278 from the PAP-SO site on (a) 4/06/2025 and (b) 20/06/2025, representing the beginning and end dates of the synthetic time series collected there. Note that these do not represent a full view of the phytoplankton cells imaged, rather they highlight the largest cells imaged in each sample.

11.4 Lessons Learned

This test deployment demonstrated that the IFCB can be relatively easily installed and deployed on an NMF research ship. With some minor additions to the digital infrastructure, including remote access for shore-based personnel to access the IFCB's web UI interface, deployments should be possible with minimal onboard supervision, except to respond to issues as they may arise. Remote access was set up and tested during this cruise and will be further assessed on the upcoming JC282 REBELS cruise later this year.

During this cruise, the IFCB was sampling from the same supply reservoir as a series of LoC sensors. This ensured that data was being collected as contemporaneously as possible but introduced the complication that cleaning cycles of the IFCB had to be performed manually to avoid contamination of the supply reservoir with bleach and biocide solution. For future concurrent LoC and IFCB deployments, particularly if they are autonomous (e.g. during a transit or SOOP deployment), separate reservoirs for the IFCB and LoC sensors should be installed.

The IFCB dataset collected during JC278, along with the concurrent data from the ship's underway TSG and fluorometer and discrete bulk and size fractionated Chlorophyll a samples, is a rich dataset that should be explored further. I have endeavoured to provide an initial, if superficial, analysis of the data here to spur

follow on work. Given the relative ease of installation and operation (assuming remote supervision from shore), future deployments of the IFCB during cruises to the PAP-SO time series should be integrated into the cruise plan to provide sustained longer-term data on phytoplankton community composition in this region over time.

Acknowledgements

Many thanks to Juan Ward and Basem Drawil (NMF) for all of their assistance with finding space to test the IFCB pre-cruise and then getting it set up on the ship's network for the cruise. Thanks also to Amanda Elineau (OBG) for her assistance with preparing chemicals and consumables and to Allison Schaap (OTE) for her help in setting up the underway seawater supply. This work was supported by a NOC RISC grant.

12. Biogeochemistry Argo

Andrew Gates, Sue Hartman & Paco Stil

Two BGC Argo floats were deployed on JC278. This extended the BGC Argo float deployments on the PAP cruise for a 6th year. One PROVOR CTS-5 float was deployed from the GEORGE project, detailed in section 16.3. A second float supplied by NOC was also deployed, the rationale being to maintain Nitrate observations around the PAP site, a variable that the GEORGE float did not measure. Validation CTD casts were carried out immediately preceding the float deployment.

Table 12.1: Argo deployments during JC278

Station number	Date	time	Deployment position	Name	Serial no.	WMO_ID	Validation CTD
JC278-015	05/06/2025	17:10	48° 55.230 N 016° 25.109 W	PROVOR-CTS5 BGC	P53380- 24EU001 fr_7902279	7902279	JC278-014
JC278-034	13/06/2025	05:32	48 50.492 N 016 12.900	PROVOR-CTS5 BGC	P53851- 23UK011	3902688	JC278-033

JC278-034 NOC PROVOR-CTS5 variables measured:

- Argo BGC - Dissolved Oxygen
- Argo BGC - NO3
- Argo BGC - pH
- Argo BGC - Chla
- Argo BGC - Backscatter
- Argo BGC – Irradiance
- Argo Core – Temperature and conductivity
- Argo Core - Pressure

JC278-015 GEORGE project PROVOR-CTS5 variable measured:

- Argo BGC – Dissolved Oxygen
- Argo BGC – pH
- Argo Core Temperature and conductivity
- Argo Core - Pressure

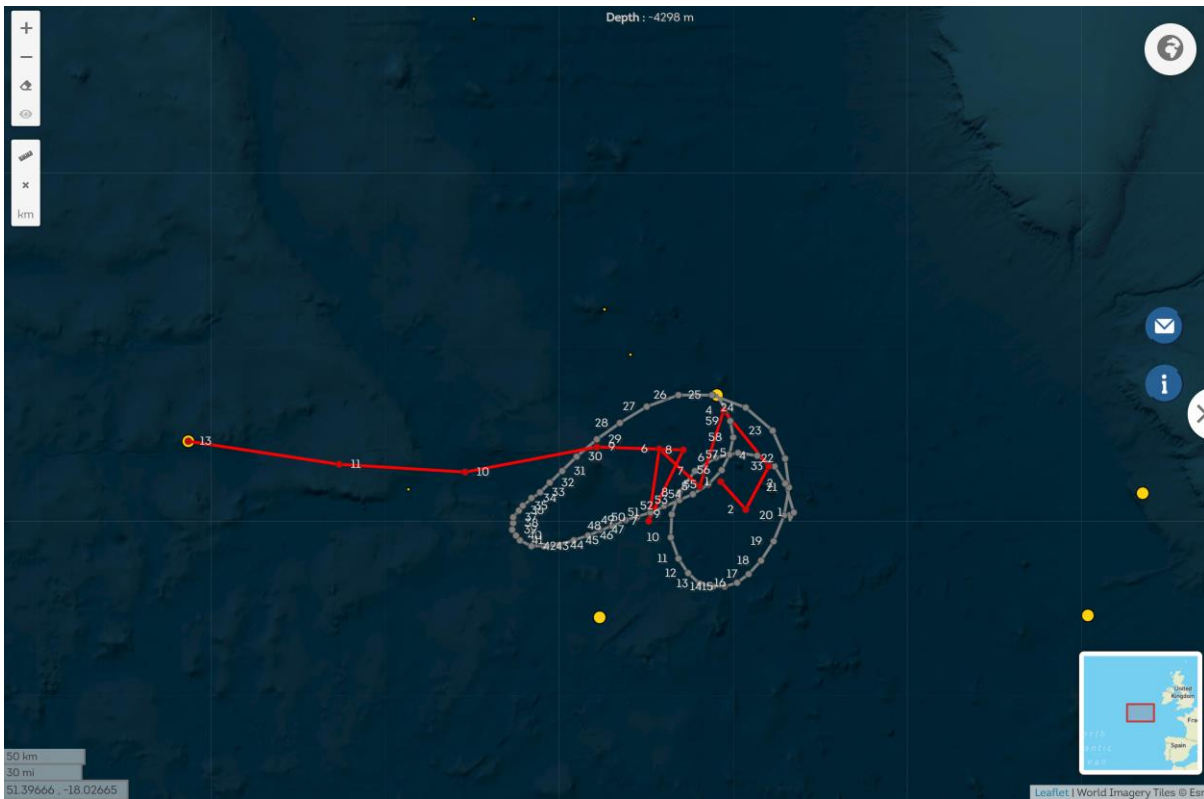


Figure 12.1: Trajectories for the two BGC Argo floats deployed at PAP on JC278, to August 2025. Red = NOC float, grey = GEORGE float with daily profiles.

12.1 Data

Plots direct from the Argo fleet monitoring pages for JC278-034 (NOC Argo float) are presented below. Data from the GEORGE float are shown in section 16.3.

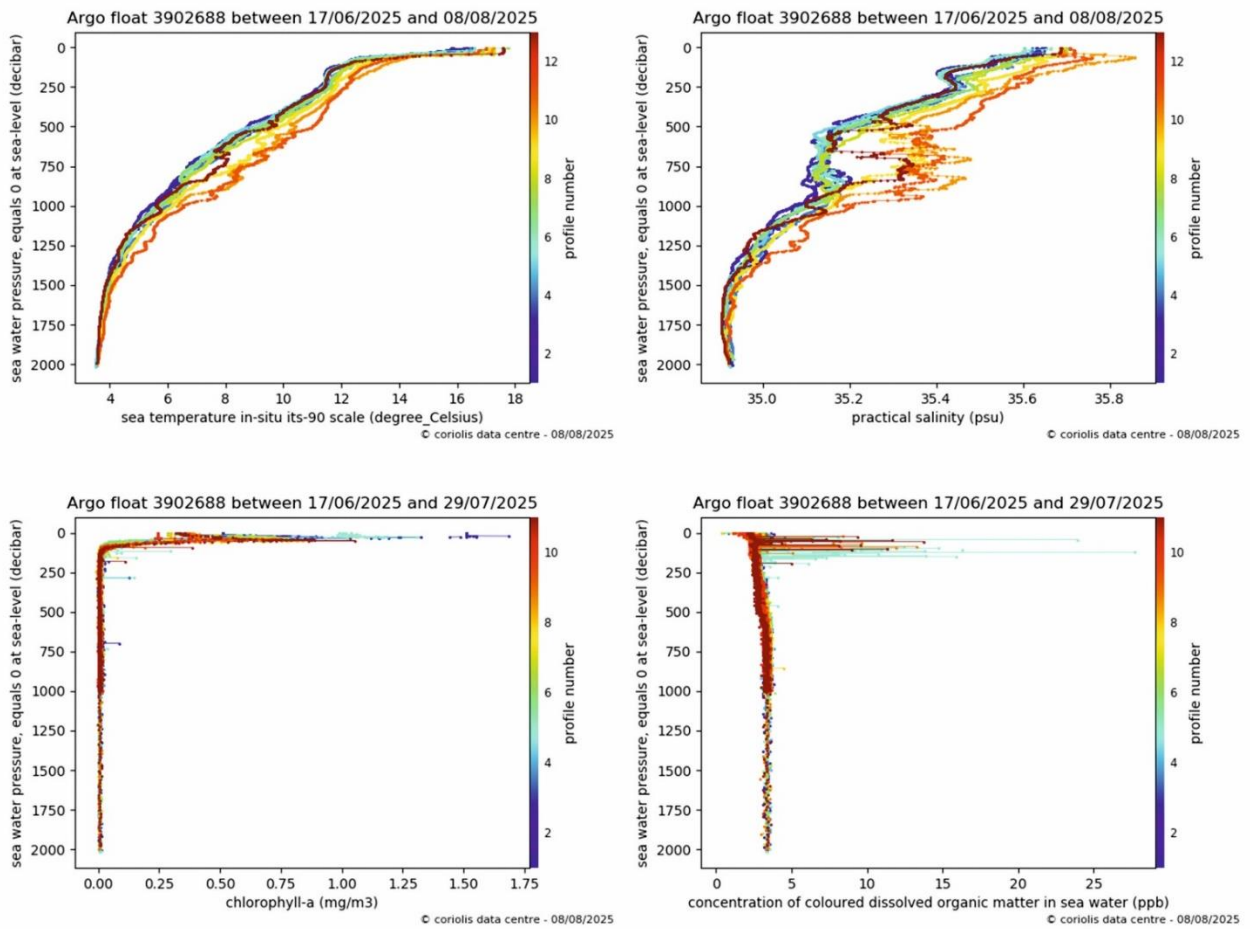


Figure 12.2: Example temperature, salinity, chlorophyll-a and CDOM profiles for JC278-034 to 8th August 2025.

Table 12.2: Summary of Argo deployments on PAP cruises since 2020

Station number	Date	time	Deployment position	Name	Serial no.	WMO_ID & data link	Validation CTD
DY116-006	20/11/2020	13:03	49° 00.03 N 016° 30.10 W	Navis BGCI	F0660	6903751	DY116-005
DY130-082*	12/04/2021	03:21	49° 15.48 N 014° 30.08 W	Navis BGCI	F1241	6903756	DY130-081
JC231-048 ⁺	08/05/2022	16:17	49 0.322 N 016 30.094 W	Navis BGCI	F1242	n/a	JC231-047
JC247-010	09/05/2023	13:32	48° 59.683 N 016° 30.053 W	Standard APEX	10066	3902494	JC247-008
JC247-011	09/05/2023	13:36	48° 59.683 N 016° 30.053 W	Engineering APEX	10068	7901093	JC247-008
JC247-019	10/05/2023	14:38	49° 00.002 N 016° 30.050 W	Navis BGCI	F1242	4903670	JC247-018
JC247-020	10/05/2023	14:40	49° 00.002 N 016° 30.050 W	BGC NKE CTS-5 (APER0)		4903740	JC247-018
JC247-049	16/05/2023	14:47	48° 58.578 N 016° 22.323 W	Standard APEX	10067	6990519	JC247-048
JC247-050	16/05/2023	14:49	48° 58.578 N 016° 22.323 W	Engineering APEX	10069	5907048	JC247-048
JC263-029	28/05/2024	11:07	49° 00.000 N 16° 29.999 W	PROVOR-CTS4 BGC	22002	3901580	JC263-028
JC278-015	05/06/2025	17:10	48° 55.230 N 016° 25.109 W	PROVOR-CTS5 BGC	P53380-24EU001 fr_7902279	7902279	JC278-014
JC278-034	13/06/2025	05:32	48° 50.492 N 016° 12.900 W	PROVOR-CTS5 BGC	P53851-23UK011	3902688	JC278-033

12.2 Procedure

Communication was maintained with the NOC Argo team (Nathan Briggs, Darren Raynor and Brian King) before and after deployment. The following instructions for preparation for the deployment were followed:

BGC Argo PROVOR-CTS4 deployment instructions (without Bluetooth connection)

Please keep NOC Argo team informed as to the likely deployment date/time so someone is available to confirm the float has started correctly.

1. Remove the float from the box and secure in an upright position with a view of the sky for GPS and Iridium tests.
 - The float can be lifted by two people with one lifting near the white buoyancy block and the other at the base. Be careful with the antennae. If the float has to be put back in the box then similarly you need to be careful lowering it in. The lifting strop often (though not always) unhelpfully goes under the float so can't be used to lift the float from the box or lower it back in



2. Approximately 1 hour before planned deployment remove the sensor covers/caps from:
 - The CTD = 2 orange plugs plus red plug attached to the orange tag
 - The oxygen optode = the black cap that says "remove before use"
 - The PAR sensor = the black rubber cap
 - The fluorometer sensor = the large white cap



3. Remove the magnet (and attached tape, but not the velcro pad) from the float completely to start the self-check process and record the time. Do not place the magnet on the Bluetooth location as this is for when talking to the floats with a computer and not for deployment. (Place the magnet safely somewhere in case the float cannot be deployed and the magnet would be reattached).



4. Listen for 5 slow clicks up to about a minute after to indicate the float has woken up (sometimes these can be a little hard to hear on a noisy ship so don't worry too much if you don't hear them)
5. Send a Whatsapp message to the group to say the float has been started
6. The float will do a series of self-checks including connecting to the GPS and Iridium satellite networks. When it has finished these if everything is ok it will do 5 quick clicks, but again it's not always easy to hear them and the time of the clicks is not that predictable as it depends on how quickly the satellite connections are made. So again don't worry if these aren't heard.
7. The float will upload some files to the Iridium server if it has passed all of its self-checks and Darren or Brian will be able to confirm if these are present. The second file should arrive after about 25-30 minutes from the time of magnet removal
8. Confirmation from Darren or Brian is required before deployment

9. When on position, carry the float (2 people) to the deployment point (either off the stern or from the side). On the UK vessels deployment will likely be made by crane, and if sea conditions are not calm then care needs to be taken to get the float far enough from the ship to prevent it swinging back and hitting the ship when lowering to the water. Deploying from a standing position is easier than lifting horizontally from the deck as the float will naturally hang at an angle that will protect the antennae from swinging up towards the lifting line above, which may happen if lifting from horizontal.
10. Use a sea-catch quick release hook or similar to lift the float by the short rope deployment strop



11. Lift the float with the crane or A-frame and lower the float into the water keeping the sea-catch release line slack until the float is in the water. Pull the release line and hopefully the antennae will be either aft or to the side of the hook so they don't hit it as it releases. If possible use the release line to pull the hook out of the way until the float is clear.
12. Record the time (UTC) and position and send this info to the Whatsapp group.
13. The float will not sink immediately so do not worry if it appears to stay floating on the surface, but keep an eye on it in case it drifts close to the ship

13. PAP3 - Sediment Traps

Christopher Feltham, Sam Castle, Victoria Hastings- Rafferty

13.1 Rationale and approach

The Porcupine Abyssal Plain Sustained Observatory (PAP-SO) sediment trap programme began in 1989 as part of the Biogeochemical Ocean Flux Study (BOFS) programme and the recovery and deployment on JC278 extends the time series. The sediment traps capture sinking particles at 3000m and 4750m in McLane parflux sediment traps with associated current meters. The sinking material is preserved and returned to NOC where it is analysed for Estimated Volume Flux, Dry Weight, Particulate Organic Carbon, Particulate Inorganic Carbon and Total Particulate Nitrogen.

The mooring (PAP3) comprises sinker plus acoustic release at sea bed; microcat (temperature and salinity) plus buoyancy at 80 mab, sediment trap plus current meter and buoyancy at 100 mab; sediment trap plus current meter and buoyancy at 3000m. The mooring is deployed for approximately 1 year. Sediment traps are programmed for maximum resolution at anticipated maximum flux and for lower resolution in winter.

Samples are preserved in 5% formalin buffered with excess di-sodium tetraborate in hypersaline seawater solution. Estimated Volume Flux (EVF) is measured on board on recovery then these samples are stored at 4-8°C for analysis at NOC Southampton, and collaborating partners.

This data provides insight into the sequestration of carbon in the north East Atlantic. This dataset comprises Estimated Volume Flux, Dry Weight, Particulate Organic Carbon, Inorganic Carbon and Total Particulate Nitrogen, measured from Particle Flux collected at 3000m on the PAP-SO mooring from 2019-2023.

13.2 Recovered Traps

The PAP3 mooring has 3 sediment traps, two at roughly 3000m (traps A and B) and one at (trap C) at 100 m above the bottom (~4750 m). A single Nortek current meter is co-located with traps A and B at roughly 3000 m. At 100 mab a Nortek current meter and Seabird MicroCAT are co-located with trap C. PAP3 was deployed on JC263 and was deployed at 13:23 on the 6th June 2023, station JC263-021. The triangulated position was 49° 0.282 N 16° 22.624 W. PAP3 was recovered on the 16 June 2025, on JC278.

Thanks to the sensors and moorings team for the recovery of the sediment traps. Trap A had appeared to have stopped at bottle 19 and trap B and C at bottle 20.



Figure 13.1: PAP-3 Sediment traps in ship hanger post recovery

The cups were lined up and photographed by Christopher Feltham with help from Sam Castle and Victoria Hastings Rafferty. Then the pH was checked (ranging from 4.5 to 6). 1 ml of concentrated buffered formalin was added to each bottle and all the Logsheets of this data and photos of the trap bottles can be seen below.



Figure 13.2: Photographs of sediment trap samples lined up in chronological order showing higher flux from the spring bloom towards the end of the deployment.

Table 13.1: Details from sediment trap recovery JC263-016

Deployment No:	XCI
Cruise deployed:	JC263
Station #:	JC263-016
Date:	26/05/2024
By:	Chris Feltham
Start & end times:	14:00:00
Position:	49° 0.282 N 16° 22.624 W
Sounding:	4837 m
Trap A:	SN: 15681-03 at 3122 m
Trap B:	SN: 15681-02 at 3175 m
Trap C:	SN: 15681-01 at 4728 m
MicroCATs:	SBE37 SN:24771 at 3124 m & SBE37 IMP ODO SN:9385 at 4780 m
Current Meters:	Nortek SN:8351 4729 m & Nortek SN:6178 3124 m
Acoustic release:	Dual release: AR861 SN 1137 & SN 1142
Deployment No:	XCI
Cruise deployed:	JC263
Station #:	JC263-016
BY:	Chris Feltham & Tim Powell

Table 13.2: Logs from recovered Trap A

<u>Sample code</u>	<u>Open Date</u>	<u>Open Date</u>	<u>Julian Day</u>	<u>Open day</u>	<u>Julian Day</u>	<u>Interval</u>	<u>Comment</u>	<u>pH</u>	<u>Flux height (mm)</u>
Trap A	at 1200h	US style	Open	2006	Mid = day	days			
XCI-A-1	28/05/24	05/28/24	148	149	155	12	Simplex Health pH papers	6.0	27.0
XCI-A-2	09/06/24	06/09/24	160	161	168	14		5.0	7.0
XCI-A-3	23/06/24	06/23/24	174	175	182	14		5.0	10.0
XCI-A-4	07/07/24	07/07/24	188	189	196	14		5.0	8.0
XCI-A-5	21/07/24	07/21/24	202	203	213.5	21		5.0	6.0
XCI-A-6	11/08/24	08/11/24	223	224	234.5	21		6.0	13.0
XCI-A-7	01/09/24	09/01/24	244	245	255.5	21		5.0	10.0
XCI-A-8	22/09/24	09/22/24	265	266	276.5	21		6.0	8.0
XCI-A-9	13/10/24	10/13/24	286	287	297.5	21		6.0	8.0
XCI-A-10	03/11/24	11/03/24	307	308	318.5	21		6.0	4.0
XCI-A-11	24/11/24	11/24/24	328	329	339.5	21		5.0	4.0
XCI-A-12	15/12/24	12/15/24	349	350	364	28		5.0	5.0
XCI-A-13	12/01/25	01/12/25	12	13	23.5	21		5.0	5.0
XCI-A-14	02/02/25	02/02/25	33	34	44.5	21		5.0	4.0
XCI-A-15	23/02/25	02/23/25	54	55	65.5	21		6.0	9.0
XCI-A-16	16/03/25	03/16/25	75	76	86.5	21		5.0	3.0
XCI-A-17	06/04/25	04/06/25	96	97	107.5	21		5.0	7.0
XCI-A-18	27/04/25	04/27/25	117	118	128.5	21		5.0	2.0
XCI-A-19	18/05/25	05/18/25	138	139	149.5	21		5.0	<1.0
XCI-A-20	08/06/25	06/08/25	159	160	170.5	21		5.0	<1.0
XCI-A-21	29/06/25	06/29/25	180	181	191.5	21		5.0	<1.0
Final move to open hole	20/07/25	07/20/25	201	202		-		-	

Figure 13.3: Logs from recovered Trap B

Sample code	Open Date	Open Date	Julian Day	Open day	Julian Day	Interval	Comment	pH	Flux height (mm)
trap B	at 1200h	US style	Open	2006	Mid-day	days			
XCI-B-1	28/05/24	05/28/24	148	149	155	12	Simplex health pH paper	5.0	23.0
XCI-B-2	09/06/24	06/09/24	160	161	168	14		5.0	4.0
XCI-B-3	23/06/24	06/23/24	174	175	182	14		6.0	8.0
XCI-B-4	07/07/24	07/07/24	188	189	196	14		5.0	8.0
XCI-B-5	21/07/24	07/21/24	202	203	213.5	21		5.0	6.0
XCI-B-6	11/08/24	08/11/24	223	224	234.5	21		5.0	15.0
XCI-B-7	01/09/24	09/01/24	244	245	255.5	21		6.0	10.0
XCI-B-8	22/09/24	09/22/24	265	266	276.5	21	Fischer brand pH papers	5.5	9.0
XCI-B-9	13/10/24	10/13/24	286	287	297.5	21		5.0	7.0
XCI-B-10	03/11/24	11/03/24	307	308	318.5	21		5.0	6.0
XCI-B-11	24/11/24	11/24/24	328	329	339.5	21		5.0	4.0
XCI-B-12	15/12/24	12/15/24	349	350	364	28		5.0	4.0
XCI-B-13	12/01/25	01/12/25	12	13	23.5	21		5.0	4.0
XCI-B-14	02/02/25	02/02/25	33	34	44.5	21		4.5	5.0
XCI-B-15	23/02/25	02/23/25	54	55	65.5	21		4.5	8.0
XCI-B-16	16/03/25	03/16/25	75	76	86.5	21		5.0	4.0
XCI-B-17	06/04/25	04/06/25	96	97	107.5	21		5.0	11.0
XCI-B-18	27/04/25	04/27/25	117	118	128.5	21		5.0	6.0
XCI-B-19	18/05/25	05/18/25	138	139	149.5	21		5.5	5.0
XCI-B-20	08/06/25	06/08/25	159	160	170.5	21		5.0	2.0
XCI-B-21	29/06/25	06/29/25	180	181	191.5	21		5.0	<1.0
Final move to open hole	20/07/25	07/20/25	201	202				-	

Table 13.4: Logs from recovered Trap C

trap C	Open Date	Open Date	Julian Day	Open day	Julian Day	Interval		pH	Flux height (mm)
	at 1200h	at 1200h	Open	2006	Mid-day	days			
XCI-C-1	28/05/24	05/28/24	148	149	155	12	Fischer brand pH papers	5.5	24.0
XCI-C-2	09/06/24	06/09/24	160	161	168	14		5.5	8.0
XCI-C-3	23/06/24	06/23/24	174	175	182	14		5	7.0
XCI-C-4	07/07/24	07/07/24	188	189	196	14		5	8.0
XCI-C-5	21/07/24	07/21/24	202	203	213.5	21		5	7.0
XCI-C-6	11/08/24	08/11/24	223	224	234.5	21		5.5	8.0
XCI-C-7	01/09/24	09/01/24	244	245	255.5	21		5.5	11.0
XCI-C-8	22/09/24	09/22/24	265	266	276.5	21		5.5	11.0
XCI-C-9	13/10/24	10/13/24	286	287	297.5	21		5	9.0
XCI-C-10	03/11/24	11/03/24	307	308	318.5	21		5	6.0
XCI-C-11	24/11/24	11/24/24	328	329	339.5	21		4.5	6.0
XCI-C-12	15/12/24	12/15/24	349	350	364	28		5	4.0
XCI-C-13	12/01/25	01/12/25	12	13	23.5	21		5	5.0
XCI-C-14	02/02/25	02/02/25	33	34	44.5	21		5	5.0
XCI-C-15	23/02/25	02/23/25	54	55	65.5	21		5	7.0
XCI-C-16	16/03/25	03/16/25	75	76	86.5	21		5	6.0
XCI-C-17	06/04/25	04/06/25	96	97	107.5	21		5	9.0
XCI-C-18	27/04/25	04/27/25	117	118	128.5	21		5.5	6.0
XCI-C-19	18/05/25	05/18/25	138	139	149.5	21		5	8.0
XCI-C-20	08/06/25	06/08/25	159	160	170.5	21		5.5	3.0
XCI-C-21	29/06/25	06/29/25	180	181	191.5	21		5	<1.0
Final move to open hole	20/07/25	07/20/25	201	202		-			-

13.3 Deployed traps

On the deployment all sediment traps were deployed successfully and there were no perceivable issues. The PAP3 mooring has 3 sediment traps, two at roughly 3000m (trap A at 3064 m and B at 3137m) and one at (trap C) roughly 100 m above the bottom (4737m). A single Nortek current meter is co-located with traps A and B at roughly 3000 m. At 100 mab a Nortek current meter and Seabird MicroCAT are co-located with trap C. PAP3 was deployed on JC278 and was deployed at 14:35 on the 6th June 2025 and the anchor was estimated to have reached the seafloor at 15:43. PAP-3 was logged as station JC278-020. The triangulated position was 48° 58.48 N 016° 29.45 W.

Table 13.5: Deployment details for sediment trap deployed on JC278

Deployment No:	XCI
Cruise deployed:	JC278
Station #:	JC278-020
Date:	06/06/2025
By:	Chris Feltham & Chris Crowe
Start & end times:	Deployment start: 14:35. Reached seabed: 15:43
Position:	48° 58.48 N 016° 29.45 W
Sounding:	4812 m
Geospectrum Hydrophone	RS Aqua PORPOISE-84-D SN:TR-12-IR4-231 3033m
Trap A:	SN: 12432-01 at 3064m
Trap B:	SN: 11804-02 at 3137m
Trap C:	SN:11804-04 at 4737m
MicroCATs:	SBE37 SN 7297 at 3068 m & SBE37 IMP ODO SN21549 at 4741 m
Current Meters:	Nortek SN 11630 3067m & Nortek SN 13486 4740 m
Acoustic release:	Dual release: AR861 SN 2298 & SN 2248

Table 13.6: Deployment details for Trap A

Sample code	Open Date	Open Date	Julian Day	Open day	Julian Day	Interval
Trap A	at 1200h	US style	Open	2006	Mid-day	days
XCII-A-1	08/06/2025	06/08/25	159	160	160	14
XCII-A-2	22/06/2025	06/22/25	173	174	181	14
XCII-A-3	06/07/2025	07/06/25	187	188	195	21
XCII-A-4	27/07/2025	07/27/25	208	209	219.5	21
XCII-A-5	17/08/2025	08/17/25	229	230	240.5	21
XCII-A-6	07/09/2025	09/07/25	250	251	261.5	21
XCII-A-7	28/09/2025	09/28/25	271	272	282.5	21
XCII-A-8	19/10/2025	10/19/25	292	293	303.5	21
XCII-A-9	09/11/2025	11/09/25	313	314	324.5	21
XCII-A-10	30/11/2025	11/30/25	334	335	345.5	28
XCII-A-11	28/12/2025	12/28/25	362	363	377	21
XCII-A-12	18/01/2026	01/18/26	18	19	29.5	21
XCII-A-13	08/02/2026	02/08/26	39	40	50.5	21
XCII-A-14	01/03/2026	03/01/26	60	61	71.5	21
XCII-A-15	22/03/2026	03/22/26	81	82	92.5	21
XCII-A-16	12/04/2026	04/12/26	102	103	113.5	21
XCII-A-17	03/05/2026	05/03/26	123	124	134.5	14
XCII-A-18	17/05/2026	05/17/26	137	138	145	14
XCII-A-19	31/05/2026	05/31/26	151	152	159	14
XCII-A-20	14/06/2026	06/14/26	165	166	173	14
XCII-A-21	28/06/2026	06/28/26	179	180	187	14
Final move to open hole	12/07/2026	7/12/26	193	194		

Table 13.7: Deployment details for Trap B

Sample code	Open Date	Open Date	Julian Day	Open day	Julian Day	Interval
trap B	at 1200h	US style	Open	2006	Mid-day	days
XCII-B-1	08/06/2025	06/08/25	159	160	160	14
XCII-B-2	22/06/2025	06/22/25	173	174	181	14
XCII-B-3	06/07/2025	07/06/25	187	188	195	21
XCII-B-4	27/07/2025	07/27/25	208	209	219.5	21
XCII-B-5	17/08/2025	08/17/25	229	230	240.5	21
XCII-B-6	07/09/2025	09/07/25	250	251	261.5	21
XCII-B-7	28/09/2025	09/28/25	271	272	282.5	21
XCII-B-8	19/10/2025	10/19/25	292	293	303.5	21
XCII-B-9	09/11/2025	11/09/25	313	314	324.5	21
XCII-B-10	30/11/2025	11/30/25	334	335	345.5	28
XCII-B-11	28/12/2025	12/28/25	362	363	377	21
XCII-B-12	18/01/2026	01/18/26	18	19	29.5	21
XCII-B-13	08/02/2026	02/08/26	39	40	50.5	21
XCII-B-14	01/03/2026	03/01/26	60	61	71.5	21
XCII-B-15	22/03/2026	03/22/26	81	82	92.5	21
XCII-B-16	12/04/2026	04/12/26	102	103	113.5	21
XCII-B-17	03/05/2026	05/03/26	123	124	134.5	14
XCII-B-18	17/05/2026	05/17/26	137	138	145	14
XCII-B-19	31/05/2026	05/31/26	151	152	159	14
XCII-B-20	14/06/2026	06/14/26	165	166	173	14
XCII-B-21	28/06/2026	06/28/26	179	180	187	14
Final move to open hole	12/07/2026	7/12/26	193	194		

Table 13.8: Deployment details for Trap C

trap C	Open Date	Open Date	Julian Day	Open day	Julian Day	Interval
XCII-C-1	08/06/2025	06/08/25	159	160	160	14
XCII-C-2	22/06/2025	06/22/25	173	174	181	14
XCII-C-3	06/07/2025	07/06/25	187	188	195	21
XCII-C-4	27/07/2025	07/27/25	208	209	219.5	21
XCII-C-5	17/08/2025	08/17/25	229	230	240.5	21
XCII-C-6	07/09/2025	09/07/25	250	251	261.5	21
XCII-C-7	28/09/2025	09/28/25	271	272	282.5	21
XCII-C-8	19/10/2025	10/19/25	292	293	303.5	21
XCII-C-9	09/11/2025	11/09/25	313	314	324.5	21
XCII-C-10	30/11/2025	11/30/25	334	335	345.5	28
XCII-C-11	28/12/2025	12/28/25	362	363	377	21
XCII-C-12	18/01/2026	01/18/26	18	19	29.5	21
XCII-C-13	08/02/2026	02/08/26	39	40	50.5	21
XCII-C-14	01/03/2026	03/01/26	60	61	71.5	21
XCII-C-15	22/03/2026	03/22/26	81	82	92.5	21
XCII-C-16	12/04/2026	04/12/26	102	103	113.5	21
XCII-C-17	03/05/2026	05/03/26	123	124	134.5	14
XCII-C-18	17/05/2026	05/17/26	137	138	145	14
XCII-C-19	31/05/2026	05/31/26	151	152	159	14
XCII-C-20	14/06/2026	06/14/26	165	166	173	14
XCII-C-21	28/06/2026	06/28/26	179	180	187	14
Final move to open hole	12/07/2026	7/12/26	193	194		

14. Benthic Systems and Sampling

*Jennifer Durden, Lisa Skein, Dara Farrell, Leonor Pizarro, Jethro Reading,
Petr Slavik, Ben Walker, Andrew Gates*

14.1 Aims and objectives

The main aim of the benthic team was to continue the different streams of time series observations of the benthos and seafloor of the Porcupine Abyssal Plain Sustained Observatory site.

The objectives were to:

1. Collect replicate sediment cores by megacorer at the PAP Central location, with a focus on macrofaunal community characterisation;
2. Collect scavenging amphipods using replicate baited trap deployments;
3. Capture time-lapse photographs of the seabed over both short- and long-term deployments of the Bathysnap camera system; and,
4. Capture seabed photographs using the HyBIS system at the PAP Central site to monitor the megafaunal community.
5. Collect a small amount of multibeam data to improve the bathymetric maps of the site.

A second aim was to conduct preliminary seafloor photograph and video transects at two interflaves of Whittard Canyon using the HyBIS system.

A third aim was to collect sediment cores for use in an experiment studying the effects of heavy metals exposure to microbes conducted by Leonor Pizarro (CIIMAR) as part of an Atlantis Fellowship.

A fourth aim was to collect sediment cores for geochemical porewater analysis to calibrate the nitrate concentrations determined using the benthic lander, and trial an alkalinity sensor.

The majority of this assessment was conducted at the PAP Central area, a 1 km² area that has been the focus of the sediment coring and seabed photography since 2011. The amphipod trap and time-lapse camera were deployed in the 'moorings area' to the north.

14.2 Narrative of benthic activities

31/05/2025 – 01/06/2025: HyBIS: HyBIS was deployed for its first dive on JC278 at 23:21 at Whittard Canyon's Explorer interflume. The purpose of the dive was to characterize coral mounds mapped by AUV during JC237, as potential deep-sea cold-water coral restoration sites for the EU-H2020 REDRESS project. The HyBIS was deployed at 23:21 and reached WP1 with the transect starting at 00:13. The vehicle was subsequently towed at a speed of 0.2 kts and at an altitude of 2 m above the seabed. A 10-second interval for stills images was set. Aperture and white balance settings were automatic, with no zoom. Visibility at the bottom was considered good. Six mounds were targeted in a down-slope direction, all characterised by fine coral rubble, and only one piece of intact dead coral framework was observed. The dive was concluded at 02:58 when WP3 was reached.

01/06/2025 – 02/06/2025: HyBIS: On its second dive on JC278, Hybis was deployed this time over the Dangaard interflume of the Whittard Canyon. As during the previous night, the aim was to characterize coral mounds that may be targets of future restoration as part of the REDRESS project. An additional aim at this site was to perform a repeat survey of an earlier ROV line that was carried out by the Isis

ROV during the JC266 expedition. Locations of coral mounds were informed by a combination of AUV side-scan sonar (from JC237), as well as dive track and altitudes from JC266 ROV dive. The same settings were applied for this survey, namely a target altitude of ship speed of 0.2 kts, with the camera system positioned 2 m above the seabed, and a still image taken every 10 seconds along with continuous video recording. The overall impression of this dive was a greater abundance and diversity of benthic fauna comparison to the previous dive at the mounds on the Explorer interfluve, notably crinoids, and two octopus. The dive was successfully concluded and HyBIS back on deck at 23:36. Transit back to the Explorer to conduct another survey line, starting at WP8. Short delay due to cable issue leading to a pause in the survey from 01:19 – 01:49. High density of *Cidaris* urchins between WP10 and WP11. Rubble density on mounds seems higher than on Dive 001 at this interfluve. Dive successfully concluded.

04/06/2025 – 05/06/2025: Megacore: The first megacore of JC278 was deployed at the PAP-Central coring site, station JC278-012, at site MGC1. The megacorer was fitted with 8 tubes and 4 weight plates, as well as USBL that was switched on when the megacorer was near the seabed. Out of the 8 tubes deployed, 7 came back well-filled, all of which were processed for subsequent macrofauna analysis, where the top 5 cm of each core was retained in 5l buckets and fixed in 99% ethanol (approximately 1 l per bucket).

05/06/2025 – 06/06/2025: Bathysnap: The bathysnap time-lapse camera system was successfully retrieved and on deck by 13:06 (station JC263-072).

Megacore: The first megacore of the evening was deployed at 18:14 and retrieved by 22:45 (JC278-016, site MGC2). Of the eight tubes, five were returned with sediment although the content of one was lost when removing the tube from the megacorer. Of the four remaining tubes, none had colour separation and had generally low levels of sediment. All four were subsequently processed for macrofauna analysis. The second deployment of the evening started at 23:18 and was retrieved at 03:24 (JC278-017, site MGC3). Six of the eight tubes were filled for sediment, two of which were processed for metals analysis and experiments (L. Pizzaro, CIIMAR), and the remaining four were processed for macrofauna analysis.

06/06/2025 – 07/06/2025: Megacore: Deployment commenced at 17:45 and was retrieved by 22:11 (JC278-021, site MGC4). Seven well-filled tubes were returned, the best on the cruise so far, although one was unfortunately lost during processing. All remaining tubes were processed for macrofauna analysis. The second megacore of the evening (JC278-022, site MGC5) was deployed at 22:54 and retrieved by 03:08, returning 6 filled tubes with lower levels of sediment, none of which had colour changes. Note that the coordinates recorded for sample location were read from the USBL attached to the corer as this position was slightly different than that of the ship.

07/06/2025 – 08/06/2025: Megacore: The megacorer was deployed at 17:59 with the descent and ascent rates adjusted to an average of 45m/min as opposed to the previous 40m/min (JC278-026, MGC6). On the descent, the ship's position was adjusted by roughly 50m NE due to the wire's position and the USBL's position at the bottom was recorded when the corer was at the seabed and was taken as the station's coordinates. All eight tubes were retrieved well-filled although some had breaks toward the bottom of the tubes. An interesting Echiuran burrow was noted in tube B. Five of the eight tubes were processed for macrofauna analysis, two for metals (L. Pizzaro) and one for nitrate / geochemistry (A. Schaap).

11/06/2025 – 12/06/2025: HyBIS: HyBIS went into the water at 16:45 at PAP, marking the first dive at PAP for the JC278 expedition (JC278-029). The dives are planned to follow the same lines as JC263, with starting locations at the top of replicated lines randomly chosen for each dive. This evening, the dive started at H5A. A microCAT was fastened to HyBIS and set to log data at 5-minute intervals. The vehicle shifted a considerable distance from the ship during the descent, resulting in a slightly delayed start of the transect at 20:07. The HyBIS was towed at a speed of 0.3 kts and stills taken every 10 seconds, and the Scorpio camera set to auto. After completing lines H5A-H5B and H4B-H4A, lift off commenced at 01:03, and the HyBIS was back on deck by 02:56.

12/06/2025 – 13/06/2025: HyBIS: A slightly later start to the HyBIS dive of the evening commenced at 19:06, with a transect start at 21:15 at the northern section of line H10 (H10A) (JC278-032). Strong water movement resulted in the ship being aligned to the west of the survey line as during the previous nights' survey. A microCAT CTD was attached to the vehicle and set to the same logging intervals as the evening before. The same survey protocol as the previous night evening was applied. Notably, several trawl scars with plastic debris were observed throughout this dive. The dive was concluded at 01:30 with the HyBIS back on deck by 03:25.

13/06/2025 – 14/06/2025: Amphipod trap: The amphipod trap was successfully deployed with an estimated time at bottom around 09:00 and a goal to be retrieved in approximately 48 hours (JC278-036).

HyBIS: In water by 16:45 and with a transect start around 19:35, the survey this evening started to the north of line H8 (H8A) (JC278-040). No CTD was attached to the HyBIS for this dive. Strong water movement from the previous few nights persisted resulting in the ship position adjusted to the west of the envisioned transect line, with the HyBIS transect more in between lines H8 and H7 aiming in a southerly direction toward H7B. Once turned and ending at H7A, the plan was to follow line H6 but realistically the line that was followed was closer to line H7. Notable observations this evening included a dumbo octopus (in forward-looking camera), glass sponges, and a predatory tunicate *Octacnemus* sp. The dive was successfully concluded at 01:30 and vehicle was back on deck by 03:26.

15/06/2025 – 16/06/2025: Amphipod trap: Following a 48-hour deployment, the amphipod trap was released at 14:25 and recovered on deck by 16:08 marking the end of station JC278-036. The amphipod trap took longer than anticipated to reach the surface, as well as being spotted much further away than expected. Upon recovery it was revealed that one of the buoys had imploded which may be the reason for the delayed arrival of the equipment at the surface. Nevertheless, the deployment was a success and all traps contained amphipods. A second trap is being prepared on this evening's night shift, with deployment expected for the next morning.

HyBIS: The delayed recovery of the amphipod trap resulted in a delayed start this evening's HyBIS survey. An additional element to this evening's survey was a trial with the Bathysnap camera system (camera & flash) added to the HyBIS vehicle to inspect the applicability of this camera system to the survey work done by HyBIS. Some troubleshooting with the Bathysnap system's settings was required, after which the system was subsequently programmed to take stills at 4-minute intervals. Stills intervals was confirmed as successfully set prior to deployment. The HyBIS was deployed at 20:44, reached the seafloor at 22:56 and started the transect on the north of line H6 (H6A) at 23:00 (JC278-045). The transect realistically followed between lines 6 and 7, and concluded nearer to the southern section of line 6 (H6B). HyBIS lift off and at approximately 15m altitude, the wire frayed, compromising the protective cabling and exposing the fibre optic cable. HyBIS was then lowered back to the seafloor, its position then recorded as at 48 49.8813°N, 16 31.2290°W. Wire was payed out to release tension while the ship manoeuvred closer to the HyBIS vehicle. During this time the HyBIS was dragged to 48

50.2303'N, 16 30.8189'W. A second recovery attempt failed at 05:54 when the cable snapped (~5000m cable out), and the last position of HyBIS was recorded as 48 50.303'N, 16 30.723'W.

16/06/2025 – 17/06/2025: Bathysnap: The long-term Bathysnap was deployed at 18:14 with estimated arrival at the seabed at 19:45 (JC278-048). The system was set to collect stills at 4-hour intervals. A Nortek current meter was added to the frame.

Megacore: Following repairs to the winch after the previous evening's cable failure, megacoring could continue. A 500m exclusion zone around the last recorded position of the HyBIS (and attached cabling) was set for the remaining deployments of JC278 at the PAP Central area. The megacorer was deployed at 21:17, descended at a slightly faster rate of ~50-55 m/min (as opposed to 40-45 m/min) and successfully sampled site MGC09 at 23:12, at which time the USBL position indicated the megacorer to be approximately 136.5m from the ship (this position was noted as the station's position; JC278-049). The megacorer was back on deck by 01:12, returning eight well-filled tubes, all intact and with colour separation. Seven of the eight tubes were processed for macrofauna analysis and the remaining core was processed for nitrate / geochemistry (A. Schaap).

17/06/2025 – 18/06/2025: Megacore: The megacorer was deployed at 18:15. The ship moved during the descent to compensate for the positioning after wire, although when the megacorer was approximately 400m from the seafloor the USBL indicated that it was positioned outside of the PAP Central area. Following adjustment of the ship and tracking of the USBL's position until within the focus area, the corer successfully sampled the seabed at 21:16, not quite at MGC014. The actual position from the USBL was recorded as the station's position (JC278-053; 48 50.456'N, 16 31.428'W) with a clean drop in tension at the time of sampling. Ascend and descend rates were at 45 m/min. The megacorer was secured on deck at 23:21 and returned eight well-filled tubes, all of which were processed for macrofauna analysis. The remains of two cores were kept aside for A. Schaap for additional inspection (tubes S and X).

Multibeam: Following megacoring, a short multibeam survey was carried out in the vicinity of the PAP Central area with the goal of removing noise from the existing multibeam bathymetry around the area, particularly one patch of noise to the west of PAP Central. The planned lines were run at a speed of 4 – 6 kts with a 60-degree swath angle.

18/06/2025 – 19/06/2025: Amphipod trap: Trap number "Bottom 2" flipped horizontally, so that the opening resulted in being more in line with the top two traps as opposed to the bottom trap. The catch in Bottom 2 was also more in line with what would be expected from the top two traps. The Bottom 1 catch was quite poor, but the blue barrel returned large numbers of large amphipods (*Eurythenes* spp) (JC278-047).

Megacore: The megacorer was deployed at megacore site MGC17. The currents appeared weaker than the previous evening, as the USBL's position revealed the corer to be close (~50m) from the ship at the time of sampling (00:30; JC278-057). Usual descent and ascent rates of 40-45m/min were followed and the corer returned eight well-filled tubes, all but one demonstrating colour changes. All tubes were processed for macrofauna analysis.

19/06/2025 - 20/06/2025 This time was dedicated to the recovery of HyBIS. Once on deck, still photos from the Scorpio and Bathysnap cameras were downloaded.

14.3 Sediment coring

Selection of coring locations

Megacoring sites were generated through the 'Create Random Points' features in the Data Management Tools toolbox in ArcGIS Pro. A 500m radius buffer around the PAP central midpoint (48° 50.22'N, 16° 31.27'W) was selected as the constraining feature and a minimum allowable distance of 150m between points was set to avoid potential spatial autocorrelation among samples. In some cases, the actual positions at which the megacorer sampled the seafloor (indicated by the USBL attached to the corer) differed quite notably from that of the ship due to bottom currents, resulting in some stations being closer to each other than initially planned (Fig. 14.1).

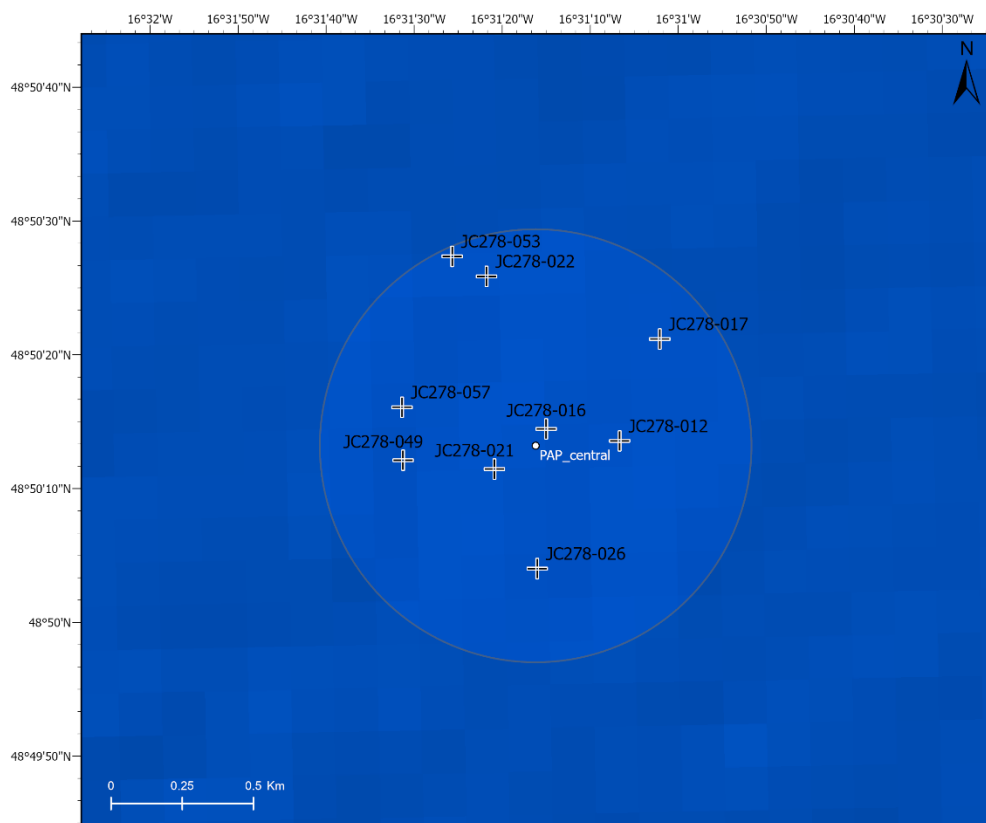


Figure 14.1: Megacore stations completed during JC278 at the PAP Central study site.

Core processing protocols and equipment

On deck: Once the megacorer was recovered to deck, the cores were examined for overlying water clarity, disturbance/cracks in the core and notable layers or patches in the sediment. The depth of the pale clay sediment horizon, ubiquitous at PAP Central, was also recorded for each core. Failed cores were recorded. The depth of cored sediment was measured, and each core tube was photographed (Figure 14.2). Cores were then removed from the megacorer and processed.

Sample processing equipment: Megacorer equipment for a team of two/ three persons processing a core comprised: a large, tall, bucket, in which a plunger was placed to extrude the core; a tube, a

syringe, and/or a pipette, to extract the overlying water into a 250 µm sieve; slicing rings (small or large depending on sample) marked at 5.0 and 10 cm; slicing plates (metallic and plastic); at least two wash bottles filled with filtered seawater (macrofauna); tweezers for extracting opportunistic specimens; two 20L plastic boxes filled with filtered seawater for washing excess sediment from equipment after processing; ethanol/waterproof pens to write on the paper labels. A sieving table supplied with filtered seawater was used for washing equipment between deployments.

Processing protocols

Macrofauna (MAC): The supernatant fluid was siphoned through a 250 µm sieve with syringes and pipettes used to extract the small volume of remaining fluid. The sieve was then rinsed into the same 5L bucket as the rest of the macrofauna sample. Slicing plates were used to slice the top 0.0 - 5.0 cm, measured with a premade 5CM ring, of the core, which was then placed in the 5L bucket. Both the slicing plate and rings were rinsed into the bucket with filtered seawater. Each bucket was labeled with station number, date at which the megacorer impacted the seabed, and core tube A paper label was placed inside the sample with identical information. Samples were preserved in 100% ethanol. Sample destination: Discovery Collections (DISCOLL, NOC, Ocean BioGeosciences; T. Horton).

Metal impact on Microbes (MET): Sediments for background microbial genomics and metal exposure experiments. The top 10 cm of each core was sliced with a plastic slicing plate and stored in a ziplock sterile bag in preparation for experiments.

The top 10 cm of cores N and K from Station JC278-017, and cores N and H from Station JC278-026 were collected with a plastic slicer to a sterile bag each. The whole content was homogenized inside the sterile bags and each core subsampled into (a) 20 x 25 cm² culture flasks for metal exposure experiments, (b) four 5 mL Eppendorf tubes frozen at -80°C for background microbial omics, and (c) one 15 mL Falcon tube to dry at room temperature and quantify metal content.

For the metals experiments, ≈ 1,5 cm sediment was added to each culture flask, to which 40 mL of filtered sea water was added. This bottom water was collected by Niskin 1 from the CTD-05 at Station JC278-013, at 4827 m, and Niskin 1 from CTD at Station JC278-023, at 4820 m. The flasks were then incubated overnight in the cold room, in the dark. To each flask was added 200 µL of the treatment. For each metal, we achieved five different treatments: control (no metal added), and 0.015 mM, 0.15 mM, 1.5 mM, and 15 mM of either CdCl₂ or CuCl₂.H₂O. The flasks were then incubated for 96 hours in the cold room (5°C), in the dark. After the 96 hours of exposure, the contents of the flasks were subsampled into (a) one 15 mL falcon with overlaying water filtered through 0.22 µm disk filter frozen at -80°C, (b) one 5 mL Eppendorf with sediment for DNA extraction frozen at -80°C, (c) one 2 mL Eppendorf with sediment and DNA/RNA shield for RNA extraction kept in the cold room, and (d) one 15 mL falcon with sediment to dry at room temperature and quantify metal content.

Sample destination: Centro Interdisciplinar de Investigação Marinha e Ambiental (CIIMAR, PT; Leonor Pizarro).

Geochemistry (GEO): A pre-drilled core liner with holes every 1 cm was installed on the MUC for one station. After recovery the supernatant fluid was removed via syringe and two samples stored. Pore water was extracted by inserting a 5 cm long Rhizon CSS sampler (Rhizosphere Research Products, NL) through the holes and applying suction with a 10 mL syringe. The initial ~0.1 mL of water to reach the syringe was discarded, and then suction reapplied until 1-2 ml of pore water was recovered. Each cm was sampled in the top 10 cm of sediment, and each 2 cm was sampled in the lower section (12-30 cm). Samples were frozen at -20C for later lab analysis. The primary intended analysis is nitrate

concentrations, to compare with the benthic lander *in situ* nitrate pore water analysis. Sample destination: NOC (Allison Schaap & Anna Lichtschlag)

A summary tabulation of all megacore deployments and their sample retention is provided in Tables 14.1.

Table 14.1: Summary tabulation of megacore deployments and core retention for each purpose.

Station	MAC NOC	MET CIIMAR	GEO NOC
JC278-012	7		
JC278-016	4		
JC278-017	4	2	
JC278-021	6		
JC278-022	6		
JC278-026	5	2	1
JC278-049	7		1
JC278-053	8		2 (unused material from other tubes)
JC278-057	8		



Figure 14.2: Composite image of Megacore profile photographs.

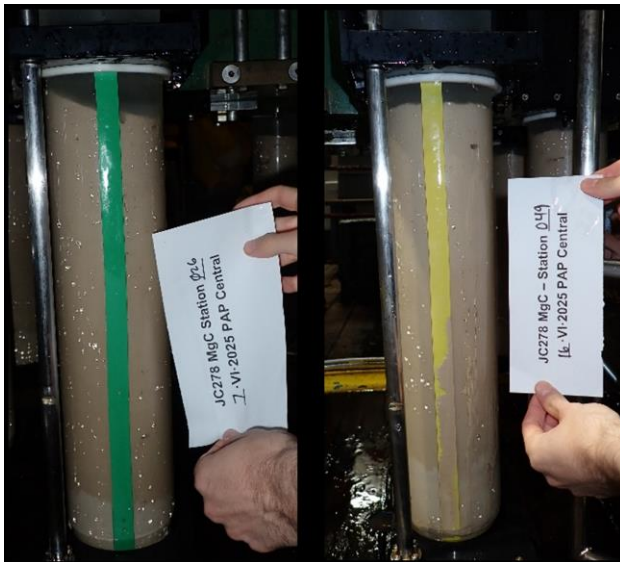


Figure 14.3: Composite image of Megacore GEO cores profile photographs.

Details of megacore deployments

The dates indicate the date of the start of the shift (16:00h). It does not indicate when the megacorer reached the bottom nor when it came back on deck.

04/06/2025 - The megacorer was configured with eight 10 cm cores, four layers of ballast lead, and a USBL, a configuration that was kept for all megacorer deployments except on day 07 and 16/06/2025. The deployment (station JC278-012, site MGC-01) returned seven cores (340 - 395 mm). Four of the seven cores had a noticeable colour change towards a lighter-coloured material in the bottom (320 - 340 mm), and the others contained breaks in the sediment (170 - 290 mm). All seven cores provided MAC samples.

05/06/2025 - The first deployment (station JC278-016, site MGC-02) returned five shallow and disturbed cores (75 - 260 mm). One of those five was lost upon retrieval from the megacorer. The remaining four cores provided MAC samples. The second deployment (station JC278-017, site MGC-03) returned six full good cores (390 - 440 mm) with noticeable colour change towards a lighter-coloured material in the bottom (320 - 355 mm). Four cores provided MAC samples, and two cores were processed for MET.

06/06/2025 - The first deployment (station JC278-021, site MGC-04) returned seven full good cores (400 - 530 mm) with noticeable colour change towards a lighter-coloured material in the bottom (230 - 440 mm). One of the seven cores was lost during processing. The remaining six cores provided MAC samples. The second deployment (station JC278-022, site MGC-05) returned six cores (195 - 340 mm). All six cores provided MAC samples.

07/06/2025 - One of the eight cores tubes was replaced by a tube for pore water sampling, for GEO purposes. The deployment (station JC278-026, site MGC-06) returned eight well-filled cores (390 - 440 mm), with noticeable colour change towards a lighter-coloured material (360 - 390 mm), and some breaks towards the bottom. Five cores provided MAC samples, two were processed for MET, and one for GEO.

16/06/2025 - One of the eight cores tubes was replaced by a drilled tube for pore water sampling, for GEO purposes. The deployment (station JC278-049, site MGC-09) returned eight very well-filled cores (410 - 430 mm), with noticeable colour change towards a lighter-coloured material (340 - 360 mm), and no apparent breaks. Seven cores provided MAC samples, and one was used for the GEO protocol.

17/06/2025 - The megacorer was reconfigured with the eight 10 cm cores. The deployment (station JC278-053, site MGC-14) returned eight well-filled cores (410 - 430 mm) with a noticeable colour change towards a lighter-coloured material in the bottom (340 - 360 mm). All eight cores provided MAC samples. The bottom of two cores were kept for GEO analysis.

18/06/2025 - The deployment (station JC278-057, site MGC-17) returned eight well-filled cores (410 - 440 mm), seven of which with a noticeable colour change towards a lighter-coloured material in the bottom (350 - 365 mm). All eight cores provided MAC samples.

14.4 Amphipod trap

Amphipod trap deployment locations

The amphipod trap was deployed in the conventional manner on two occasions in “PAP Central” during the cruise. A summary tabulation of the deployments can be found in Table 14.2. A map with the locations of the different deployments can be found in Figure 14.4.

Table 14.2: Summary tabulation of amphipod trap deployments:

	JC278-036	JC278-047
Latitude	48 55.367 N	49 0.6160 N
Longitude	16 28.695 W	16 24.65 W
Start date and time	13/06/2025 0900	16/06/2025 1548
End date and time	15/06/2025 1425	18/06/2025 1508
Soak time (hours)	53	47
Corrected depth (m)	4848	4848

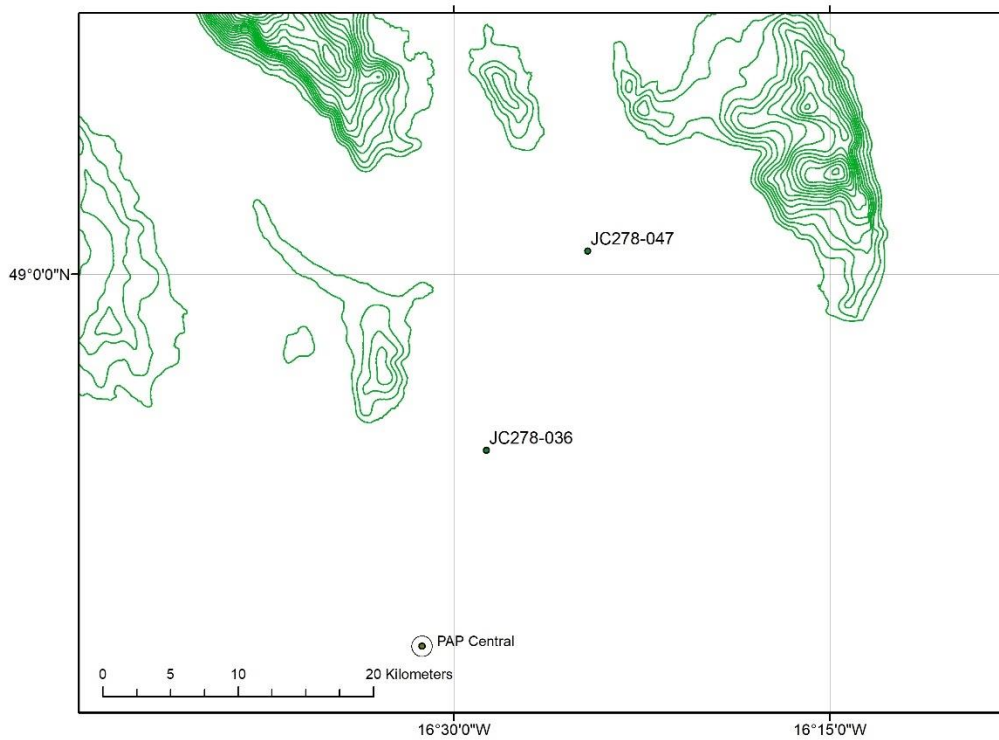


Figure 14.4: Amphipod trap deployment locations

Trap set up

The trap carries four cylindrical traps with 50 mm holes and sieve like-mesh in both the front and back opening. An additional 'blue barrel' trap was attached at about 15 m above bottom on the mooring. Each trap was baited with a single Atlantic mackerel partially wrapped around a mesh like plastic fabric. The cylindrical trap BOTTOM2 was partially bent following the amphipod trap crashing onto the seabed in the first deployment of cruise JC263 (JC263-021), and so was replaced with an undamaged cylindrical trap.



Figure 14.5: The amphipod trap as deployed in JC278-047. Left: Duct-tape added to two of the openings on the lid of TOP 2 to prevent sample loss on recovery. Right: inverted position of BOTTOM 2 on recovery.

Sample processing

Nitrile gloves were used to avoid biological contamination of the samples. Amphipods were removed from the trap by gently washing the trap cylinder with filtered seawater above the sieving table that was used as a working station (two traps were processed at the same time to speed up the process). Specimens were retained on a 250 μ m sieve that was placed on a tray to prevent sample loss. The bait mackerel was examined (dissected if necessary) to collect amphipods within the flesh, and was then stored in a 5L bucket containing 100% EtOH for further dissection to collect amphipods onshore. Specimens were transferred to absolute ethanol in the same 5L bucket containing the mackerel for the trap. Each bucket was labelled with Station number, position of the trap (i.e. TOP 1, TOP 2, BOTTOM 1, BOTTOM 2, BLUE BARREL), date, depth, and preservation method (100% ETOH).

Deployment and catch details

First deployment (JC278-036): The barrels were attached with a single hole in each of TOP1 and BOTTOM1 traps and three for traps TOP2 and BOTTOM2. Trap lids were positioned so that the mesh was below the openings. This was to ensure that water drained through the mesh and not the opening, which could potentially lead to the loss of amphipods through the trap opening on ascent. The mooring descent rate was estimated at 58 m min⁻¹, and ascent rate at 26 m min⁻¹. During ascent, the glass in one of the floats had blown, meaning the mooring ascended to the surface ~1 hour later than expected.

The catch for the blue barrel was large, including several large *Eurythenes* specimens and many medium-sized and smaller specimens with a high consumption of the bait. In the traditional amphipod traps, most amphipods comprised small individuals. The BOTTOM 2 trap caught the most amphipods, with moderate consumption of the bait. BOTTOM 2 consisted of many small individuals (mainly *Paralicela tenuipes*). TOP2 contained a moderate catch of amphipods, with individuals being larger on average compared to BOTTOM 2, comprising seemingly of a mix between *P. tenuipes* and *P. caperesca*. The consumption of the bait was substantially less than in BOTTOM 2. TOP 1 contained a small number of specimens, with the bait retaining most of its flesh. BOTTOM 1 caught very few amphipods, with seemingly no consumption of the bait.

Second deployment (JC278-047): Trap lids were also positioned so that the mesh was below the openings for this deployment. To minimise possible further loss of amphipods, one of the trap lids with three openings was replaced with a spare lid that had a single opening. As only one spare lid was available, the remaining three-opening lid (on TOP2) was modified by sealing two of its side openings with duct tape, leaving only the central opening exposed (Figure 14.5). Thus, each of the four barrels had a single opening. After the trap had been recovered, it was noted that BOTTOM 2 had inverted, rotating on its mounting so that the elevation of the trap opening was more in line with the top traps. The distance from the deck to the bottom edge of the opening was of 84 cm for the trap TOP1, 83cm for TOP2, 27 cm for BOTTOM1 and 64 cm for BOTTOM2. The descent rate was 55 m min⁻¹, and the ascent rate was 45 m min⁻¹.

The catch from the blue barrel was greater than the previous deployment (Figure 14.6, left), with many large, medium-sized and smaller *Eurythenes* specimens and very high consumption of the bait. Catches from the traditional amphipod traps yielded smaller catch sizes, with much reduced consumption of the bait. The largest catch from the traditional traps was BOTTOM 2, comprising seemingly of a mix between *P. tenuipes* and *P. caperesca*.



Figure 14.6: Example catch from two barrels. Left: blue barrel, Right: a bottom barrel

14.5 Time-lapse photography with Bathysnap

Bathysnap operations involved the recovery of the lander deployed on JC263, a short-term deployment and a long-term deployment. Images were converted from RAW format to TIFF using the code provided by MARS (Bathysnap SOP v1.1 and the AESA-ii-QC tool).

Recovery of JC263 long-term deployment

The Bathysnap deployed as JC263-072 (camera number 22109670) was recovered. It had recorded 2216 photos of the seabed. The camera was set to a 4h interval. Photo intervals determined from the recorded photo date/timestamps were as shown in Figure 14.7. The recovered equipment was inspected and the timing batteries (coin batteries) were tested to determine whether they were the source of the timing issue at the end of the deployment; these batteries were still at 3V, so deemed not to be the source of the timing problem. As the number of photos captured was approximately correct for the elapsed time between camera programming and image recovery, it is possible that the “timing issues” are only a problem with the datetime recorded while the timing of the shutter is correct (note that there are two clocks on board).

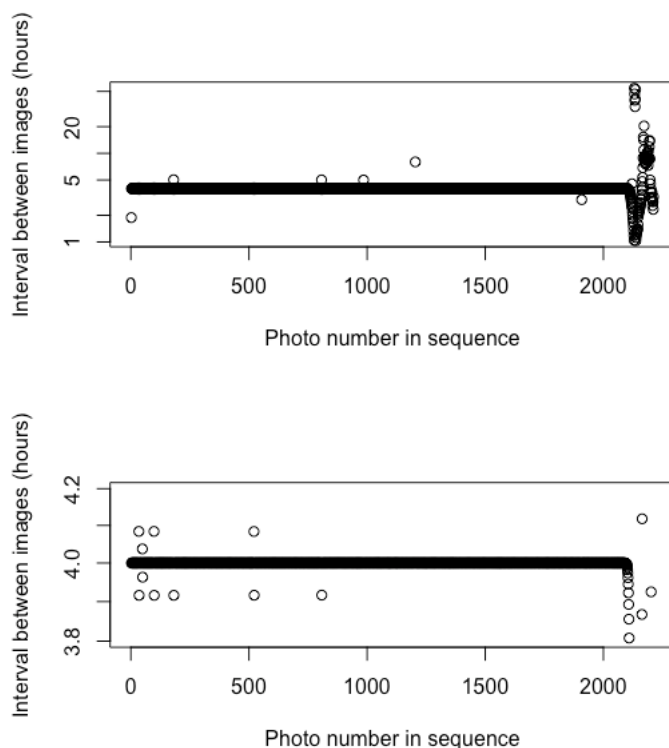


Figure 14.7: Interval of images captured by Bathysnap (JC263-072): all image intervals (top), and image intervals around 4 hours to show detail of initial timing issues (bottom).

The photos from this deployment were very dark (Figure 14.8), with a notably oblique field of view and the flash centred below the bottom of the image. This suggests that the camera and flash were mounted in opposite locations to their intended set up.



Figure 14.8: Example photo from Bathysnap deployment on JC263, recovered on JC278.

Bathysnap Lander Camera setup for JC278

The timelapse photography set-up deployed during JC278 was similar that of JC263. Imaging and lighting equipment carried by the Bathysnap lander (Figure 14.9) included one optically corrected High-Definition (HD) camera, the FLIR Blackfly S BFS-PGE-200S6C camera with Computar V1224-MPZ 16 mm lenses and the flash, both mounted to the front of the lander.

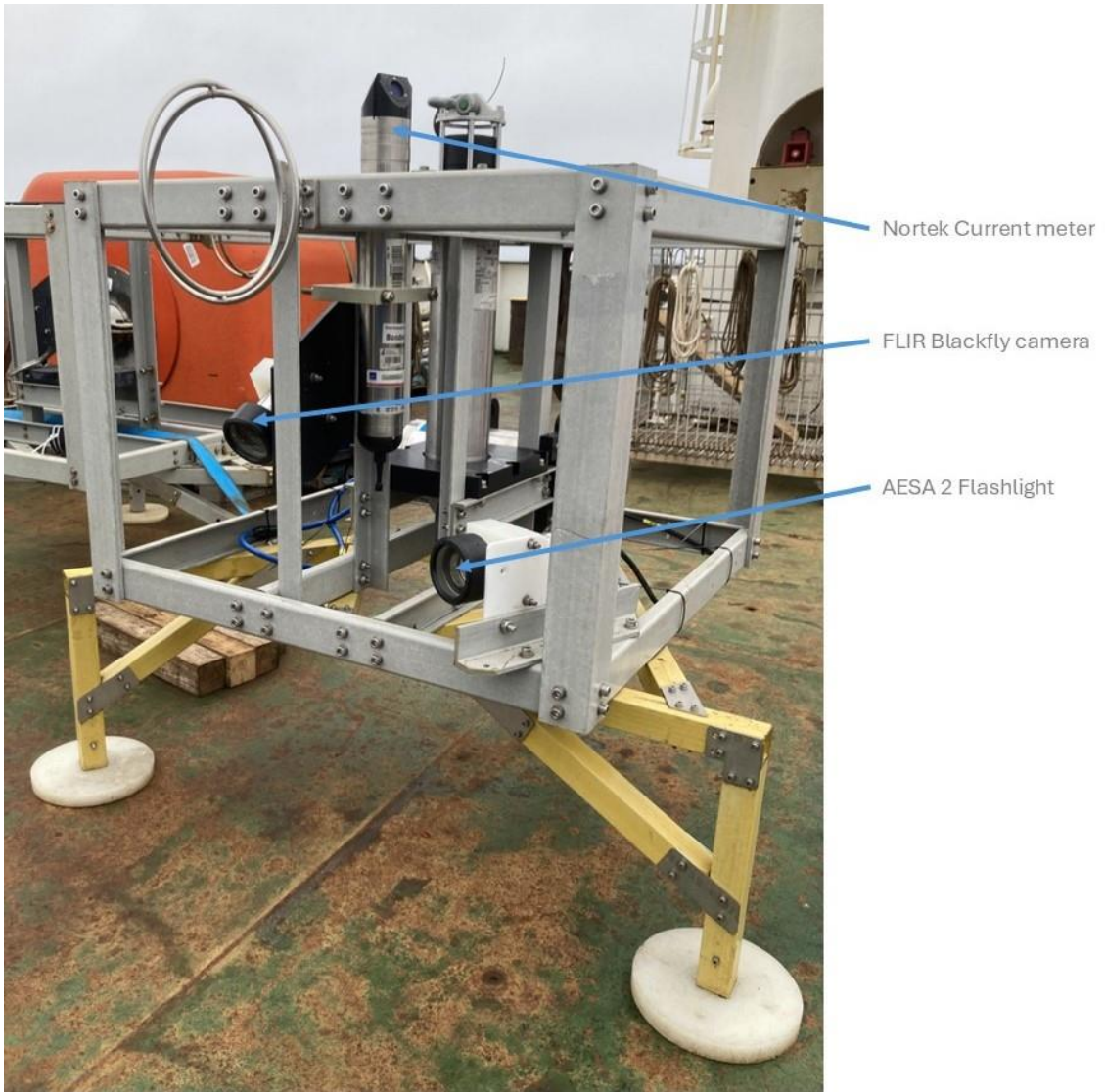


Figure 14.9: The front of the Bathysnap lander deployed on JC278-048



Figure 14.10: The mounting orientations of the camera (a) and flash (b).

The camera (Table 14.3) was mounted on a fixed bracket to the front frame of the lander (centrally, with a ca 0.13 m leftward offset and the lens being positioned 0.75 m above the lander’s bottom limits; Figure 14.10), facing downward at a 36° angle relative to the vehicle’s x-axis. The flash (Table 14.4) was mounted on a fixed bracket to the lander’s left bottom frame (0.3 m from the centre; 0.67 m above the bottom limit of the lander; 0.47 m diagonally from the camera; Figure 14.10).

Table 14.3: FLIR Blackfly S BFS-PGE-200S6C Camera Specifications

Still imagery	5K, 20MP
Sensor	Sony IMX183 Colour CMOS sensor
Focal length	16 mm
Aperture	F8
Horizontal acceptance angle°	43.8
Vertical acceptance angle°	33.6
Image dimensions (px)	5472 x 3648
Pixel size (um)	2.4
Gain (dB)	17.1
Bayer	RGGB
ADC	12
Bit depth	16

Table 14.4: AESA 2 Strobe Specifications

Flash energy	20 J
Bulb	Excelitas Tech. BHN 2647(G)(H)
Reflector	Khatod N. America LLC KESQ 1938ST

The camera bracket was improved from JC263 to hold the camera still.

Deployments on JC278

Two bathysnap systems were deployed to observe seafloor biological activity over a short period (JC278-025) and extended period (JC278-048; intended recovery on next time series cruise).

Short-term deployment (JC278-025)

Bathysnap (camera number 22196651) was deployed on 7 June 2025 at 15:02, at a corrected depth of 4849m. The camera timer was set to take an image every 10 minutes. A Nortek current meter (10 minute interval) and a CTD (5 minute interval) were attached to the lander, but the clocks were not synchronised between instruments. The lander was recovered earlier than planned, to allow the camera to be mounted to the Hybis camera frame for a trial (see Hybis section).

Irregular time intervals between photos were also observed on this deployment (Figure 14.11). The photos were more downward facing and better lit (Figure 14.12) than those from the long-term deployment on JC263.

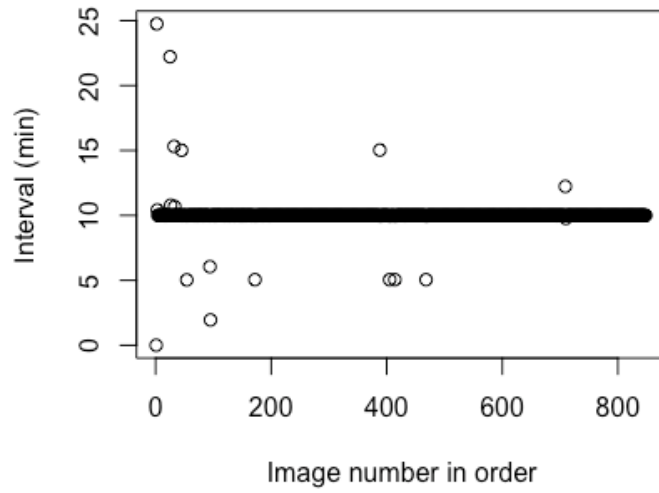


Figure 14.11: B.5.6. Image intervals for the short-term deployment of Bathysnap.



Figure 14.12: Example photo from short-term Bathysnap deployment with squat lobster in foreground

Long-term deployment (JC278-048)

Bathysnap (system #004) was deployed on 16 June 2025 for intended recovery in 2026. The camera timer was set to take an image every 4 hours. A Nortek current meter was attached to the frame.

14.6 Seabed photography with HyBIS

Survey locations

Deployments at Whittard Canyon targeted mounds on two interfluves (Figure 14.13). Two dives occurred on the well-mapped Explorer interfluve, with the aim of crossing at least 6 mounds each. The dive on the Dangaard interfluve followed a previous ROV track as detailed bathymetry was not available. These dives were intended to characterise the area and provide information relevant to determining the future locations of coral colonisation experiments.

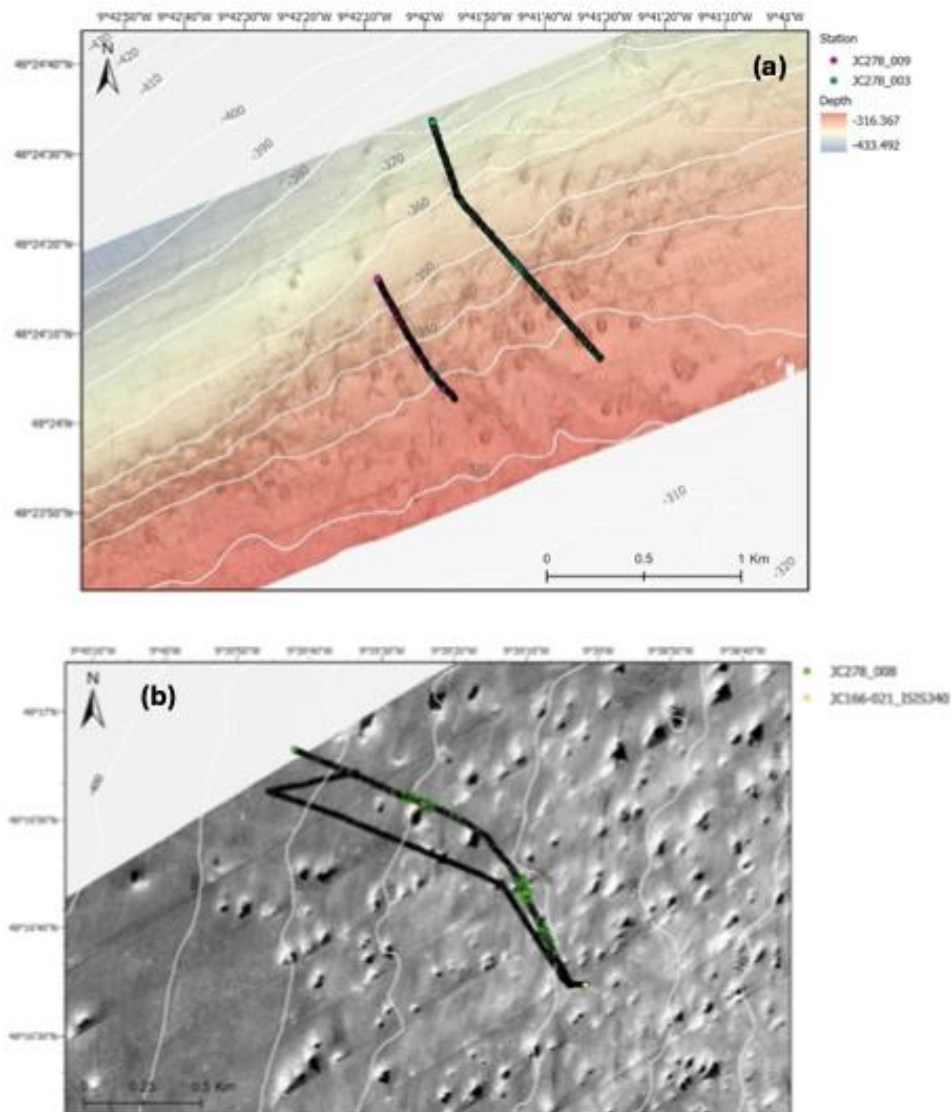


Figure 14.13: HyBIS survey transect tracks at Whittard Canyon: (a) Explorer Interfluve – two dives, and (b) Dangaard Interfluve – 1 dive along green points shown, with the previous ROV dive to the southwest in black.

HyBIS deployments at the PAP site occurred at the usual PAP Central site (Figure 14.14).

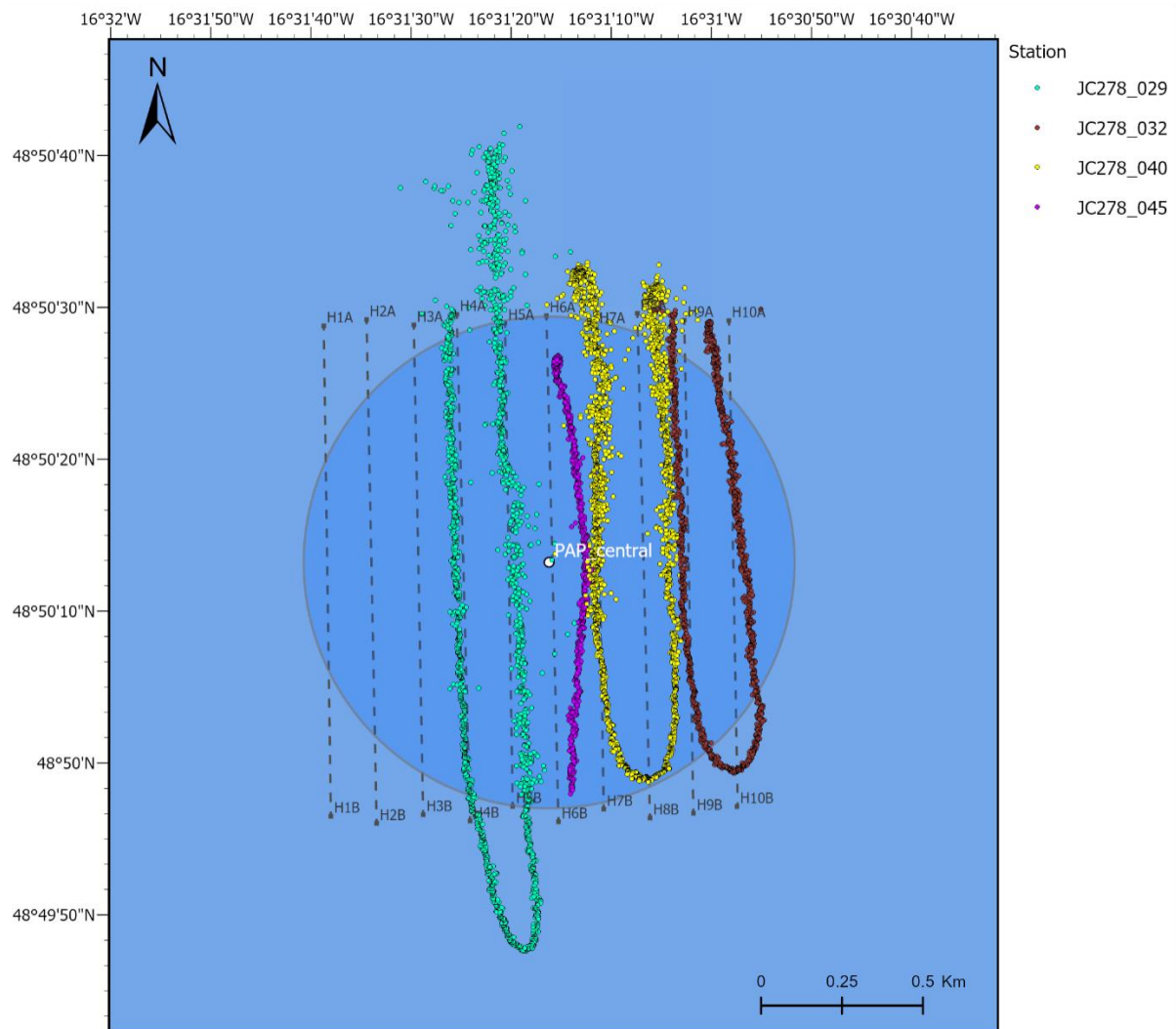


Figure 14.14: PAP Central HyBIS deployment locations

ROV HyBIS Camera setup

Imaging and lighting equipment carried by *HyBIS* (Figure 14.15, 14.16) included two optically corrected High-Definition (HD) cameras, the HDPT (HD Pilot) PAL composite camera and the SCORPIO (SONY HDR-CX560V; specifications in Table 14.5) video and still camera, mounted to the front and the bottom of the vehicle, respectively.

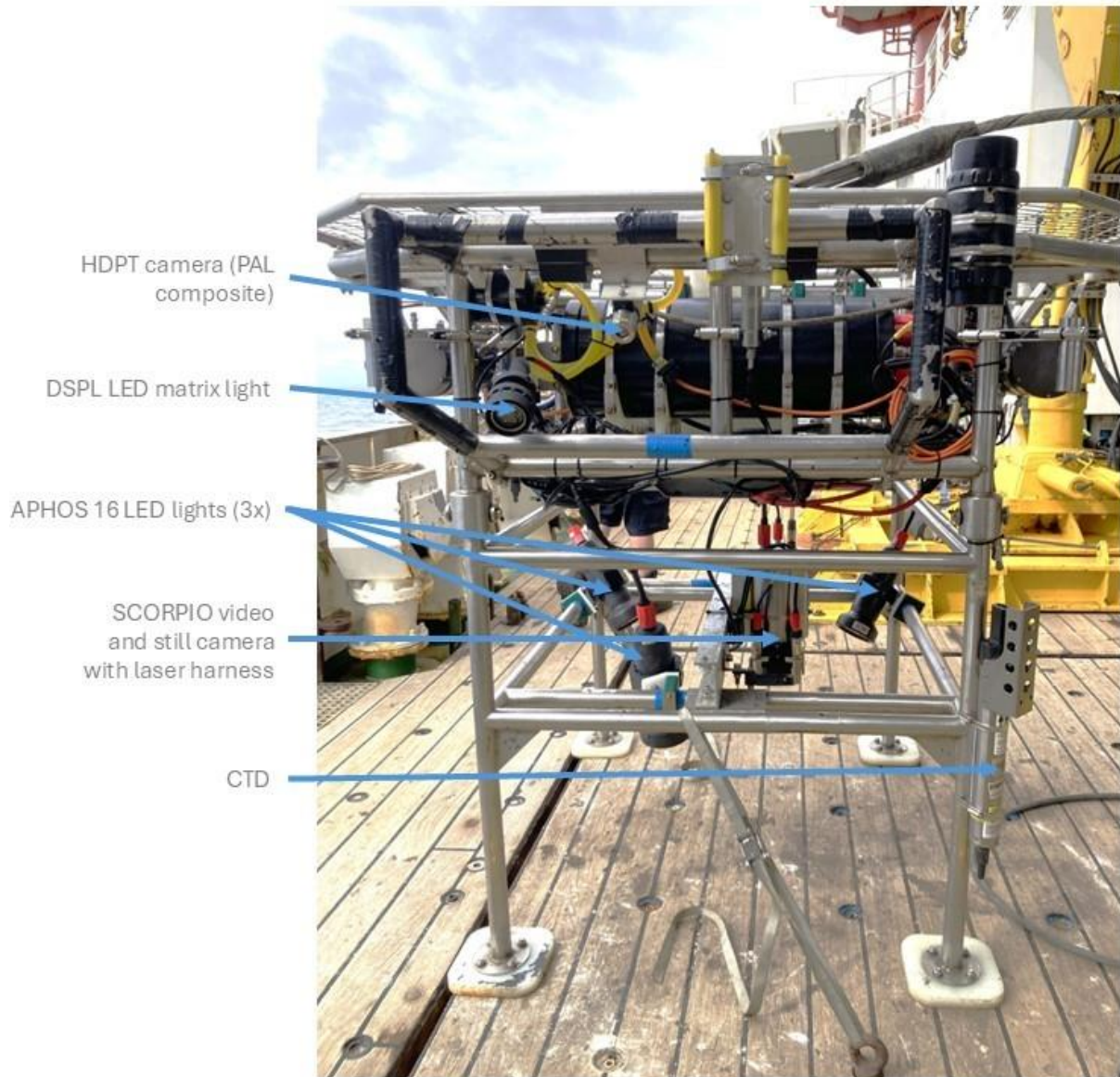


Figure 14.15: Camera and lighting set-up on HyBIS ROV (front view)

Table 14.5: HDR-CX560V SCORPIO Camera Specifications

Video	Full HD (1920 x 1080), 60fps, 12MP
Still imagery	UHD (4672 x 2628), 12.3MP
Sensor	6.2mm Back-illuminated "Exmor R" CMOS Sensor
Focal length	f = 3.8mm-38mm (set to auto)
Aperture	F1.8-9.6 (set to auto)
ISO	auto
White balance	auto
Horizontal acceptance angle	51.5°
Vertical acceptance angle	43.5°
Optical zoom	10x (not used)
Digital zoom	120x (not used)

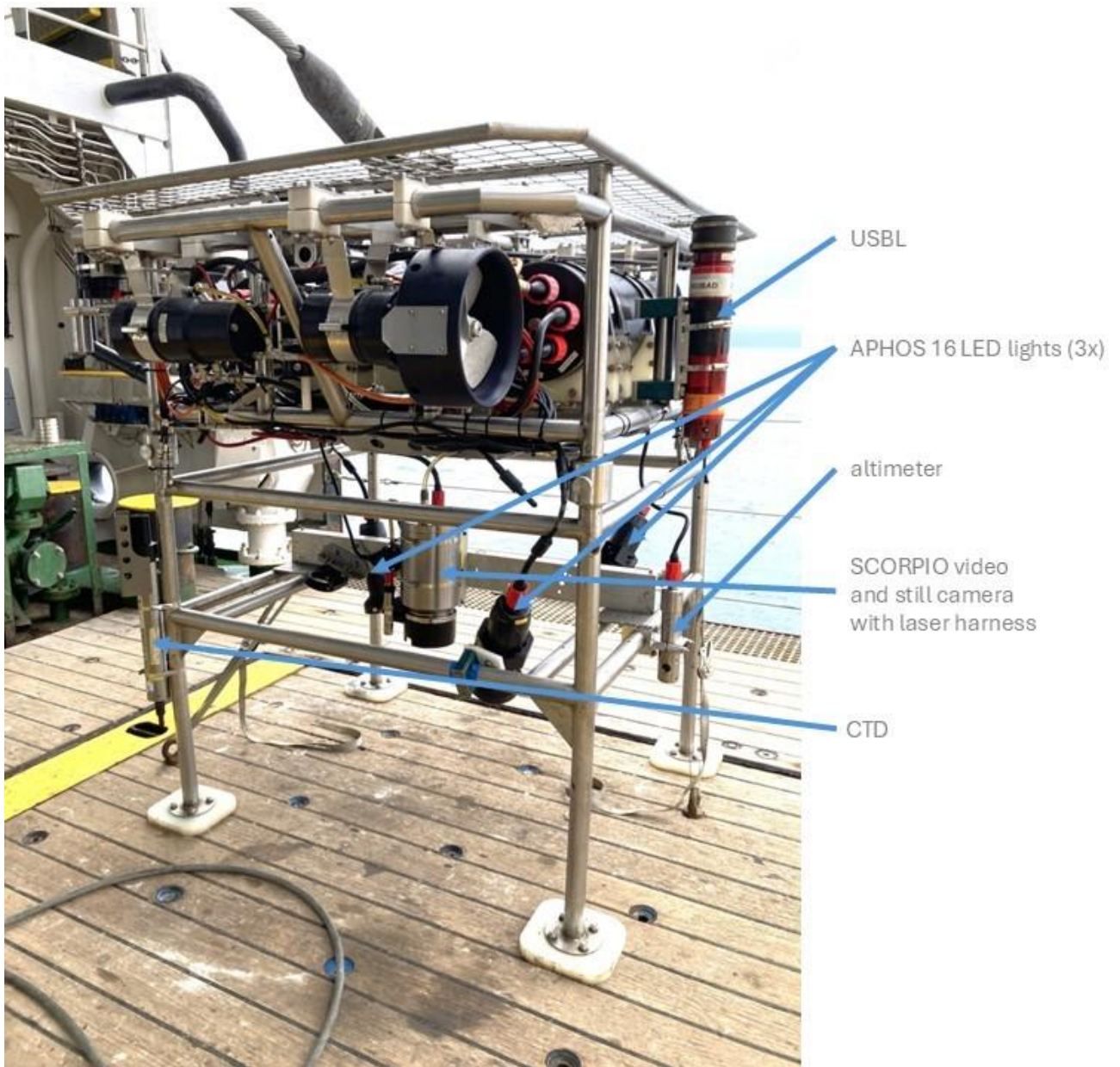


Figure 14.16: Camera, lighting, and location system set-up on HyBIS ROV (portside view)

Four LED lamps, a single DSPL LED and three CATHX APHOS 16 LEDs (specs shown in Table 14.6), were mounted on fixed brackets to the vehicle and used to provide illumination for the forward and downward-facing cameras, respectively. To provide a fixed scale in images, two sets of lasers (Fig. B.6.3a) were mounted 10 cm apart parallel to the focal axis of the SCORPIO camera. During video transects, the SCORPIO camera's zoom lens was set to no zoom and the lowest focal length to maintain the maximum possible seabed area in the field of view.

Table 14.6: CATHX APHOS 16 LEDs Specifications

Continuous light power output	28 000 Lumens
Light colour temperature	5700°K (standard Colour temperature)
Beam angle/shape	50° beam angle flood

A high power Ranger 2 USBL tracking and telemetry transponder (Sonardyne WMT 6), mounted to the rear frame centre of the vehicle, was used for tracking the vehicle to a <0.015 m range precision. Lastly, a Sea-Bird microCAT CTD was attached to the HyBIS frame (apart from the last dive) 0.46 m above the vehicle’s bottom limits on the front-left leg of HyBIS and used to collected additional oceanographic data.

HyBIS operation

At locations of the Whittard Canyon, the ship maintained 0.2 knots, due to the complexity of local terrain. For all transects at PAP Central zone, the ship maintained a speed of 0.3 knots, temporarily increasing to 0.4 knots to accommodate for manoeuvring the ship relative to HyBIS when turning. The target altitude for HyBIS was set to 2 meters above bottom, to provide consistent illumination and detail of observed megafauna. Active heave compensation was used on the winch throughout most dives to decrease the motion and maintain the targeted 2 m.

Video was captured using the Scorpio and PAL (forward-facing) cameras simultaneously and during HyBIS descents and ascents (Table 14.7). Still images (JPEG) of the seafloor were captured at 10-second intervals for all dives using the downward-facing Scorpio camera (Table 14.8).

Table 14.7: Table of number and size of videos taken during HyBIS deployments.

Station	HyBIS dive name	Number of videos from SCORPIO	Size of video from SCORPIO (GB)	Number of videos from PAL	Size of images from PAL (GB)
JC278-003	HY100	2	184.17	2	187.67
JC278-008	HY101	2	194.32	2	199.16
JC278-009	HY102	1	126.79	1	128.62
JC278-029	HY103	5	536.91	5	541.86
JC278-032	HY104	4	433.93	4	435.04
JC278-040	HY105	6	563.65	6	568.70
JC278-045	HY106	3	240.31	3	240.72
All		23	2280.08	23	2301.77

Table 14.8: Table of number and size of still images captured during HyBIS deployments.

Station	HyBIS dive name	Number of images	Size of images (GB)
JC278-003	HY100	1057	4.25
JC278-008	HY101	1094	4.09
JC278-009	HY102	662	2.58
JC278-029	HY103	2131	7.27
JC278-032	HY104	1584	5.44
JC278-040	HY105	2432	8.31
JC278-045	HY106	831	2.85
All		9791	34.79

We noted the following issues:

- **Grease smear:** A grease smear was apparent in the centre of the SCORPIO lens throughout all HyBIS deployments, resulting in some distortion in the captured images.
- **Obstructed view:** A hair or filament was also visible on the inside of the camera lens throughout all deployments, further obstructing the field of view.
- **Date logging in OFOP:** As in previous years, the observation recording software (OFOP) does not update the date while running; the date is only set at start-up. Since most dives spanned two calendar days, the date was not logged correctly for those that crossed midnight.
- **Lens protector visibility and camera stability:** In the SCORPIO still imagery, the edges of the lens protector were visible in the right edge of the camera’s field of view during most deployments. Although the protector’s position was adjusted between dives to mitigate the issue, the problem persisted. It is possible that the camera is not fully secured within its housing, allowing vibrations during deployment to slightly shift the camera’s orientation.

Whittard Canyon deployment details

Table 14.9: General information for HyBIS deployments at Whittard Canyon.

Location	Whittard Canyon	Whittard Canyon	Whittard Canyon
Depl. Station	JC278-003	JC278-008	JC278-009
Date	31/05/2025 – 01/06/2025	01/06/2025 – 02/06/2025	02/06/2025
Transect station start	H1W1	H2W4	H3W8
Transect station end	H1W3	H2W7	H3W10
Bottom start time	00:07	20:09	01:09
Bottom end time	02:58	23:10	03:00
Altitude	1.8 – 2.5 m	1.6 – 2.5 m	
Towing speed	0.2 kt	0.2 kt	0.2 kt
Imaging interval	10 s	10 s	10 s
Max depth reached	360 m	390 m	360 m

JC278-003: The HyBIS ROV was deployed at station H1W1 (Explorer Interfluve, Whittard Canyon). Using the ship’s dynamic positioning system, HyBIS was towed NW along transect H1 and reached stations H1W2 and H1W3. HyBIS was towed at a speed of 0.2 knots (speed over ground) and a target altitude of 2 m above the seabed (with heave compensation activated). After 2 hours 39 mins, HyBIS reached the end of the unidirectional transect (i.e., H1W3), overall covering ~ 1.5 km of horizontal distance. Megafauna seen included crabs, sea stars, sea cucumbers, fish, shrimp, anemones, and coral. Debris (e.g. fishing line, bottle) was also observed, while HyBIS navigated across several small “mounds”. More broken coral debris was apparent on the slopes of the mounds.

JC278-008: The HyBIS was deployed on top of station H1W4 (Dangaard Interfluve, Whittard Canyon) to continue the yesterday’s transect H1 above the Whittard Canyon’s mounds. Once on the seabed, the ship towed HyBIS along the north-western unidirectional transect. HyBIS was towed at the speed of 0.2 kt and a target altitude of 2 m above the seabed, made possible by an active heave compensation on the deep tow winch. After 3 hrs and 1.5 km of horizontal distance, HyBIS was hauled back to the ship and recovered without any issues. Visibility at the seafloor was good and backscatter in the forward-facing camera was moderate. A grease smear patch obscured the centre of the image, and a large, curled hair was visible in the downward-facing camera (video/stills).

Epifaunal species observed included sea cucumbers, swimming crinoids, large swarms of shrimp, 2 octopuses of an unknown species, rock and dog fish, and three chimaeras.

JC278-009: Following a short transit after JC278-009, HyBIS was deployed at a transect point H1W8 (Explorer Interfluve, Whittard Canyon) before being towed north-west for a horizontal distance of ca 700 m to the end of the transect at H3W10. Approximately 10 mins into the dive, the deployment was paused for a few mins due to a winch cable issue; HyBIS hovered at ca 5 m of altitude for around 30 mins before resuming the transect at 01:49 am. The HyBIS dive was eventually terminated at 3:00 am having completed approximately three thirds of the transect H3 (distance of ca 700 m, which allowed to observe 5 small sea mounts). HyBIS was towed at a speed of 0.2 knots and a target altitude 2 m above the seabed. The seabed was similar to that seen in JC278-003.



*Figure 14.17: Highlights of the HyBIS dives from Whittard Canyon (left to right and top to bottom): a segment of the seafloor with no visible fauna and some coral debris (JC278-003); a cat shark, an aggregation of cidaroids, an octopus and *Trachurus trachurus*, and a swimming crinoid (JC278-008).*

PAP Central deployments

Table 14.10: General information for HyBIS deployments at PAP Central.

Location	PAP Central	PAP Central	PAP Central	PAP Central
Depl. Station	JC278-029	JC278-032	JC278-40	JC278-45
Date	11/06/2025 – 12/06/2025	12/06/2025 – 13/06/2025	13/06/2025 – 14/06/2025	15/06/2025 – 16/06/2025
Transect station range	H5A – H4A	H9A – H10A	H8A – H7B	H6A – H6B
Bottom start time	19:06	21:08	18:44	23:00
Bottom end time	01:02	01:34	01:30	01:15
Altitude (m)	0.6 – 2.8	1.7 – 2.5	1.8 – 2.4	1.7 – 2.4
Towing speed (kt)	0.3	0.3 - 0.4	0.3 – 0.4	0.3
Imaging interval (s)	10	10	10	10
Max depth reached (m)	4849 m	4845	4845	4848

JC278-029: HyBIS was deployed at transect point H5A before being towed along south–north oriented transects crossing the PAP Central zone over a horizontal distance of approximately 2 km. The tow was initially planned to start at H4A; however, due to navigational issues related to delayed position signals from the HyBIS USBL, the vehicle began the transect at H5A. Overall, two transect legs were completed: H5A–H5B and H5B–H4A. The SCORPIO was set to the standard 10-second still-capture interval, and the lights were maintained at angles used in previous deployments. The forward PAL camera’s light angle was adjusted during deployment to improve illumination in front of the vehicle. HyBIS was also equipped with a micro-CTD to collect oceanographic parameters throughout the transects. Megafauna observed included some of PAP’s common species, such as holothurians (e.g., *Psychropotes* sp.), cnidarians (e.g., *Cerianthid* sp. and *Solubellula* sp.), goblet sponges, and crustaceans (e.g., *Munida* sp.), among others. Multiple trawl marks, often filled with plastic debris, were also observed.

JC278-032: HyBIS was successfully deployed at transect start point H9A before being towed along a south–north oriented transect to continue surveying the PAP Central zone. The dive proceeded to H9B first, followed by another leg to H10A, where the deployment concluded - covering approximately 2 km of horizontal distance in total. The towing speed was set to 0.3 kt as in the previous dive. Approximately 2.5 hours into the dive, just after the ship turned from a southward to northward heading, the towing speed was increased to 0.4 kt for 0.5 hours to keep the ship ahead of HyBIS. Megafauna included some of the species observed on the previous dive (e.g., *Psychropotes* sp. and *Solubellula* sp.). Multiple trawl marks were observed again, some containing plastic debris and being utilized by deposit-feeding species.

JC278-40: The next HyBIS dive initiated at transect start point H8A before being towed, as in previous PAP Central Deployments, along a south-north oriented transect. The dive proceeded to H8B, then H7A, and concluded at H7B, overall covering over 2 km of horizontal distance. As in previous deployments, towing speed was 0.3 kt, but increased to 0.4 kt 5 hours into the dive for 0.5 hrs. Notable species observed included large *Colossendis colosse* specimens, *Octacnemus* sp. *Grimpteuthis* sp., a scleractinian and polynoids, to name a few.

JC278-45: Following a delayed recovery of the amphipod trap, HyBIS was deployed at transect start point H6A and towed southward to its final destination at transect point H6B. This deployment included a trial of the Bathysnap camera and flash system, aimed at evaluating its suitability for future HyBIS benthic imagery operations. Still-image capture was set to a 4-minute interval. During recovery of HyBIS, damage to the towing wire and fibre optics took place due to an unexpected malfunction in the winch system, leaving the vehicle without power. The vehicle was successfully recovered a few days later, allowing access to its imagery. Notable species observed included *Deima validum*, a large retracting echiuran, and *Freyatsera* sp.



Figure 14.18: Highlights of the HyBIS dives from PAP Central (left to right and top to bottom): Psychropotes sp.; Echiuran; Solumbellula sp. with plastic debris.; Kophobelemnion sp.; rattail; Paroriza prouhoi; Benthodytes lingua; Cerataspis monstruous; Deima validum validum.

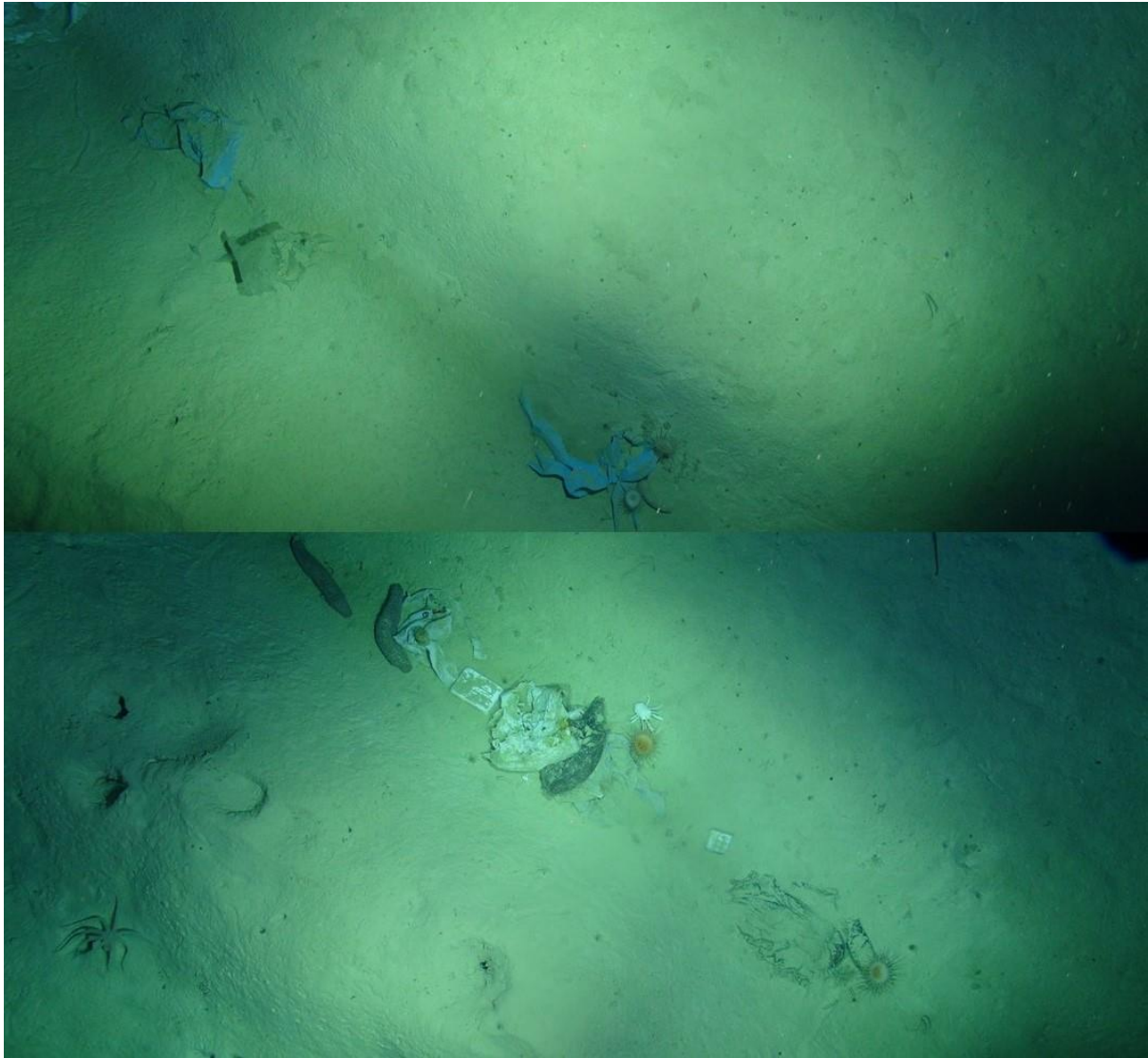


Figure 14.19: Examples of images with evidence of scientific trawl scars from previous expeditions seen during HyBIS dives, often showing accumulation of debris and megafauna.

HyBIS coupled with Bathysnap still camera trial

For HyBIS dive HY106, the Bathysnap camera and flash were mounted onto HyBIS (Figure 14.20) to test the suitability of the system for future benthic imagery operations. The camera settings (e.g., focal length, aperture, shutter speed, etc.) were not changeable at sea, so the camera was mounted in an orientation to cater to the existing settings. The camera was mounted as high as possible on the vehicle (138.5 cm), facing down. The flash was positioned as far as possible from the camera without having the light from it intersect the Scorpio camera field of view, and on the available cross bar (46.5d cm above deck). It was angled at 70 degrees.

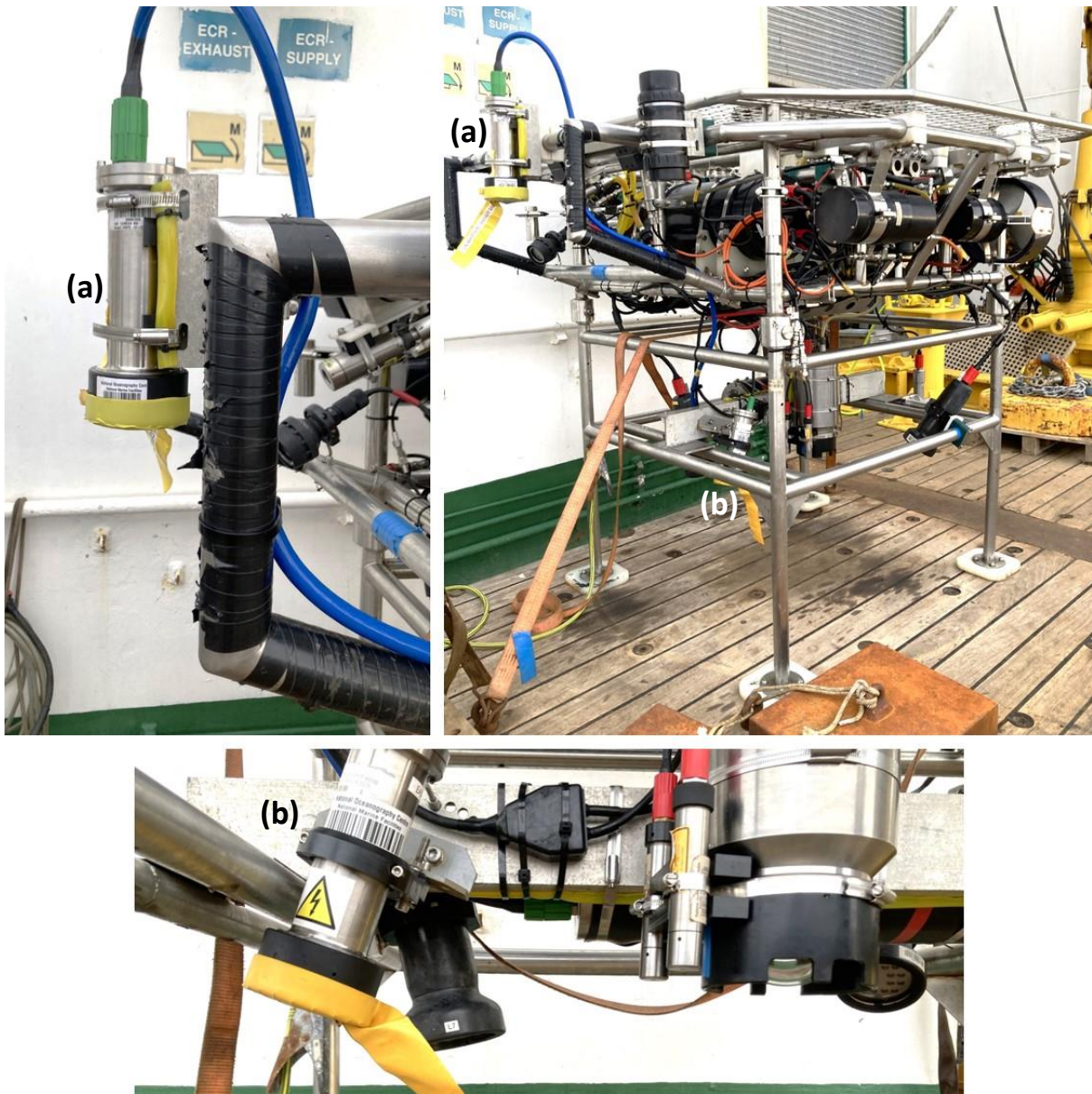


Figure 14.20: Placement of the Bathysnap camera (a) and flash unit (b) on the HyBIS ROV during the setup trial conducted on dive HY106.

The still-image capture was set to a 4-minute interval, resulting in a total of 99 images captured during the deployment (39.9 GB). Of these, 66 images were of the seabed, with 35 found to be overexposed due to the intensity of the HyBIS strobe lights (Figure 14.20). One image was taken without HyBIS CathX lights illumination, relying solely on the Bathysnap flash, which resulted in a very evenly-illuminated image (Figure 14.21). Scorpio video and images were unimpacted by the illumination from the Bathysnap flash.

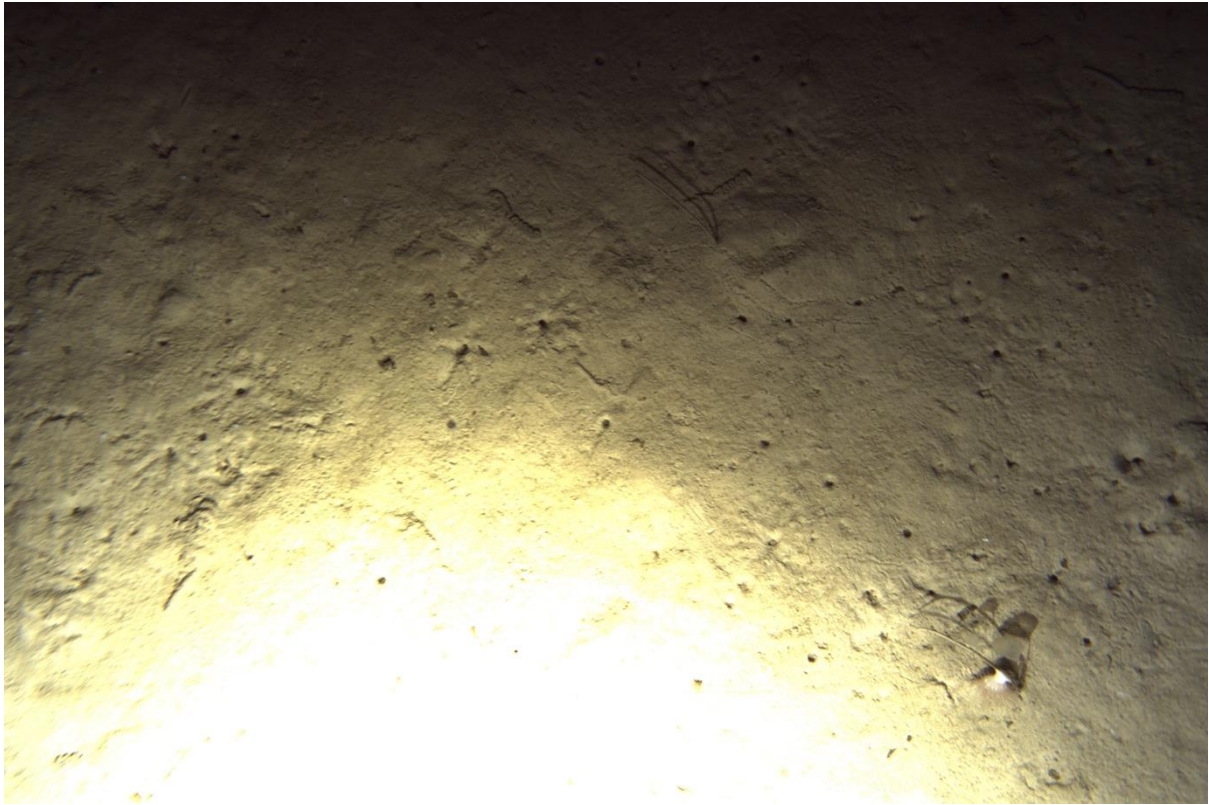


Figure 14.21. Two example photos from Bathysnap camera mounted on HyBIS: (top) the overexposure from the CathX lights, (bottom) the evenly-illuminated image lit only by the flash

14.7 Acoustic mapping

Shipboard multibeam echosounder data were continuously collected during transits throughout the cruise, including one dedicated multibeam survey using the Kongsberg EM122 system operated in “deep” mode. This survey (JC278-054) took place focused on the area surrounding the PAP Central megacoring and visual benthic biodiversity monitoring site (Figure 14.22). The main goal of this survey was to resolve noise in the existing bathymetry in the immediate vicinity of the PAP Central site, particularly to the west, to compare depths between this site and its surrounds.

The survey was performed at a speed of 4 – 6 kts with swath width set at 60 degrees, and the heading of lines followed by the ship was aligned with the observed wave direction at the time. A CTD-derived Sound Velocity Profile (SVP) was used.

The sonar files processed from this survey were:

- 0343_20250618_005236_JamesCook.all
- 0344_20250618_015233_JamesCook.all
- 0345_20250618_022646_JamesCook.all
- 0346_20250618_030304_JamesCook.all
- 0347_20250618_040257_JamesCook.all

And Sound Velocity Profile:

- SVP_20250615_001.asvp

Data were processed on board using Qimera (2.6.3). Following import of raw (.all) sonar files and SVP (.asvp), a Dynamic Surface was created at an automated suggested resolution of 100 m and projected coordinate system (WGS 1984 UTM Zone 28N). Data were subsequently cleaned using the 3D Editor tool, and exported as .tif files.

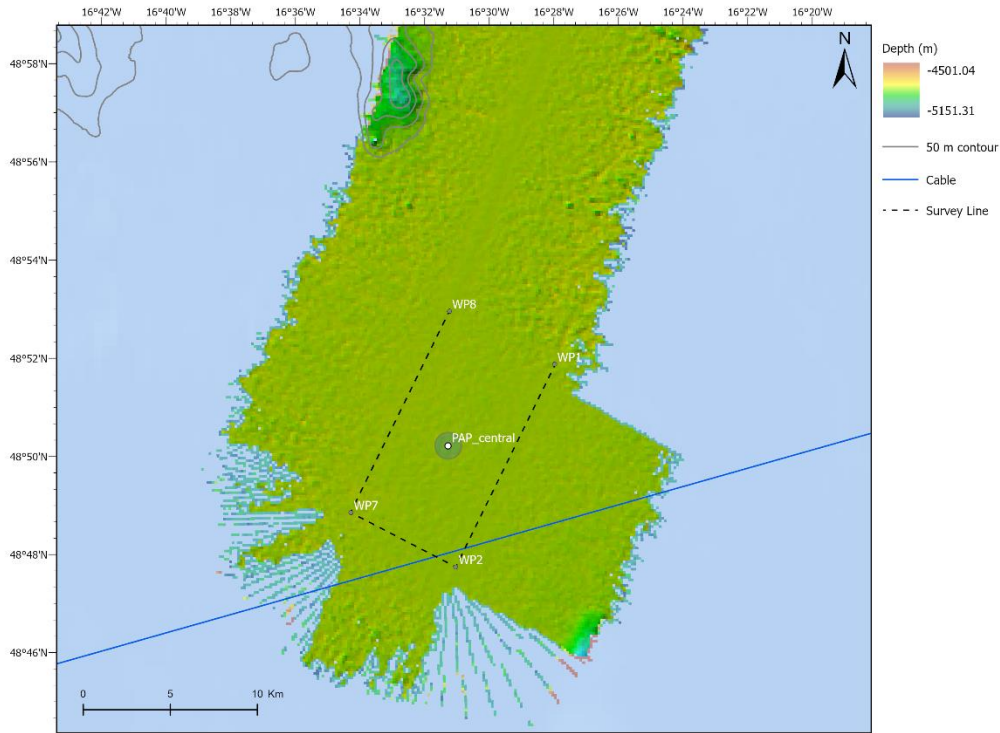


Figure 14.22: Processed 100m resolution MBES bathymetry, JC278-054. The ship track followed WP1-WP2-WP7-WP8, from whence the ship continued transit in a NE direction. Bathymetry processed beyond this planned survey track is also shown.

The survey managed to resolve much of the perceived noise in the prior bathymetry for the area (Figure 14.23).

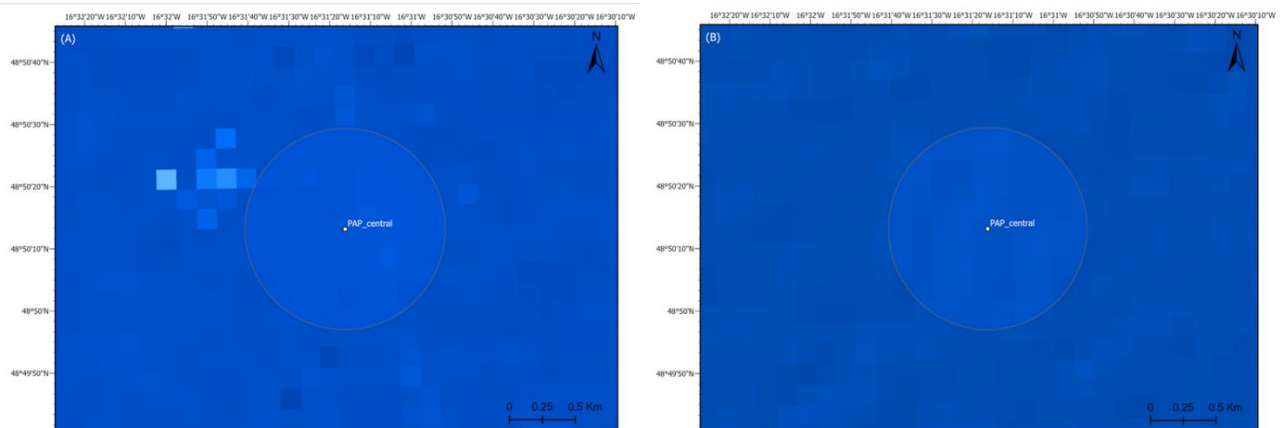


Figure 14.23: Zoomed in view of bathymetry surrounding the PAP Central site showing (left) prior noise surrounding the area and (right) updated bathymetry with some noise resolved following the most recent survey (JC278-054).

15. Benthic chamber lander

Allison Schaap

15.1 Overview and goals

A new lander for analysing benthic biogeochemical fluxes was brought along on JC278 for its first deployment.

The lander is designed to measure fluxes of biogeochemical compounds into or out of the sediment with a benthic chamber. The chamber is open on the bottom and, when deployed, its open bottom pushes several cm deep into the sediment, enclosing a fixed volume of water above the sediment. By monitoring the concentration of chemical parameters of interest in the water above the sediment, we can estimate an uptake rate of that chemical by biological activity taking place in the seafloor.

This technique is already regularly used to measure oxygen uptake rates (Glud, 2008). On this lander we have supplemented oxygen measurements with a custom-designed lab-on-chip nitrate sensor similar to the one described in Beaton *et al* (Beaton, 2022), but with additional sample inlets to enable sampling from multiple spatial locations with the same instrument. The sensor is set up to analyse seawater samples from both inside and outside the chamber, hourly. The sample intake within the chamber is 15 cm below the lid. The samples both inside and outside the chamber pass through 13 mm diameter 0.45 µm pore size PES syringe filters to prevent particles from entering the sensor.

In addition to the chamber technique, the lander has also been designed to enable direct chemical analysis of the porewater at a range of depths into the sediment. This is being performed by the same lab-on-chip nitrate sensor as the chamber analysis. Analytical blank (0 µM nitrate artificial seawater) is pushed out of the sensor through “Sensor port 3” (Figure 15.1) into an acrylic cylinder containing an acrylic piston, pushing the piston down towards the sediment. Attached to the end of the piston is a custom-made Rhizon sampling probe with a 1 cm long filter at the bottom, and tubing potted into a 6 mm diameter metal tube. The sensor can push the sampling probe down in 1 cm intervals and analyse the pore water through the Rhizon sampling probe.

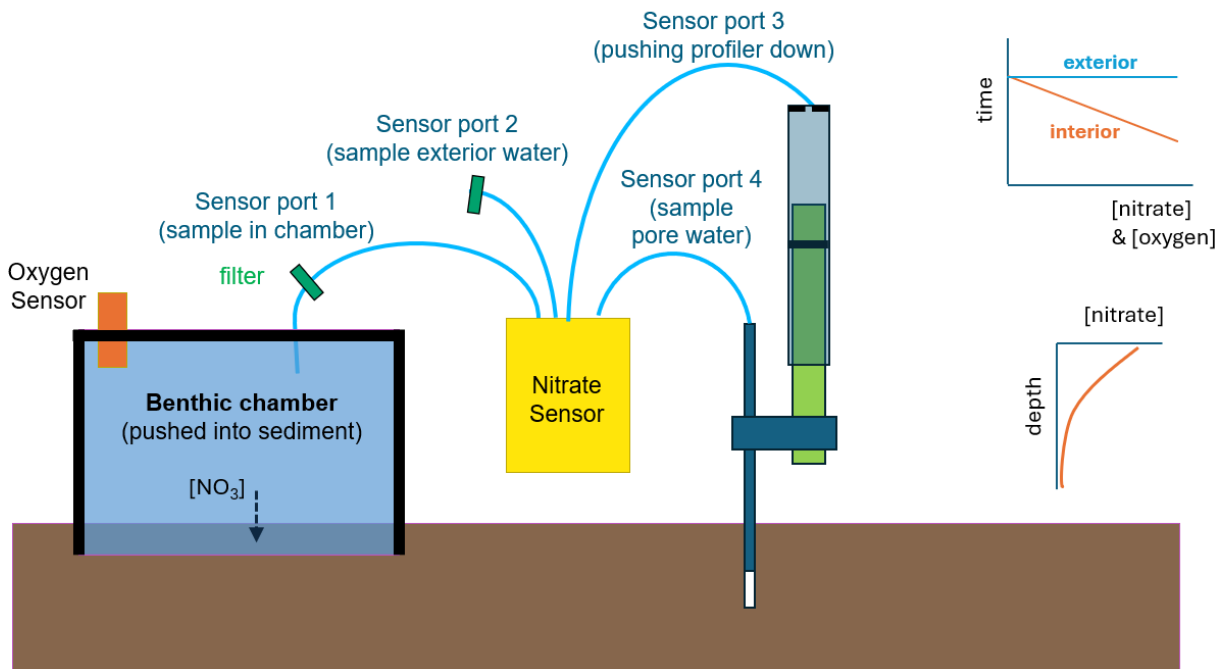


Figure 15.1: Schematic of the lander and the nitrate sensor's connections to the chamber, the exterior bottom water, and the profiling system. (Right) Cartoon plots of the kind of data we aim to collect with the system.

15.2 Setup details

Overall setup

The legs of the benthic lander are moveable; they were moved down for transport and on-deck setup. Figure 15.2 shows the general schematic for setup on deck, while ready for deployment, and the expected layout on the seafloor.

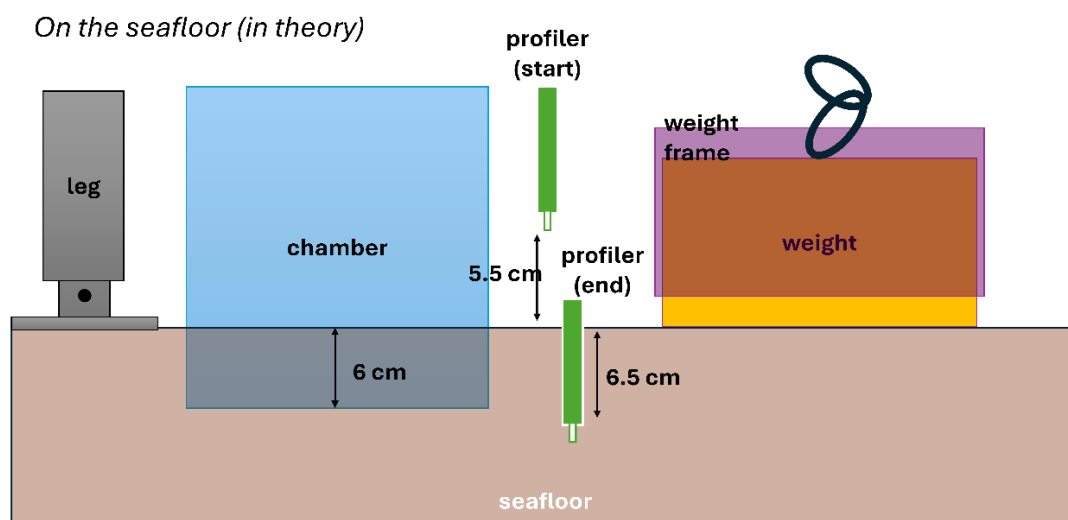
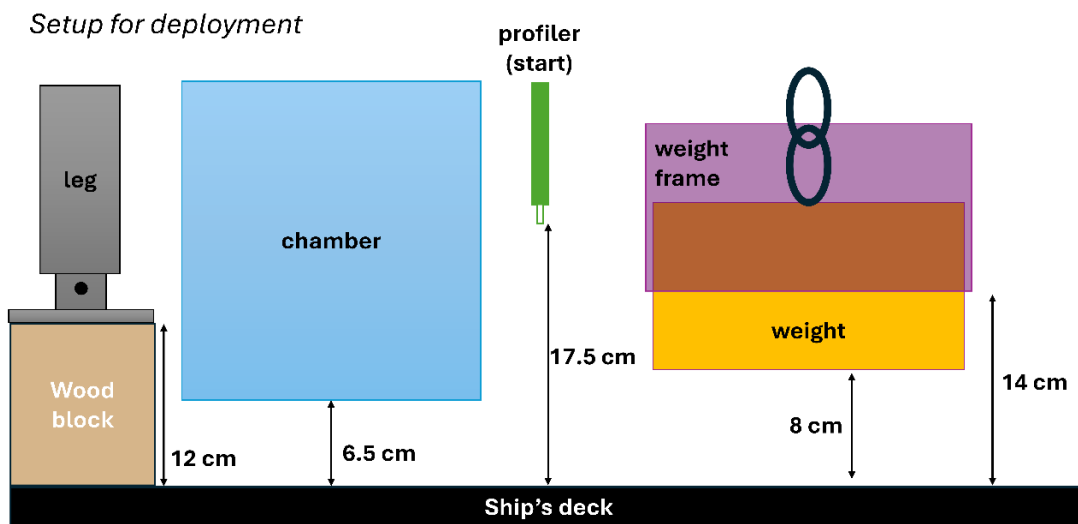
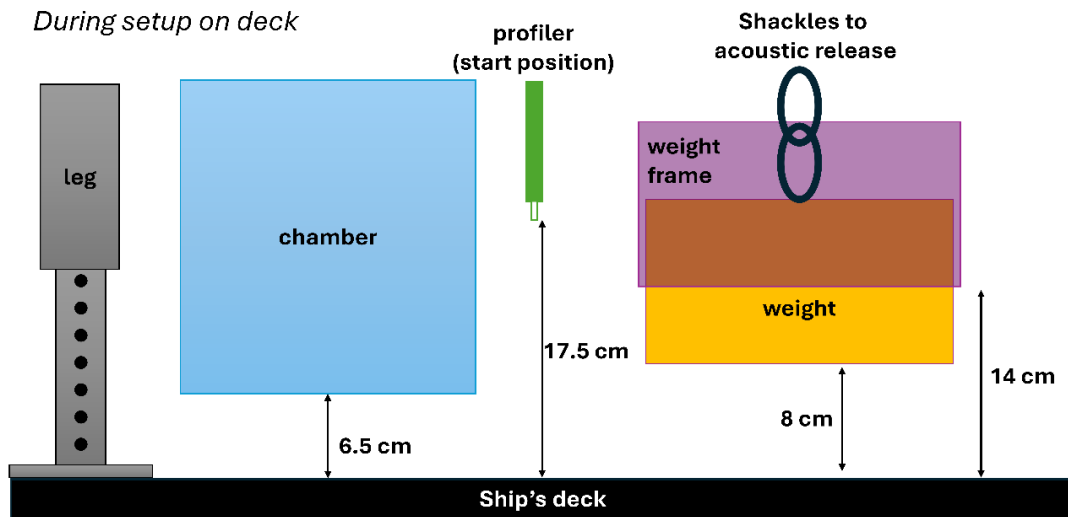


Figure 15.2. Schematic of lander setup and heights from lower datum during setup, deployment preparation, and expected values while at the seafloor

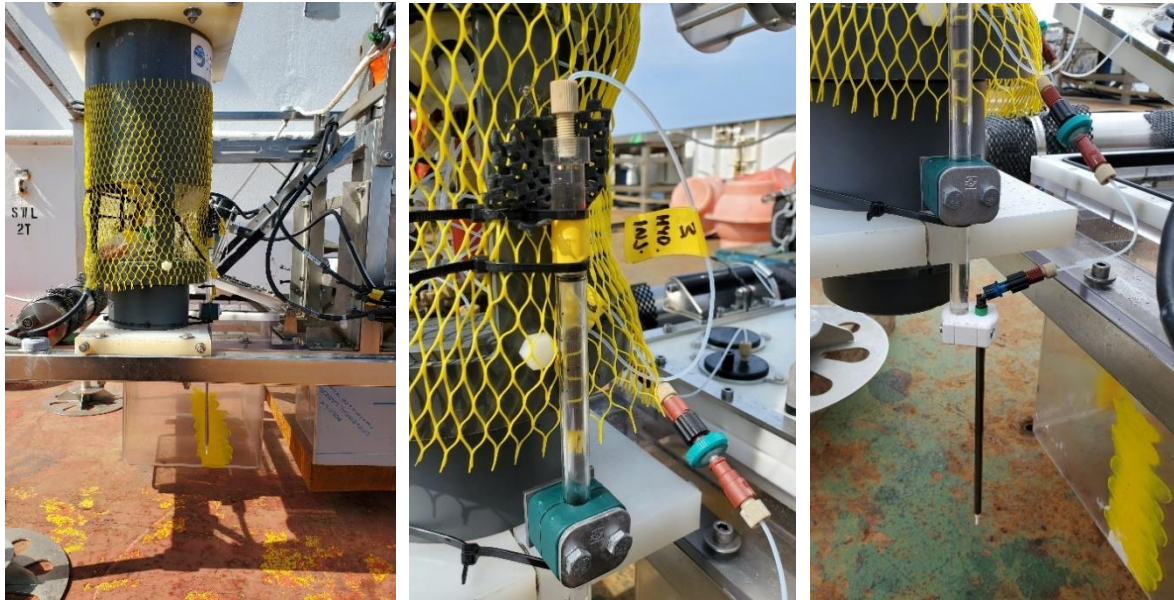


Figure 15.3: Side view of the lander including LOC nitrate sensor, rhizon profiler

Nitrate sensor

This work used NOC LOC nitrate sensors serial number 135 (deployment 1) and 132 (deployment 2). Both were version 3.5a of the instrument, which is a custom design specifically for this work.

The sensor was deployed with an analytical blank and 30 μ M standard, both made in artificial seawater. Upon receiving power, it automatically started opening valves for 10 seconds out of every 90 seconds just to enable regular pressure equalisation during descent. This phase lasted 8 hours (deployment 1) or 4 hours (deployment 2).

After this, the nitrate sensor operated on a 3-hour cycle, illustrated in Figure 15.4. Every hour, the surrounding bottom water and water inside the chamber were measured. After the first measurement, the Rhizon piston was moved downwards 1 cm. After the second measurement, the sensor just waited. After the third measurement, the sensor sampled the pore water through the Rhizon.

After this 3-hour cycle had been completed 12 time, the sensor switched to a mode of only hourly measurements of the bottom water and in-chamber water.

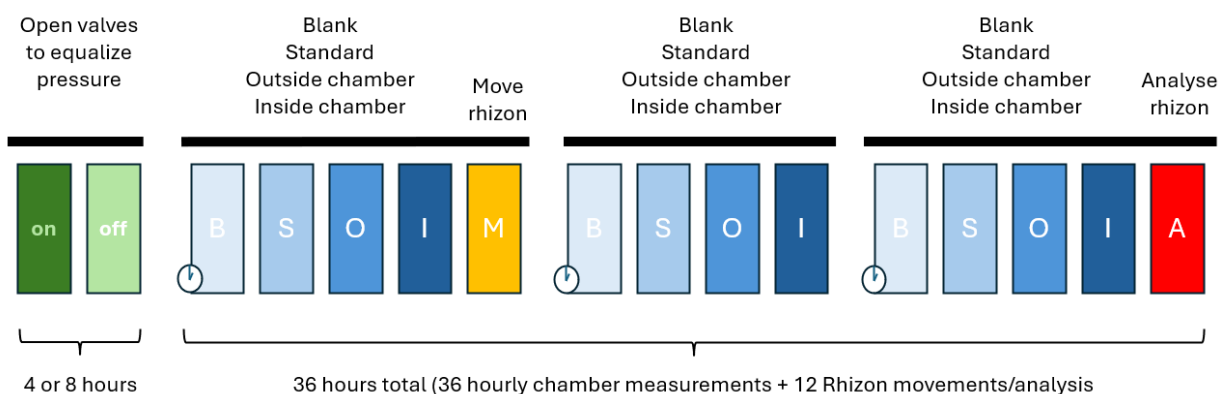


Figure 15.4: Overview of the nitrate sensor's programming for the benthic chamber lander.

Oxygen sensor

Oxygen uptake was measured with an Aanderaa optode. The optode was tested in oxygenated underway seawater before deployment and showed good agreement with expected O₂ concentrations at saturation for the temperature and salinity of the water (Figure 15.5).

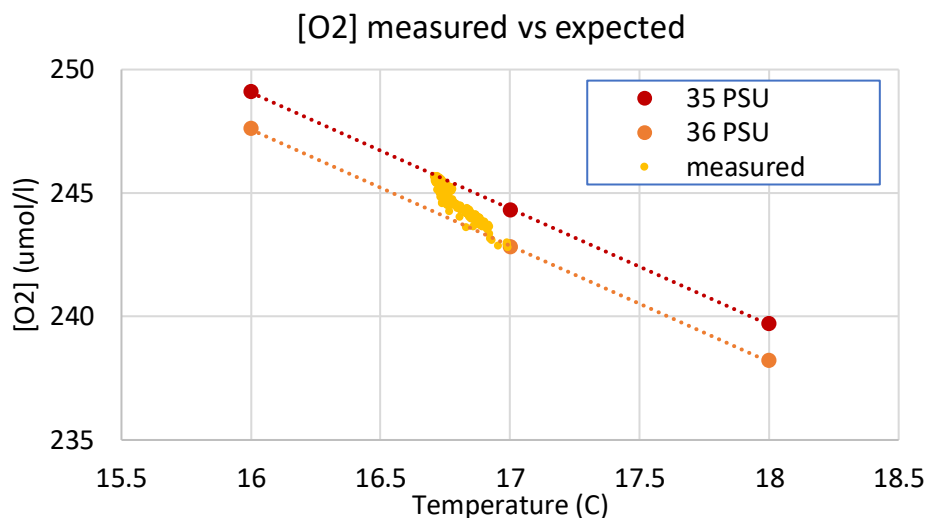


Figure 15.5: O₂ concentrations (in blue dots) in aerated underway seawater across a small temperature range. [O₂] was within the limits of expected concentrations for these temperatures. The underway water was at salinity = 35.6 PSU according to the ship's TSG system.

To check if the sensor correctly responded to a deoxygenated environment, it was immersed in a solution of seawater with sugar and yeast (which consumes the oxygen); data is shown in Figure 15.6.

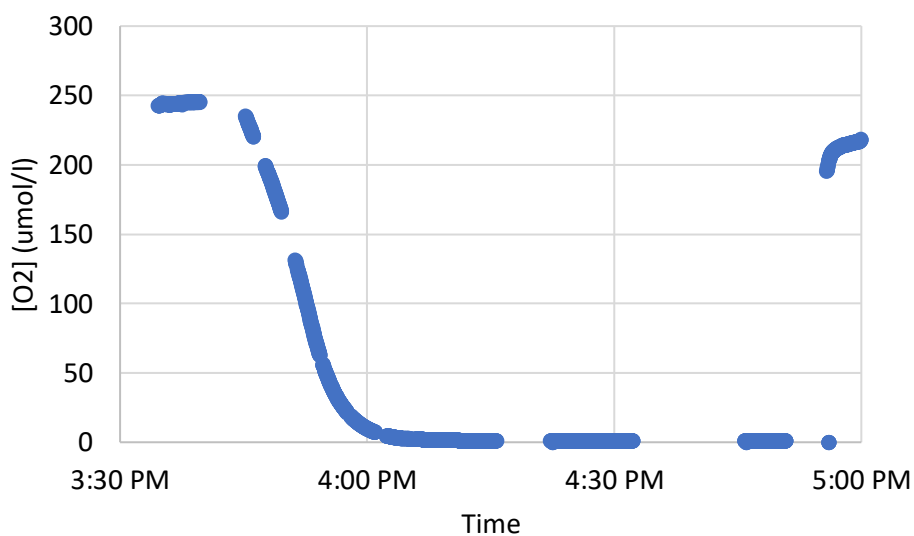


Figure 15.6: Data from the Aanderaa optode, tested initially in O₂-saturated seawater, then put in a seawater mixture with yeast and sugar to reduce [O₂] to 0, then back in normal seawater.

Chamber control and system power

The chamber system enables the timed release of the lid to close the chamber while at the seafloor, the powering of a stirrer to ensure the water is uniformly mixed in the chamber, and the logging of the Aanderaa optode data. The chamber's power and control system, called its "field data logger", was programmed to wait 8 hours (deployment 1) or 4 hours (deployment 2) before starting the stirrer, closing the lid, and starting a 1 Hz data collection on the optode.

The battery on the chamber system was expected to last for ~30 hours according to the manual but in reality it only lasted about 10 hours.

The nitrate sensor was operating on a separate battery, a SubCTech "Long John" 14.4 V battery with 47 Ah capacity.

Release and buoyancy

The lander, without additional weight or buoyancy, weighs an estimated 118 kg in water. A weight (154 kg in water) was added, along with an acoustic release. To provide buoyancy for recovery, 192 kg of buoyancy (8 glass spheres) was added. The release and buoyancy were provided by NMF.

15.3 Deployments

Deployment 1

Deployment 1 began on 13/06/2025 at station 35.

Position: 48.922217 N, 16.501604 W

Depth at location: 4832 m

Deployment timeline:

Date	Time	Event
13/06/2025	06:20	Lander power was turned on, on the deck. Nitrate sensor power turned on and operation program begins.
13/06/2025	06:36	The system was in the water.
13/06/2025	08:40	System lands on seafloor
13/06/2025	14:20	Chamber lander turns on, stirrer starts
13/06/2025	14:30	The lid closes and the Aanderaa optode starts logging.
13/06/2025	19:59	Chamber lander runs out of battery
15/06/2025	09:30	Lander acoustic release triggered
15/06/2025	10:50	Lander spotted on sea surface

A MicroCAT was attached to the lander for this deployment to verify the descent and ascent rate. The total descent time was 125 min, equating to a descent rate of 39.5 m/min or 0.66 m/s. The ascent took 85 minutes, with an ascent rate of 58 m/min or 0.97 m/s.

The near-surface currents, measured by the ship's ADCP, were ~0.5-0.6 m/s, causing the lander to drift northwards during its descent and ascent. When it was on the surface, it was found about 1 km north of where it had been deployed.

At the seafloor, the temperature was 2.570 (± 0.001) °C, salinity 34.878 (± 0.001) PSU, and pressure 4933.74 (± 0.85) db.



Figure 15.7: Lander and buoyancy aids on the back deck directly before Deployment 1.

Several issues arose during deployment 1:

- The lab-on-chip nitrate sensor worked for only about an hour before suffering a leak of seawater into the housing, causing an electronic short and ending the deployment.
- The inlet tubing for the nitrate sensor inside the chamber was too long, and ended up pinned underneath the chamber lid (with its opening outside of the chamber).
- The chamber battery only allowed the system to operate for ~7.5 hours.

To resolve these issues, a few changes were made:

- The spare nitrate sensor (serial number 132) was installed instead
- The tubing for the nitrate sensor inside the chamber was cut shorter, from its original length of 15 cm within the chamber to 3 cm within the chamber (see photo)
- The chamber battery was charged overnight
- The Rhizon starting position was moved down 1 cm, so that there was 10 cm distance between the bottom of the chamber and the bottom of the Rhizon

Deployment 2

Deployment 2 was on 16/06/2025 at station 46. with lander power on at 14:20 and system in the water at 14:33.

Date	Time	Event
16/06/2025	14:20	Lander power was turned on, on the deck. Nitrate sensor power turned on and operation program begins.
16/06/2025	14:33	The system was in the water.
16/06/2025	16:40	System lands on seafloor (estimated time)
16/06/2025	18:20	Chamber lander turns on, stirrer starts
16/06/2025	18:30	The lid closes and the Aanderaa optode starts logging.
17/06/2025	03:46	Chamber lander runs out of battery (LOC nitrate sensor continues operating on separate battery)
18/06/2025	08:40	Lander acoustic release triggered
18/06/2025	10:30	Lander spotted on sea surface

After its release, the lander drifted quite far north and wasn't observed until the Iridium transmitted a location. The lander was found 2.5 km away from the deployment site.

This deployment was more successful, with the Rhizon piston successfully pushing into the sediment and the sensor collecting a vertical profile of nitrate concentrations in the lower few cm of the water column and in the top ~5 cm of the seafloor (Figure 15.8).

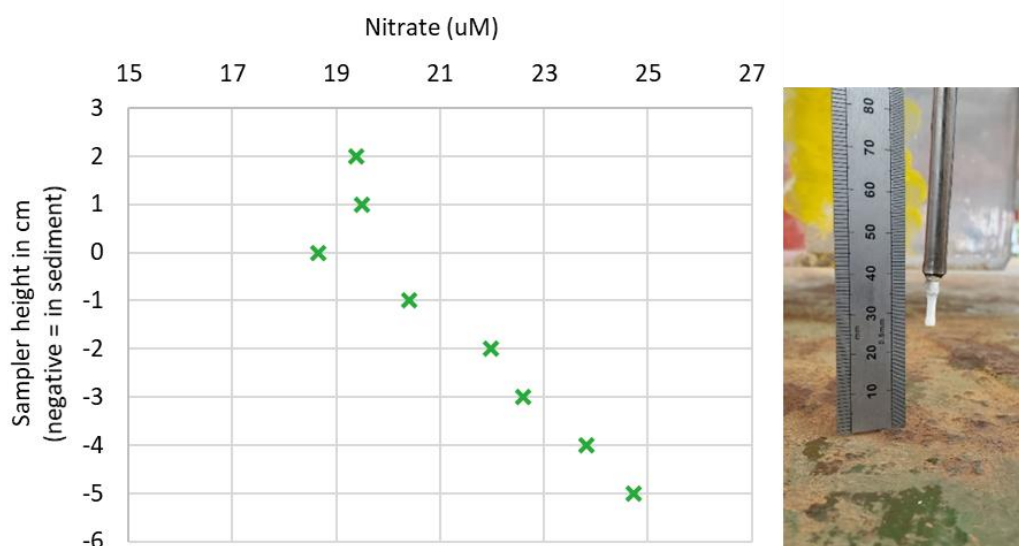


Figure 15.8 (Left) Preliminary data from nitrate profile in the sediment. (Right) Distance of the Rhizon filter after recovery; the profiler had moved down as expected.

The overall shape of the curve – with an increase in nitrate in the upper few cm of the sediment, compared to the water column values – is in line with observations taken in collected sediment cores in the past (e.g. Brunnegård, 2004).

The chamber's battery only worked for 10 hours and, upon preliminary examination of the data, no measurable flux of nitrate was observed (e.g. the concentration inside the chamber was not

different to the outside bottom water). The [O₂] did not change significantly enough in this period to confidently calculate a flux value.

To provide a comparison to this data, a sediment core was collected at a different location in PAP and the pore water extracted manually for later lab analysis; information on this is available in the chapter on coring. After Deployment 2, the sensor and Rhizon system were moved to the cold room and then used to profile the sampled core for direct comparison to the manual samples.

15.4 Recommendations for future use

Several modifications could be made to improve this system before it is used again:

- Build an attachment fixture to quickly attach and detach the Rhizon profiling system to an internal support beam of the lander. On this deployment it was attached to the LOC which limited the positioning and left it close to the edge of the lander, and more susceptible to damage during handling and deployment.
- Replace the batteries in the Field Data Logger, or use the supplemental external battery system.
- Use a longer Rhizon profiling system, to allow further penetration into the sediment.
- Add measurement tools to observe:
 - The penetration depth of the chamber into the sediment
 - The penetration depth of the rhizon into the sediment
- Add a small CTD sensor to the lander to observe the descent and ascent and verify sea bottom conditions
- Consider increasing the net buoyancy to allow for a slower descent.

References

Beaton, A. D.; Schaap, A. M.; Pascal, R.; Hanz, R.; Martincic, U.; Cardwell, C. L.; Morris, A.; Clinton-Bailey, G.; Saw, K.; Hartman, S. E.; Mowlem, M. C. Lab-on-Chip for In Situ Analysis of Nutrients in the Deep Sea. *ACS Sens.* **2022**. <https://doi.org/10.1021/acssensors.1c01685>.

Brunnegård, J.; Grandel, S.; Ståhl, H.; Tengberg, A.; Hall, P. O. J. Nitrogen Cycling in Deep-Sea Sediments of the Porcupine Abyssal Plain, NE Atlantic. *Progress in Oceanography* **2004**, *63* (4), 159–181. <https://doi.org/10.1016/j.pocean.2004.09.004>.

Glud, R. N. Oxygen Dynamics of Marine Sediments. *Marine Biology Research* **2008**, *4* (4), 243–289. <https://doi.org/10.1080/17451000801888726>.

Funding acknowledgements

The funding which enabled this work is from:

- the NERC National Capability programme “AtlantiS” work package 3, module 4 (grant reference NE/Y005589/1)
- the UKRI Future Leaders Fellowship project “SANDMAN” (grant reference MR/X035387/1)
- the NERC Global Partnerships Seedcorn Fund project “Hadal Sensors” (grant reference NE/V008870/1).
- NOC capital funding

16 GEORGE Project Cruise Report

Socratis Loucaides, Paco Stil, Sam Castle, David Le Piver, Wahida Bhuiyan, Adrien Chauvet

16.1 The GEORGE Project Information

The aim of the GEORGE project is to develop and demonstrate cutting-edge biogeochemical, multi-platform marine technologies for ocean carbon observations for three ERICs including EMSO, EurArgo and ICOS. The project aims to advance the technology readiness level of sensors and samplers, to enable autonomous, in situ, seawater CO₂ system characterisation and CO₂ fluxes on moving and fixed platforms and throughout the water column. Together with sensor manufacturers, GEORGE will optimise sensor technologies for measurements on platforms operated by the three ERICs and according to their operational requirements. Technology will be co-developed between industry and ERICs ensuring direct route to market and potential for scalability. The technologies will be validated according to a rigorous TRL progression engineering process and demonstrated at sea as an integrated multi-platform observing system during several field campaigns where ERICs are active. Additionally, GEORGE aims to advance the integration and interoperability of measurements gathered within GEORGE and between EMSO, EuroArgo and ICOS ERICs. This work includes streamlining the integration of different data formats originating from the various sensor/platform combinations.

PAP Mission within the GEORGE context

This deployment is part task 5.3 (Field trials to demonstrate the operation of the mature systems together in a multi-RI context). The aim is to test key GEORGE observing technologies in an operational environment (deep open water), a stage gate for achieving TRL8. The main GEORGE objectives for this mission were:

- Evaluate long-term performance of sensors and samplers over 1-year deployment in open ocean and at depth (~ 5000 m). The deployment at PAP will be the only long term and very deep-sea deployment of the project. The mooring and the EGIM lander will be on site over one year at near 5000 m depth.
- Evaluation of the performance of the sensors during the mission by data calibration against bottle samples taken from ships.
- Determination of the optimal set of observations to describe air/sea flux with high precision
- Deployment and cross-calibration of floats with other platforms
- Full characterization of the carbonate system using the multiple platforms

Table 16.1: Platforms and sensors deployed (specifically for GEORGE)

Platform	Sensor	Deployed Location	Deployment time	Recovery			
EGIM	SeaBird SBE37-SIP			Planned for spring/summer 2026			
	SeaBird SBE54						
	Tsunami						
	AADI-3005214831						
	DW4831						
	Wetlabs NTUrdt						
	Teledyne Workhorse monitor						
	ADCP 300 kHz*						
	Ocean Sonics icListen						
	SB60L-ETH						
Contros HydroC CO ₂ with SBE-5T pump	49.040413N 16.519725W	6/6/25 10:05h					
CWS LOC pH							
NOC LOC TA							
NOC LOC DIC							
NOC LOC TA							
SBE SUNA Nitrate sensor							
RBR CTD							
SEAEXPLORER 038				CWS pH with integrated fast ISFET	49.039287N 16.52042W	6/6/25 9:27h	
				Pro Oceanus mini CO ₂			
				RBR CTD			
NKE PROVOR CTS5 Float P53380-24EU001 fr_7902279	DRUCK 2900PSIA pressure sensor	48. 5523N 16.25109W	5/6/25 at 17:10	No planned recovery			
	SBE41CP V7.2.5 Temp and Conductivity sensor						
	AANDERA 4330 Oxygen optode						
	SBE SEAFET pH sensor						

16.2 Glider Missions

Brief description of SEAEXPLORER

The SEAEXPLORER is an autonomous underwater glider developed in France by Alseamar. Measuring 2 meters (plus a 1-meter foldable antenna; plus 0.5 meter LOC sensor) in length, 0.25 meters in diameter, and with a wingspan of 56.5 cm, it moves by adjusting its buoyancy and rotating its internal battery pack, allowing it to glide smoothly through the water. Capable of diving up to 1000 meters, it is equipped with sensors located in the nose of the glider that measure both physical and biogeochemical parameters. Because the sensors are housed in the nose, the glider remains partially submerged even when at the surface, enabling continuous measurements during surface intervals. The LOC pH and AT sensors sample water at approximately 2.8 meters below the surface, while other sensors take measurements around 1.8 meters deep. The SUNA sensor is positioned near the middle of the glider and measures at about 1.3 meters depth. Before each surfacing, the glider flips upside down about 2 meters below the surface to prevent the sensors from coming out of the water.



Figure 16.1: Photographs of a SEAEXPLORER on recovery and at the surface.

Payload (Sensors)

During the JC278 research cruise, two SEAEXPLORER gliders (ALSEAMAR) were deployed in the PAP (Porcupine Abyssal Plain) region as part of the GEORGE project. The main objective was to perform intercomparisons with other observing systems operating in the area. Each glider was equipped with multiple sensors and piloting by ALSEAMAR.

- SEA030:
 - AROD ft (RINKO) – Dissolved Oxygen
 - ECO FLBBCD (SEABIRD) – Chlorophyll, Backscattering
 - LEGATO (RBR) – Temperature, Salinity, Pressure
 - LOC (NOC) – Alkalinity
 - SUNA (SEABIRD) – Nitrate

- SEA038:
 - AROD ft (RINKO) – Dissolved Oxygen
 - ECO FLBBCD (SEABIRD) – Chlorophyll, Backscattering
 - LEGATO (RBR) – Temperature, Salinity, Pressure
 - LOC (CW) – pH
 - MINICO2 (PRO-OCEANUS) – xCO2

SEA038

SEA030



Figure 16.2: location of sensor payload on SEAEXPLORER gliders

Sensor setup / details

See the technical report of Alseamar

Calibration on CTD

Before and after deployment, a calibration CTD cast to 1000 meters was conducted with both gliders attached to the frame, positioned nose-up.

- Calibration CTD - GLIDER 1 (05/06/2025, 10:30 to 14:30):

Files : sea038.131.pld1.raw.3/sea030.221.pld1.raw.2 (131 and 221 missions)

Note: The gliders were unable to acquire GPS data and update before the CTD due to the lack of GPS connection. As a result, the timestamps in the files may contain incorrect dates.

Prior to deployment, several one-hour stops were performed at specific depths on the CTD: 1000 m, the oxygen minimum at ~500m, and 100m, due to rough sea conditions. No surface stop was included, and the 1000m Niskin bottles were not fired.

The glider configuration, designed to prevent the TA and pH sensors from exposure to air at the surface (sampling was limited between 10 and 1000 meters), triggered an alarm during ascent. As a result, both gliders released their emergency ballast weights, which were subsequently replaced before redeployment. There is no SUNA sensor on this CTD, whereas the second one is equipped with one.)

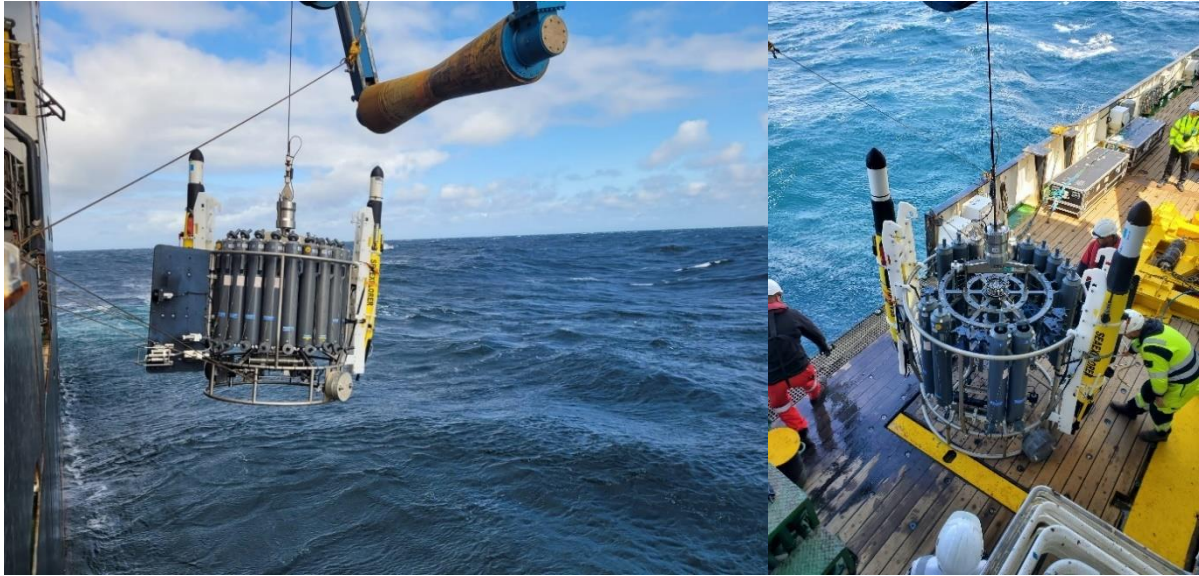


Figure 16.3: SEAEXPLOERER glider calibration CTD casts.

- Calibration CTD - GLIDER 2 (17/06/2025, 12:30 to 16:30):

Files: sea038.134.pld1.raw.2 / sea030.225.pld1.raw.2 (134 and 225 missions)

After deployment, the same CTD cast with the same parameters was performed, including three one-hour stops at 1000 m, oxygen minimum around 500 m, and 15 m.

Missions (maps, waypoints etc)

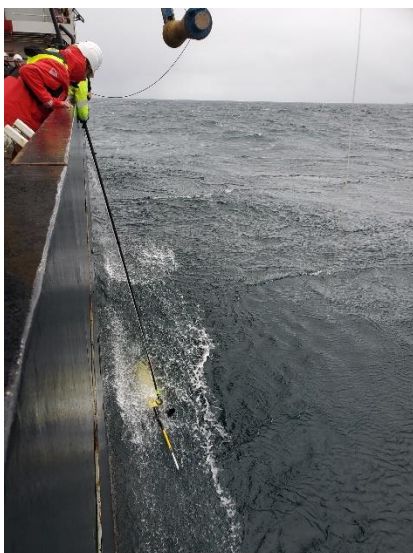


Figure 16.4: SEAEXPLORER deployment methods.

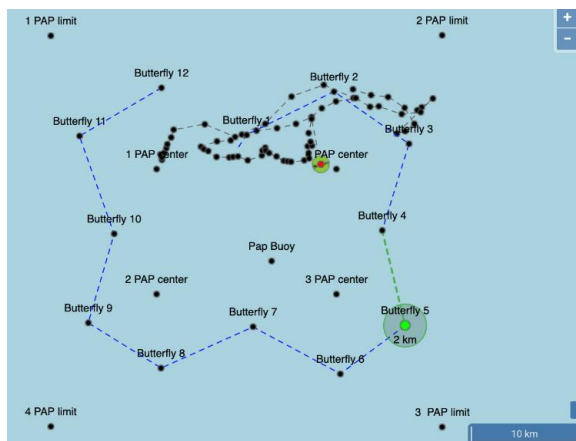
A first deployment at point (49°02'06"N; 16°31'15"W) was carried out between 06/06/2025 and 14/06/2025 for SEA030 (M222) and SEA038 (M132).

Due to a last-minute sensor change (from TADIC to TA) and modifications to the pH sensor just before deployment, a re-ballasting operation had to be performed under challenging sea conditions with 2.5-meter swell and 25-knot winds. An initial attempt was made from the deck, during which the gliders gently bumped against the hull of the RRS James Cook multiple times. The deployment was subsequently carried out using the workboat, which allowed for proper re-ballasting and final deployment.

After initial validation dives to 30 m and 100 m, the gliders performed profiles down to 1000 m with descent and ascent angles of 30° (Pitch: PU = 1030 for pitch up, PD = -1030 for pitch down), using maximum ballast settings (Ballast: BU = 500, BD = -500) to help counter the current. A navigation strategy involving three intermediate dives between 800 and 1000 m (rate = 4) was also employed. Due to strong southward currents, the gliders struggled to follow the initial mission plan, which consisted of a butterfly pattern centered around the original PAP site (represented by the blue dotted line on the map). The coordinates of the initial butterfly waypoints were:

- 49°03'50"N ; 16°24'20"W Butterfly 1
- 49°06'01"N ; 16°17'36"W Butterfly 2
- 49°03'23"N ; 16°11'51"W Butterfly 3
- 48°59'01"N ; 16°13'55"W Butterfly 4
- 48°54'13"N ; 16°12'09"W Butterfly 5
- 48°51'47"N ; 16°17'07"W Butterfly 6
- 48°54'09"N ; 16°23'50"W Butterfly 7
- 48°52'04"N ; 16°30'52"W Butterfly 8
- 48°54'21"N ; 16°36'28"W Butterfly 9
- 48°58'50"N ; 16°34'29"W Butterfly 10
- 49°03'46"N ; 16°37'08"W Butterfly 11
- 49°06'12"N ; 16°30'50"W Butterfly 12

SEA030 (M222)



SEA038 (M132)

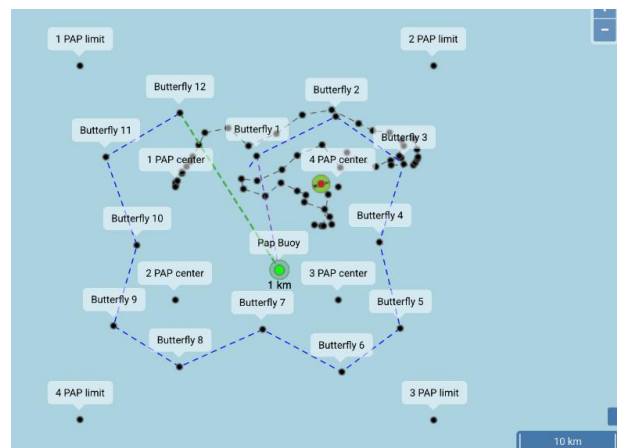


Figure 16.5: Example of SEAEXPLORER mission status

During the first deployment, the gliders had difficulty reaching the buoy, particularly SEA030, which experienced more challenging flight conditions compared to SEA038. Nevertheless, SEA038 successfully performed four surface drifts within 5 km of the RRS James Cook, while SEA030 completed two. The drift events were as follows:

- 06/06/2025 10:00 – SEA038
- 07/06/2025 12:15 – SEA038 + SEA030
- 08/06/2025 11:46 – SEA038 (>5 km from RRS James Cook)
- 09/06/2025 08:48 – SEA038 (>5 km from RRS James Cook)
- 10/06/2025 15:23 – SEA038 (>5 km from RRS James Cook)
- 11/06/2025 07:10 – SEA038
- 13/06/2025 10:03 – SEA038 + SEA030

A recovery was carried out on 14/06/2025, followed by a new deployment at (48°53'27"N; 16°23'41"W) from 14/06/2025 to 17/06/2025. The gliders were quickly pushed southward due to the intensification of the current close to the PAP buoy.



SEA030 (M224)

SEA038 (M133)

Figure 16.6: Later example of SEAEXPLORER mission status

Despite the challenging conditions, the gliders were still able to perform surface drifts near the ship, three for SEA038 and one for SEA030:

- 15/06/2025 00:34 – SEA038
- 15/06/2025 04:34 – SEA038 (>5 km from RRS James Cook) Alarm drift
- 16/06/2025 11:28 – SEA038
- 17/06/2025 09:40 – SEA038 + SEA030

After the 00:34 drift on 15/06/2025, SEA038 surfaced in alarm mode due to an inconsistent pitch caused by the current. As a result, it drifted at the surface for approximately 3 hours.

Data files collected

Two missions were carried out for each glider: SEA030 completed missions M222 and M224, while SEA038 completed missions M132 and M133. Navigation (NAV) data are available in files named sea0XX.XXX.gli.sub.XX, which include the following variables:

- **SEA038 / 030 :**

Timestamp; NavState; SecurityLevel; Heading; Declination; Pitch; Roll; Depth; PressureNav; PressureRel; Temperature; Pa; Humidity; Lat; Lon; DeadReckoning; DesiredH; DesiredHCC; BallastCmd; BallastPos; LinCmd; LinPos; AngCmd; AngPos; Voltage.

NavState indicates the current navigation phase of the glider and is useful for data processing:

Surfacing (State 115): The moving mass and ballast are adjusted to deploy the antenna above the water for communication.

Transmitting (State 116): At the surface, the glider establishes communication. It acquires a GPS fix and transmits its exact location via radio frequency or Iridium.

Inflecting Down (State 110): The glider initiates its descent. The oil bladder is deflated and the moving mass shifts forward to pitch the glider downward.

Diving (State 100): The ballast is set for descent. The glider adjusts its pitch angle and heading to maintain a controlled glide downward.

Inflecting Up (State 118): After reaching the target depth or altitude, the glider begins to ascend. The oil bladder is inflated, and the moving mass shifts backward.

Ascending (State 117): With the ballast position maintained, the glider continues rising toward the surface. It actively controls both pitch and heading to guide its trajectory.

Payload (PLD) data are stored in files named sea0XX.XXX.pld1.sub.XX, and contain the following variables:

- **SEA038:**

```
PLD_REALTIMECLOCK; NAV_RESOURCE; NAV_LONGITUDE; NAV_LATITUDE;  
NAV_DEPTH; LOC_PH; LOC_SAMPLE_TIME; LEGATO_CONDUCTIVITY;  
LEGATO_TEMPERATURE; LEGATO_PRESSURE; LEGATO_SALINITY;  
LEGATO_CONDTEMP; FLBB_CD_CHL_COUNT; FLBB_CD_CHL_SCALED;  
FLBB_CD_BB_700_COUNT; FLBB_CD_BB_700_SCALED; FLBB_CD_CDOM_COUNT;  
FLBB_CD_CDOM_SCALED; AROD_FT_TEMP; AROD_FT_DO; MINICO2_RAW;  
MINICO2_CORR; MINICO2_TEMP; MINICO2_PRES.
```

- **SEA030:**

```
PLD_REALTIMECLOCK; NAV_RESOURCE; NAV_LONGITUDE; NAV_LATITUDE;  
NAV_DEPTH; LOC_ALKALINITY; LOC_SAMPLE_TIME; AROD_FT_TEMP; AROD_FT_DO;
```

FLBBCD_CHL_COUNT; FLBBCD_CHL_SCALED; FLBBCD_BB_700_COUNT;
 FLBBCD_BB_700_SCALED; FLBBCD_CDOM_COUNT; FLBBCD_CDOM_SCALED;
 SUNA_MOLAR_NITRATE; SUNA_NITRATE; SUNA_HUMIDITY_NITRATE;
 SUNA_TEMP_NITRATE; LEGATO_CONDUCTIVITY; LEGATO_TEMPERATURE;
 LEGATO_PRESSURE; LEGATO_SALINITY; LEGATO_CONDTEMP.

Additional data are also available from the LEGATO and SUNA sensors in separate raw files:

- LEGATO: [seaXXX.XXX.legato.raw.XX](#)
- SUNA (for SEA030, M224): [seaXXX.XXX.suna.raw.XX](#)

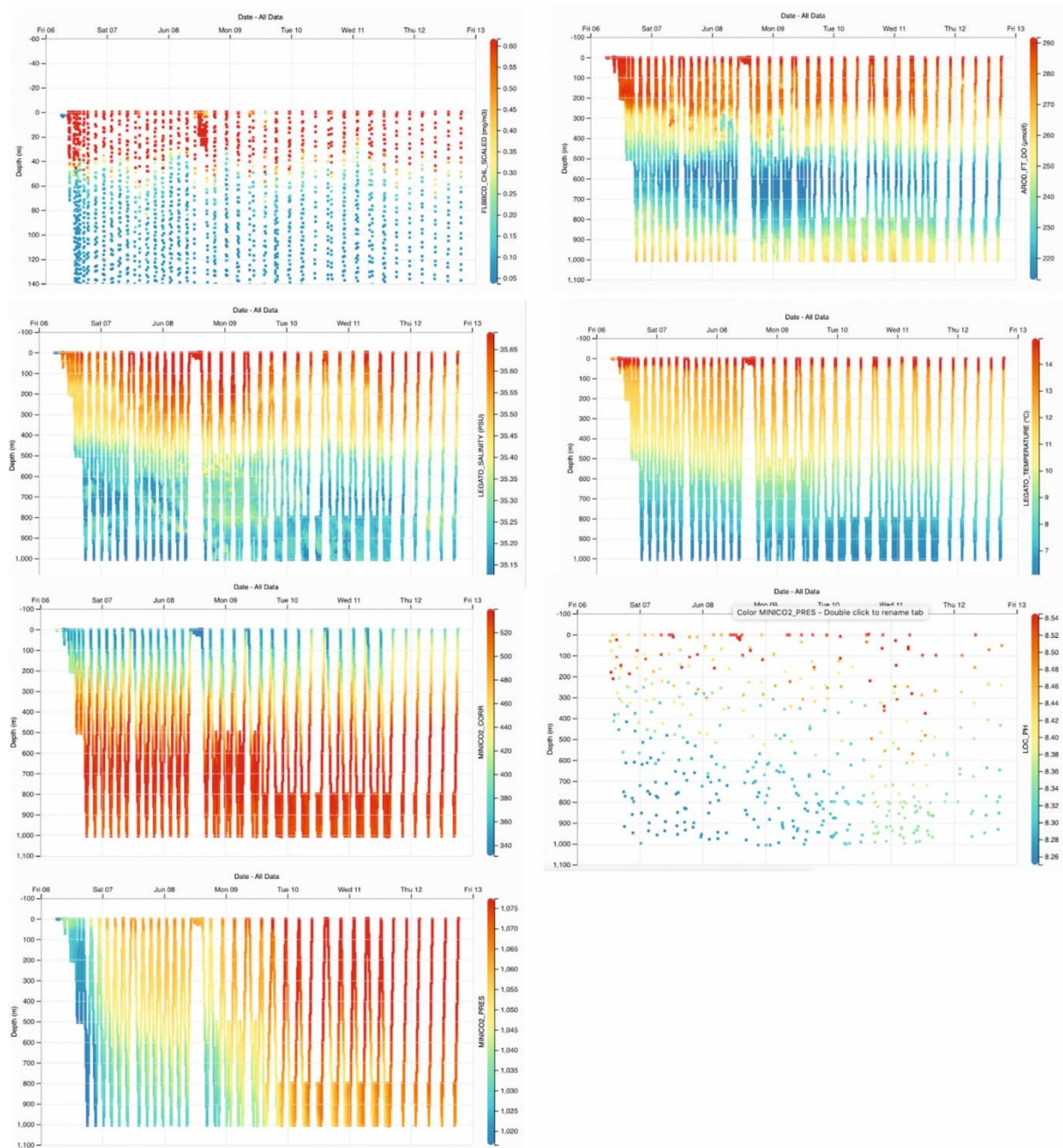


Figure 16.7: example mission data SEA038 glider for mission M132

A progressive drift was observed in the internal pressure readings, likely linked to the repeated pressurization cycles of the MiniCO₂ PrOceanus sensor during the dives. This behavior, which appears to be correctable, had already been noted during previous missions at the DYFAMED site.

16.3. Profiling float

One profiling float was deployed as part of the GEORGE project.

WMO number: 7902279, **Serial number:** P53380-24EU001

Sensors: CTD_PRES, CTD_TEMP, CTD_CNDC, OPTODE_DOXY, TRANSISTOR_PH

Deployment date time: 05/06/2025 17:10

Deployment location: 48.9205, -16.4185

The float was deployed on a daily cycle while the ship is on site. It has been achieving 2000 m profiles every day.

A calibration CTD (JC278-058) and water samples were collected to 2000 m on the 20th of June, 2025 at the last recorded location of the float 16° 56.720, 48° 34.425

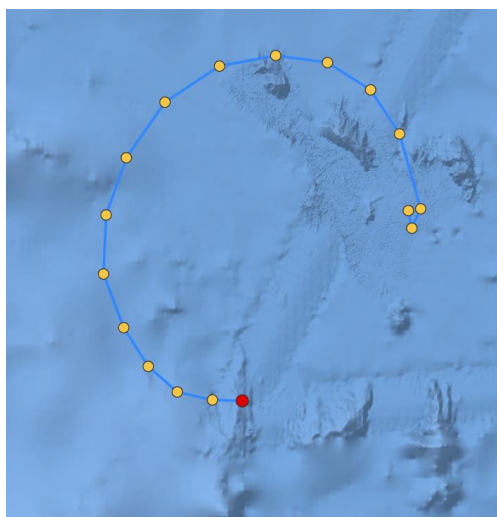


Figure 16.9: The trajectory of the float until the 20th of June 2025

Table 16.2: date, time and positional information from float surfacing

PLATFORM	DATE (yyyy-mm-ddThh:mi:ssZ)	LATITUDE (degree_north)	LONGITUDE (degree_east)	LATITUDE (degree_north_ddm)	LONGITUDE (degree_east)
7902279	2025-06-20T09:16:04Z	48.5737	-16.9453	48 deg 34.425 N	16 deg 56.720 W
7902279	2025-06-19T09:15:04Z	48.5751	-17.0405	48 deg 34.508 N	17 deg 2.432 W
7902279	2025-06-18T09:16:52Z	48.5906	-17.1497	48 deg 35.433 N	17 deg 8.982 W
7902279	2025-06-17T09:16:35Z	48.6435	-17.2416	48 deg 38.608 N	17 deg 14.494 W
7902279	2025-06-16T09:23:28Z	48.7239	-17.3182	48 deg 43.436 N	17 deg 19.092 W
7902279	2025-06-15T09:25:22Z	48.834	-17.3802	48 deg 50.040 N	17 deg 22.809 W
7902279	2025-06-14T09:29:03Z	48.955	-17.3719	48 deg 57.298 N	17 deg 22.316 W
7902279	2025-06-13T09:32:05Z	49.0717	-17.3087	49 deg 4.302 N	17 deg 18.519 W
7902279	2025-06-12T09:34:34Z	49.1854	-17.1883	49 deg 11.123 N	17 deg 11.297 W
7902279	2025-06-11T09:32:52Z	49.2593	-17.0171	49 deg 15.557 N	17 deg 1.026 W
7902279	2025-06-10T09:28:34Z	49.2797	-16.8417	49 deg 16.779 N	16 deg 50.504 W
7902279	2025-06-09T09:26:33Z	49.2652	-16.6811	49 deg 15.913 N	16 deg 40.864 W
7902279	2025-06-08T09:15:33Z	49.21	-16.5448	49 deg 12.602 N	16 deg 32.687 W
7902279	2025-06-07T08:47:34Z	49.1209	-16.4549	49 deg 7.251 N	16 deg 27.294 W
7902279	2025-06-05T21:41:28Z	48.9678	-16.3891	48 deg 58.068 N	16 deg 23.347 W
7902279	2025-06-05T17:25:21Z	48.9274	-16.4173	48 deg 55.643 N	16 deg 25.039 W
7902279	2025-06-05T16:49:27Z	48.9641	-16.4277	48 deg 57.847 N	16 deg 25.661 W

Example Data

Complete float information and data can be found here: <https://fleetmonitoring.euro-argo.eu/float/7902279>

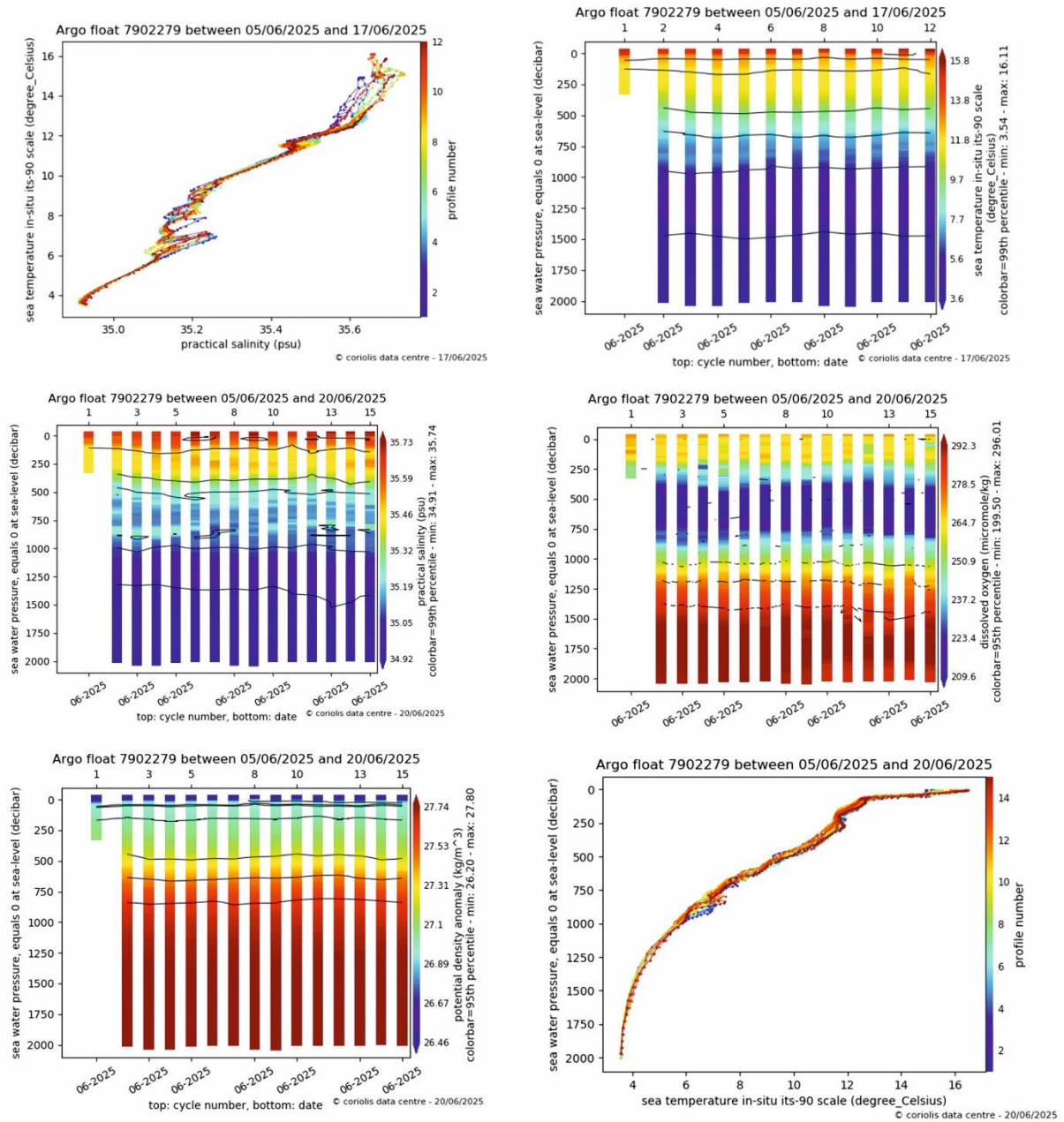


Figure 16.10: Example near real-time data plots for the GEORGE profiling floats

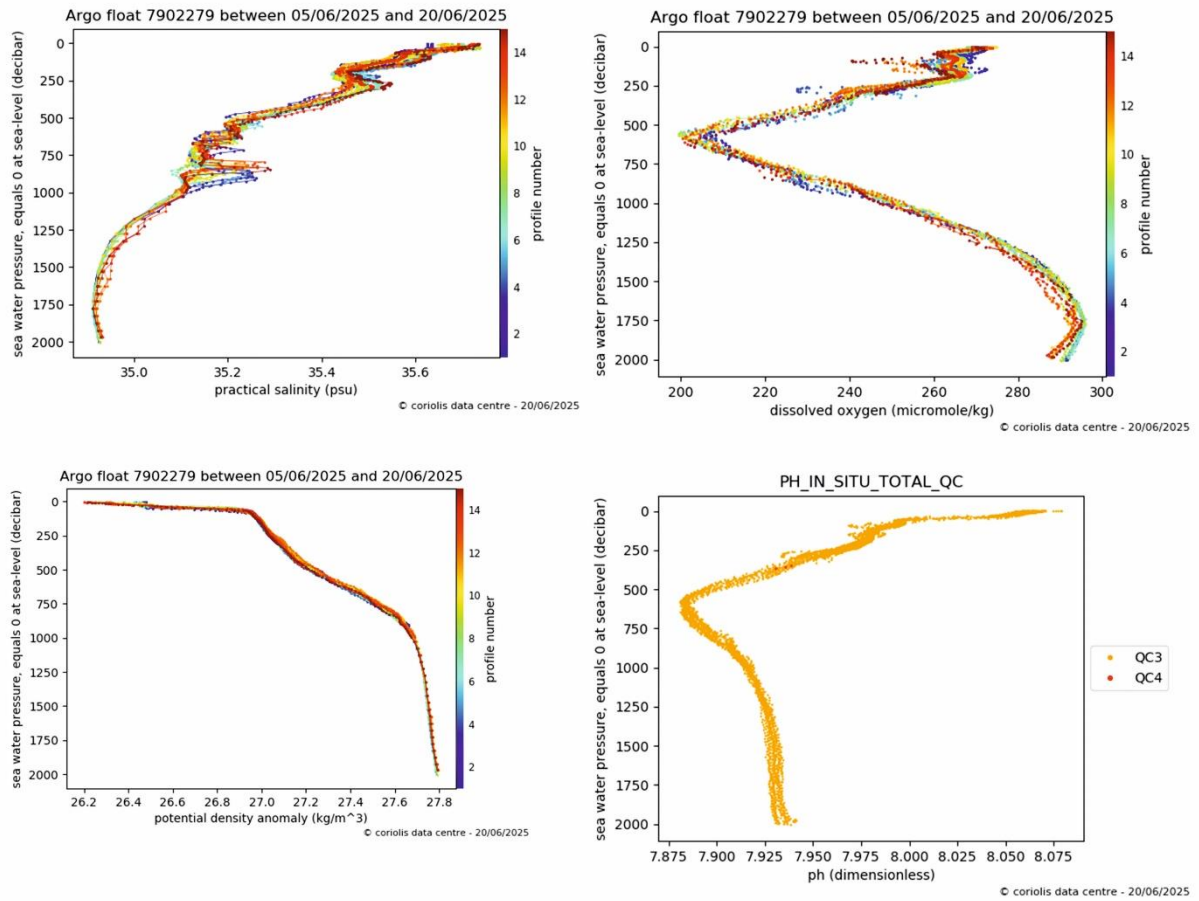


Figure 16.11: Further example near real-time data plots for the GEORGE profiling floats

16.4 EGIM Lander

Adrien Chauvet & David Le Piver

EMSO Generic Instrument Module (EGIM), a deployment ready multi-sensor instrumentation module, designed to measure physical, biogeochemical, biological and ecosystem variables consistently, in a range of marine environments, over long periods of time. Here, we describe the system, features, configuration, operation and data management. We demonstrate, through a series of coastal and oceanic pilot experiments that the EGIM is a valuable standard ocean observation module, which can significantly improve the capacity of existing ocean observatories and provides the basis for new observatories. The diverse examples of use included the monitoring of fish activity response upon oceanographic variability, hydrothermal vent fluids and particle dispersion, passive acoustic monitoring of marine mammals and time series of environmental variation in the water column. (Lanteri et al 2021).

Description of the deployed system

Mechanical design

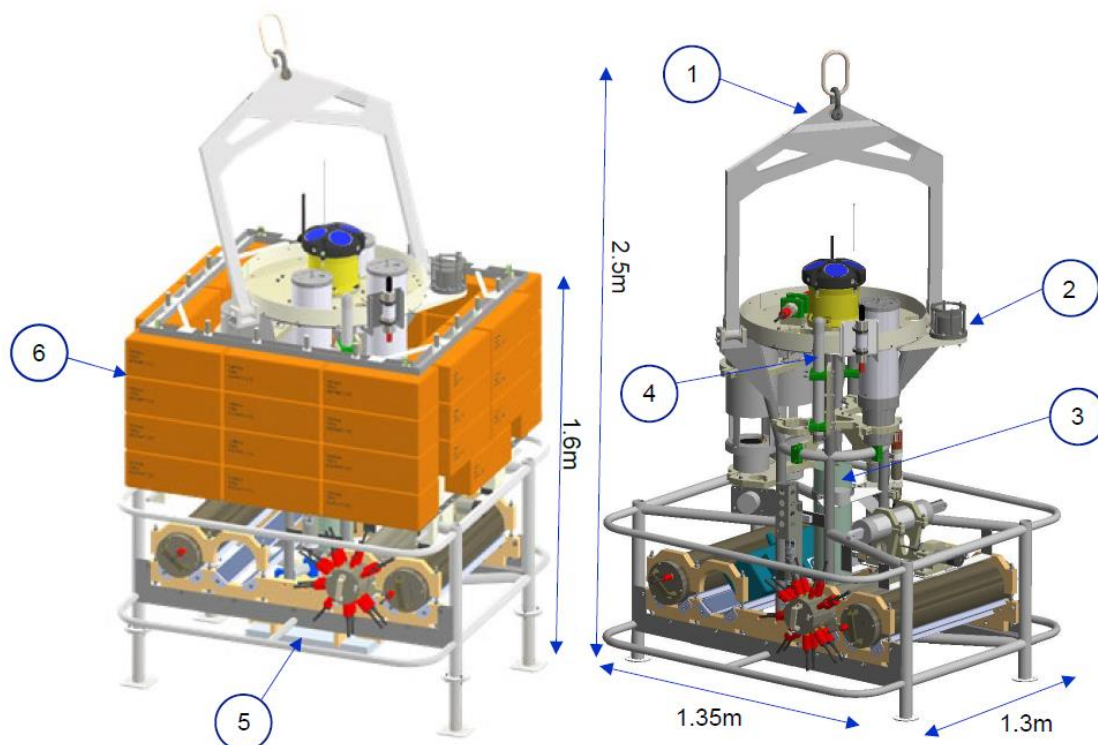


Figure 16.12:EGIM lander with and without float (arrows and numbers pointing at key parts of the system)

Table 16.3: Glossary of the items fitted on the EGIM lander

Number	Component
1	Lifting point bracket
2	Acoustic release head
3	Acoustic release system
4	Flash light, Argos and Gonio beacon
5	Removable weight
6	Float

The EGIM lander is designed to be deployed using a cable and retrieved on its own. To do so it is fitted with a 90 kg removable weight (5) that can be acoustically released (2&3). When the weight is fitted the system weights 45kg, when the weight is released, the landers become 45kg buoyant thanks to the float (6). For deployment or transportation, the lander can be lift using the lifting point bracket. This bracket prevents any entanglement between the lander and the lifting rig when it is released (compared to slings). The weight release system is completely power independent from the sensors and acquisition system. The lander is equipped with a flash light, an ARGOS and a VHF beacon that turn on when the lander arrives to the surface to be easily spotted from the ship. The mechanical characteristics are summarized in the table below.

Table 16.4: Mechanical characteristics of the EGIM lander

Length		1.35 m
Width		1.3 m
Height	Rotating arm fold down	1.6 m
	Rotating arm deployed	2.5 m
Weight in air	Deployment time	635 kg
	Retrieving time	545 kg
Weight in water	Deployment time	54 kg
	Retrieving time	-36 kg

Sensors

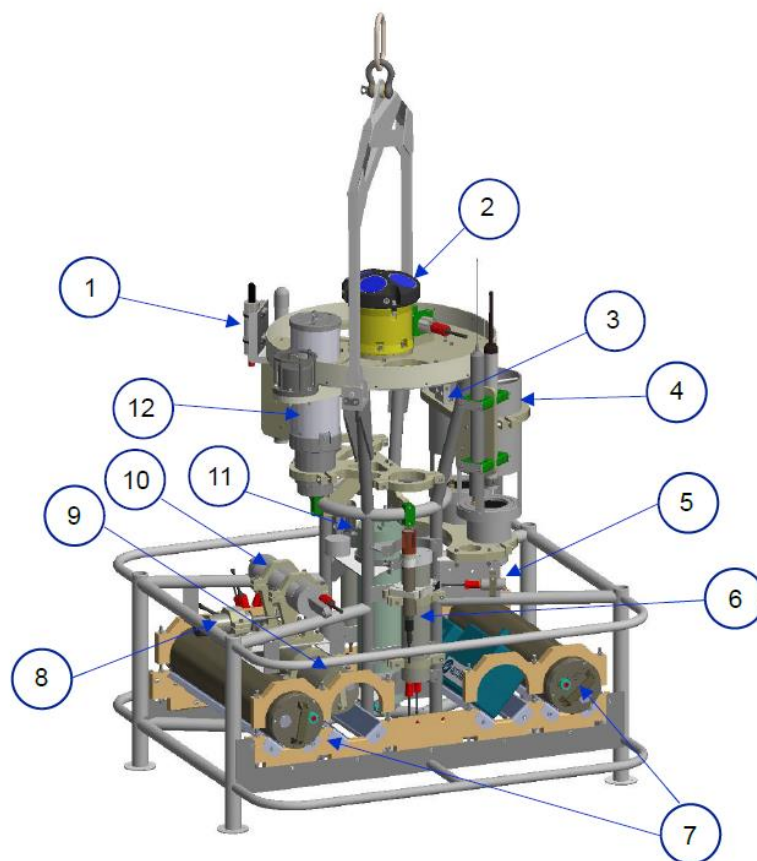


Figure 16.12: The EGIM without its float (arrows and numbers pointing at sensors listed in Table 16.5)

Table 16.5: The deployed EGIM is highly customised to embed all the sensors listed below.

Number	Description	Manufacturer	Name	S/N
1	Hydrophone	Oceansonic	SB60L-ETH	1638
2	ADCP	RDI	Workhorse 300KHz	24492
3	TA sensor	NOC	TA	NOC00048
4	DIC sensor	NOC	DIC	NOC00015
5	Oxygen sensor	Anderaa	4831	678
6	pCO2 sensor	4HJena	HydroC CO2 Tough	CO2T-Leihsensor
7	Battery packs (x2)	IFREMER	Battery pack	A101804B_SN001 A101804B_SN002
8	Turbidity sensor	Wetlab	NTURTD	718
9	COSTOF acquisition system	IFREMER	COSTOF	RTSYS 1708002
10	High precision pressure sensor	Seabird	SBE54	54-0050
11	CTD sensor	Seabird	SBE37	37-13442
12	pH sensor	CWS	CWS-pH	C109 (111)

Sensor configuration and energy consumption

For the PAP deployment we only had 2 energy packs available (10.5 kWh in total). The deployment is planned to be 365 days long but may be a little longer depending on cruise planning.

Lithium batteries capacity varies depending on:

- The temperature (the capacity decreases when temperature lowers)
- The discharge rate (The more current is drawn from the battery, the less total capacity we get).

To cope with these uncertainties, we want to keep a 20-30% margin between the theoretical available energy and the estimated energy consumption.

Table 16.5: Predicted power consumption of the EGIM for a one-year long deployment

Sensor	Measurement period	Energy per measurement	Energy per year
Hydrophone	One 3days long recording	273 Wh	273 Wh
ADCP	200s long measurements every 6 hours	192 mWh	280.3 Wh
NOC TA	One 2 hours long measurement every day	~2.5Wh	912 Wh
NOC DIC	One 2 hours long measurement every 3 days	5.1Wh	616.2 Wh
Oxygen	One measure every 9 min	6 mWh	350.4 Wh
pCO2	One 2 hours long measurement every 6 days	36.3Wh	2217 Wh
Turbidity	One measurement every 15 min	1.6 mWh	58.4 Wh
Pressure	One measurement every 15 min	14 mWh	490.5 Wh
CTD	One measurement every 10 min	12 mWh	630 Wh
pH	One measurement every 6 hours	357 mWh	521 Wh
Data logger			1200 Wh
		Total	7548 Wh

This energy consumption estimation gives us a 29 % margin.

Remarks: The CTD, pH, TA, DIC and pCO2 sensor will be configured to start at the same time the day of the deployment (roughly 2h15min after the beginning of the descent). This will achieve three purposes:

- Those sensors require water to safely operate
- pH, TA and DIC sensor may fail under pressure variation if not operated while descending. Sensors will start when they (roughly) reach half depth.

As the measurement periods are multiples one another, sensors will operate at the same time periodically.

Detailed configuration

The majority of the sensor used on the EGIM do not require configuration other than the period of measurement. Others (ADCP and pCO2 sensors) do require an extended configuration to run as expected.

Table 16.6: ADCP configuration

Parameter	Value
Number of cells (WA)	50
Depth cell size (WS)	400
Pings per ensemble (WP)	150
Blank after transmit (WF)	176
Ambiguity velocity (WV)	175
Time between pings (TP)	2

Table 16.7: pCO₂ configuration

Parameter	Value
Time between data acquisition	2s
Number of acquisitions per period	3600

Table 16.8 iCListen hydrophone configuration

Parameter	Value
Sampling frequency	256 kS/s
Logging start date	21/06/2025 8:15
Logging stop date	24/06/2025 8:15

Remarks on the Oceansonics iCListen: This hydrophone is not well suited for this kind of long-term deployment. Its power consumption is high, even in standby mode. The threshold detection mode requires the hydrophone to be in running mode. Thus, the threshold detection mode consumes the same amount of energy as when constantly logging.

To avoid recording James Cook ship noises it was decided to power up the hydrophone and start recording after the ship left the area in which the EGIM was deployed, starting recording on June 21st.

See additional information about passive acoustics data collection during JC278 in Section 17.

Operations at sea
Deployment

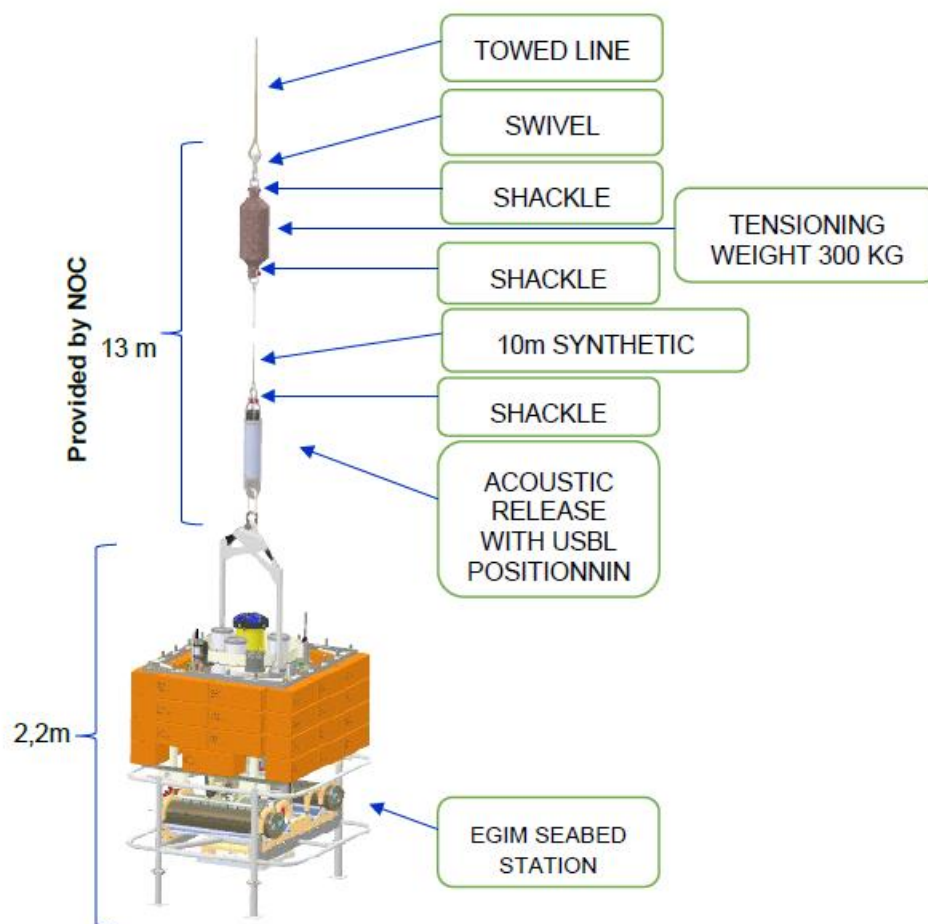


Figure 16.13: Diagram of the EGIM lander deployment rig

The EGIM lander has been deployed using the rig presented on Figure 16.13. The CTD winch was used for this deployment.

Deployment configurations and checks

The EGIM requires settings and checks for each sensor to run as intended but also for more basic functions (setting time, reset internal energy counter, ...). All these settings were performed on an external power supply to save energy on the batteries. Batteries were plugged in 45 min before deployment.

The EGIM internal clock was set from a computer synchronized with onboard NTP server. The time difference regarding reference clock at deployment time was 1-2s but will drift over time.

Mechanical checks were also performed prior to deployment to make sure everything is ready (screws tightened, sensor protective cover removed, ...). A checklist was run down to make sure all settings and checks were performed.



Figure 16.14: EGIM lander configured and checked

The EGIM lander was latched down in the starboard passage way. Once all the settings and checks performed It had to be moved to the CTD winch.

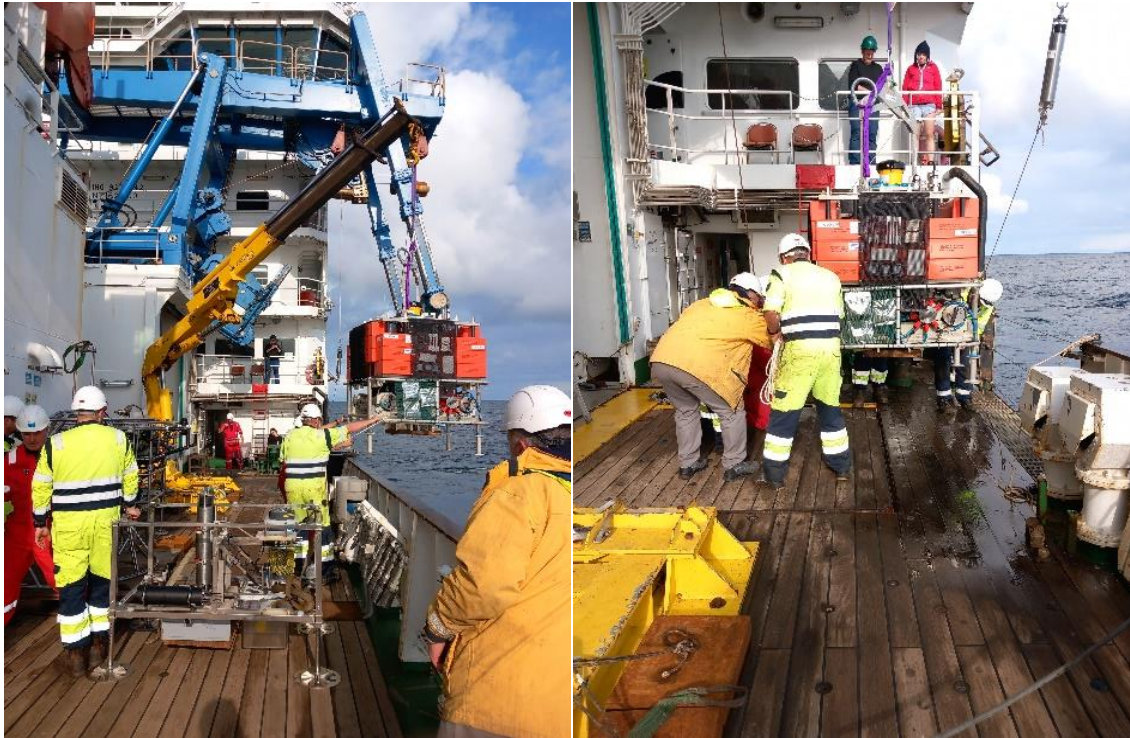


Figure 16.15: Moving EGIM lander to the CTD winch (08:02-08:04)



Figure 16.16: Connecting the acoustic release and synthetic rope (08:08)

The raising feet of the lander are unscrewed to be removed when it is lifted up. These feet are used for transportation and to ease the dead weight setting up process.



Raising feet (x4)

Figure 16.17: EGIM Lander ready for deployment (08:17)

The ship then moved to the deployment position for 30 min.



Figure 16.18: EGIM board out (08:42)

Once the ship was into position, the EGIM was lifted up to the water. The EGIM was left 3 min few meters underwater while the frame fills in with water. This removes additional buoyancy so the EGIM it can reach its nominal descent speed.

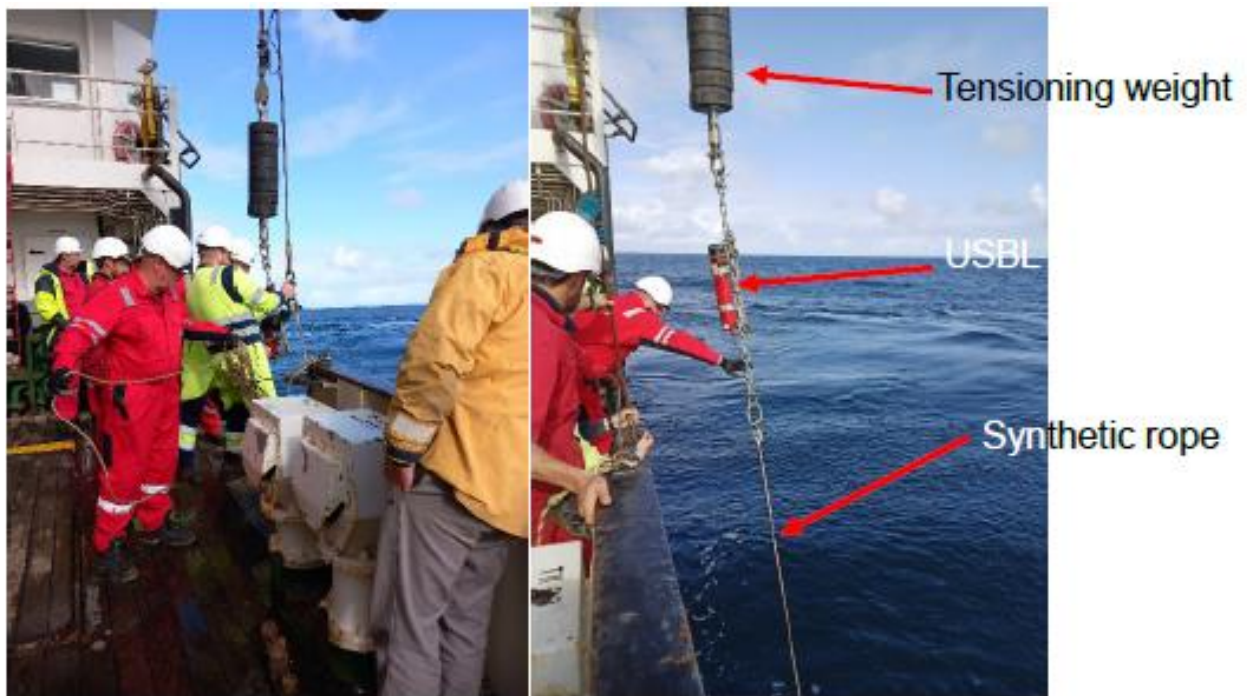


Figure 16.19: Towed line assembly to the synthetic rope (08:53)

The CTD line was then connected to the synthetic rope. An USBL was added to the line compared to the plan (**Error! Reference source not found.**16.19). This will be used to monitor the EGIM's depth and position during its descent.

EGIM descent

At 08:58 the EGIM descent began at 0.3m/s. The James Cook is equipped with a rolling compensation system that adjust the veering or hauling speed at all time to achieve a constant speed. The depth of the EGIM was monitored during the whole descent (The depth in the chart is the depth of the USBL beacon, the EGIM's are 15m below).

Table 16.9: Depth and descent rate over time for EGIM deployment

Time	Depth [m]	Speed [m/s]
08:58:00	0	0.25
11:20:00	2136	0.29
12:18:00	3168	0.30
13:11:00	4123	0.30
13:36:00	4575	0.31
13:45:00	4744	0.05
14:06:00	4814	-

The descent was stopped at 4814m (20 m above seabed) after lowering the veering speed. The EGIM had drift 200 m away from the ship due to subsea currents.



Figure 16.20: USBL positioning screen right before release

EGIM release

After checking with the acoustic release beacon that the depth was ok the acoustic release command was sent and after multiple retries the release confirmation was received. The EGIM acoustic release was also interrogated (in diagnostic mode) to check the range of the lander. The acoustic release responded well but unfortunately the range was not good enough to be used as a reference (to confirm actual release). On the other hand, it did confirm that we can communicate with it and that the release will be feasible for recovery.

The final position of the EGIM lander is: **49° 00.913 N 016° 27.319 W** 4851 m

The latitude and longitude were given by the USBL with the EGIM at 20 m above sea bed. It may have drifted slightly during its way down.

Recovery plan

Raising the lander

The lander is fitted with a 90 kg weight hold by an “IXSEA OCEANO 1250 E/HD” acoustic release device. This weight makes the lander heavy enough (54 kg) to sink on its own. The acoustic release should be triggered to release the weight and make the lander buoyant (36kg).

Table 16.10 Release codes for recovery of EGIM lander

Code name	Code
Arm	1869
Release	1855
Pinger ON	1847
Pinger OFF	1848
Diagnostic	1849

A "TT301" acoustic case should be used to trigger the release. The following command pattern should be used:

- [1]. Arm: 1869 →SAFETY →COMMAND
- [2]. Release: 1855→SAFETY→COMMAND

Once the confirmation is received the EGIM should rise up at a 0.6m/s speed (2h15 min to the surface).

Spot the lander

Once on the surface the three spotting beacons located on top of the lander will turn on:

- Flash light
- VHF (channel 73). (The VHF emission has been tested working right before deployment)



Figure 16.21: View of the VHF beacon information

-Argos



Figure 16.22: View of the Argos beacon information

The Argos beacon sends a position information to registered users. The Argos has been tested working right before deployment.



Figure 16.23: Position sent by the ARGOS beacon during tests

Hook

Once at the surface the EGIM lander can be hooked and lifted on the recovery rope (see **Error! Reference source not found.**). The recovery rope is tied down on the rotating arm with breakable zip ties. Once hooked the zip ties will break and the rope will unfold to allow an easy lifting.

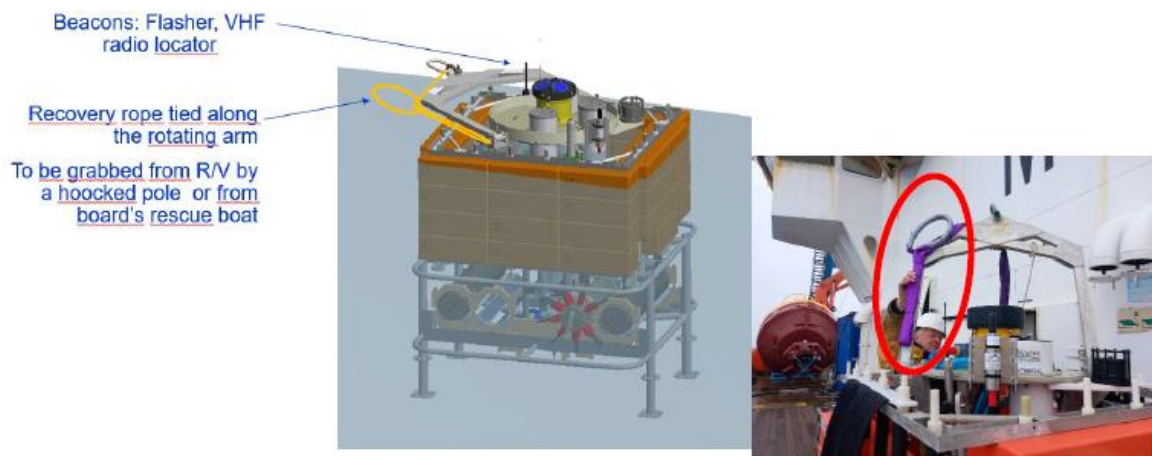


Figure 16.24: View of the recovery rope of the lander

16.5 Gas Tight Sampler

Summary

The work carried out on cruise JC278 had two main objectives. The first was to deploy six v2.0 Gas Tight Samplers (GTS) within the PAP-1 buoy skirt, using a 7-port OTE Sensor Hub to schedule their sampling. Each of the six GTSs was programmed to collect a single 500 mL seawater sample, with their firing sequence staggered in order to collect one sample every two months. These samples are intended to validate the continuous measurements taken by two Pro-Oceanus CO₂-Pro sensors installed in the buoy's keel, which each take a measurement every six hours. The GTS units, along with the samples they have collected, will be recovered during the PAP 2026 cruise. Once recovered, the samples will be decanted and analysed for dissolved inorganic carbon (DIC) and total alkalinity (TA).

The second objective was to deploy an additional two GTS units on the CTD rosette to collect oceanic samples alongside matching Niskin bottle samples. These GTS samples will be stored at the National Oceanography Centre, Southampton (NOCS) for periods of four and eight months, respectively, before being decanted and analysed for DIC and TA. The results will be compared to those from the corresponding Niskin bottle samples to assess the stability of the GTS samples over extended storage durations.

Equipment Preparation

Gas Tight Samplers

In preparation for research cruise JC278 aboard *RRS James Cook*, eight GTSs (S/N: 1–8) were assembled and tested. The units are of a new design, which amounts to a complete overhaul of the previous v1 design, tested in its initial sea trials on the DY181 cruise aboard *RRS Discovery* (Aberdeen – Reykjavik, 03 Jul – 28 Jul 2024). The major differences relevant to the end user are the much smaller package size and the 250 msw depth rating. With this version's main deployment being at <2 msw depth, the electronics have been housed in a shallow water, air-filled pressure housing rather than the oil-filled, pressure-compensated housing of the v1 design. Therefore, the GTS v2.0 depth rating stems from the maximum system pressure allowable within the MGD1000P gear pump which actuates the device.

Each sampler has been fitted with an SMC AN101-01 phosphor bronze pneumatic muffler at its inlet and exhaust, and a section of the surrounding surface has been painted with copper-based Hempel

Classic Antifoul paint. These measures have been put in place to mitigate soft marine fouling in the close vicinity of the samplers' critical fluid pathway, in an attempt to avoid clogging issues.



Figure 16.25: Section view of GTS v2.0 (left); 6x GTSs assembled and painted ready for deployment (right).

The samplers run on custom firmware, **GTS_1_11**, which provides the controls for capturing samples. Functionally, this is achieved by controlling the MGD1000P gear pump with the Allegro AMT49400 motor controller, in conjunction with measuring the piston's position using Vishay VCNL36828P laser proximity sensors. Both of these have a complex array of parameters which can be adjusted with I2C commands; however, scientific users of the device should never need to access these.

Users can control a GTS using the **GTS_1_11** GUI. The main device controls are located on the left-hand side of the GUI in the form of command buttons (e.g. 'Prime Sampler', 'Decant Sample', etc.). The flow rates, volumes, and stopping mechanisms associated with these functions can be adjusted in the 'Configure Pump Settings' menu, although for the most part, the default settings are sufficient.

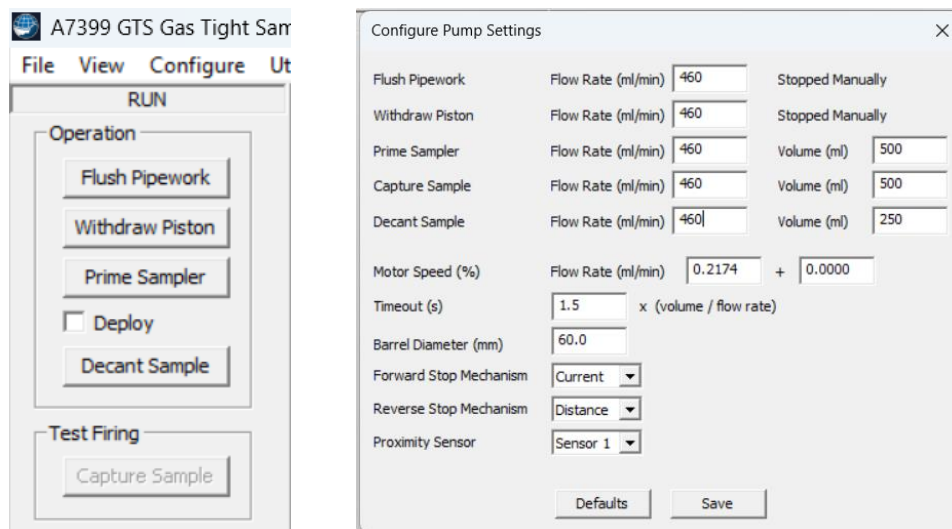


Figure 16.26: Main GTS functions (left); Pump configuration settings (right).

Sampler Frame

The six GTS units (S/N: 1–6) deployed on the PAP-1 buoy are mounted within a custom frame constructed from stainless steel and polypropylene. The frame is coated with the same antifoul paint as the samplers themselves to prevent the development of a non-representative microenvironment influenced by biological activity such as respiration and photosynthesis of the marine plant matter.

The frame is installed within a section of the PAP-1 buoy skirt and secured to its outer face using four sets of fasteners: M12 × 130 mm zinc-plated high tensile steel (grade 8.8) hex bolts, M12 × 36 mm Form G hot-dip galvanized mild steel (grade 4.6) washers, and M12 zinc-plated carbon steel (class 10) nyloc nuts. The use of zinc-plated fasteners was specified by the Met Office engineers to provide protection against galvanic corrosion.



Figure 16.27: (left to right) GTS frame pre-paint; Frame painted with antifoul paint; Frame bolted to the keel of the buoy

PAP-1 Sampler System

Each sampler is connected to a single 7-port OTE Sensor Hub via SubConn underwater cables. For the purposes of this report, this OTE Sensor Hub will be referred to as the GTSHub. The GTSHub is linked to the PAPHub via an additional SubConn cable, enabling it to receive power and communicate serially with the PAP-1 buoy infrastructure.

The GTSHub runs a custom scheduling application, **GTSHUB_1_2**, which allows users to assign a specific date and time for each sampler to be triggered. The user can access the functions of the GTSHub via its USB port and the graphical user interface (GUI), **GTSHUB_1_3**. The device's application relies on an integrated real-time clock (RTC) module to maintain accurate timing. At the scheduled time, the GTSHub supplies power to the designated sampler, initiating its sampling operation. The RTC was synchronised to GMT using the 'Set to computer time' function in the GUI.

Following activation, the GTSHub polls the sampler for a status response, i.e. waiting to hear if the sample has been collected successfully (or not). Once received this status message is transmitted via RS232 serial communication to the PAPHub, which then relays the information to NOCS via an Iridium

satellite link. The GTSHub was plugged into the PAPHub on the dockside so that it could be powered on in advance of departure.

GTS7 Rework

Before boarding the ship GTS7 had been assembled but only subjected to the initial stages of testing due to time constraints. During these tests a mechanical issue had been identified: the piston was consistently getting stuck approximately two-thirds of the way down the bore on the withdraw stroke. Testing this further on the ship it was confirmed that the piston was unable to withdraw under the vacuum pressure achievable at ambient conditions (~ -1.01325 bar), i.e. the friction force experienced by the piston exceeded the maximum pressure differential available using suction. No issue was observed during the injection stroke, where the pump can generate up to 20 bar of positive pressure.

This behaviour was consistent with previous cases of piston galling observed during the testing of other GTS units. In those cases, small fragments of titanium had been dragged from the outer surface of the piston and became caught in the annular gap between the components, causing the piston to bind up. Therefore, a disassembly of GTS7 onboard was necessary to inspect the components. The excess water was drained, the top cap and electronics housing were removed, and the floating piston was dislodged. Although it was stuck this was achieved without the need for hammering. Removing the piston revealed score marks along the bore and gouges on the piston's outer diameter, some of which were deep enough to catch a fingernail on. The piston and bore were thoroughly cleaned with degreaser before attempting to perform a dry drop-through test with the piston. The piston would not fit into the bore confirming the need for rework.

The outer diameter of the piston was dressed using fine emery cloth on the lathe to remove the high points and improve the surface finish. As this face is not a sealing face, further polishing was not required. Reattempting the dry drop-through test, the piston fell through freely and produced only light surface marks.

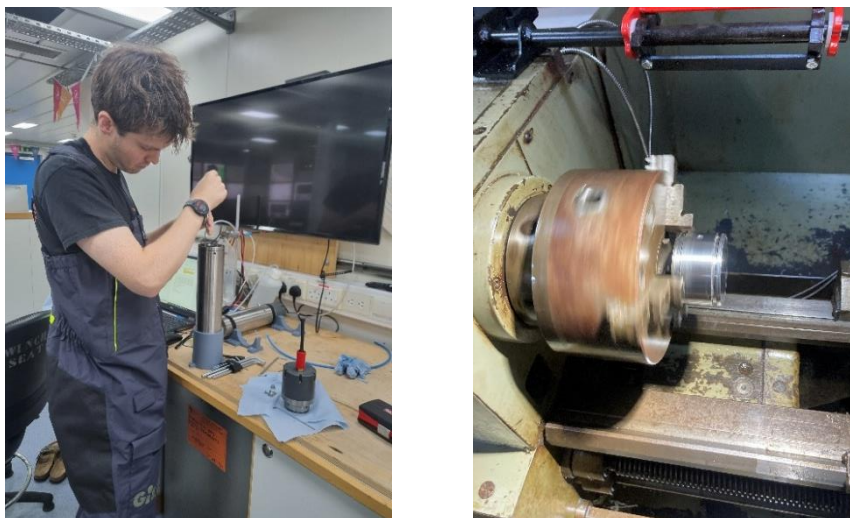


Figure 16.28: Disassembling GTS7 (left); Refinishing the piston on the lathe (right).

The piston's O-rings were cleaned and re-greased with Klüber grease before being fitted back onto the piston. Additionally, the bore ends were also lightly greased. The piston was reinserted carefully, ensuring concentric alignment, and manually cycled through the full bore several times using a push stick. The resistance to movement was smooth and comparable to the other functional samplers. The

electronics housing was refitted, and the pump was used to hydraulically complete three full strokes in both directions. These strokes exhibited a normal current draw.

Next three full inject and withdraw cycles were performed using the 'Prime Sampler' and 'Capture Sample' commands. These commands use the overcurrent protection and proximity threshold to detect the ends of the piston's travel. They ran successfully. Finally, the sampler was tested with Milli-Q supplied to the inlet check valve, again through three full cycles using the 'Prime Sampler' and 'Capture Sample' commands. These ran without a problem so GTS7 was deemed operational and suitable for deployment.

CTD Cable

On DY181 it was proven that listening into the RS232 serial firing codes used to trigger the Niskin bottles is a robust and reliable way of firing a GTS at depth. For that deployment a custom Y-shaped cable was manufactured by MacArtney (UK 15481 Rev A) and was used to connect power, ground, and RS232 comms from the CTD to the GTSv1 via its three contact SubConn Microcircular bulkhead connector. We will call this cable the 'GTS CTD cable' for the purposes of this report. The GTS CTD cable was inserted in line between the JT7 port of the SBE 9plus and SBE 32 Carousel Water Sampler (Figure 16.29). The v2.0 GTS however has an 8 contact SubConn connector, so an 8 contact SubConn tail was spliced onto the cable and potted using 3M Scotchcast SC 2131 polyurethane potting compound. A digital multimeter was used to test that all the connections had been made successfully.

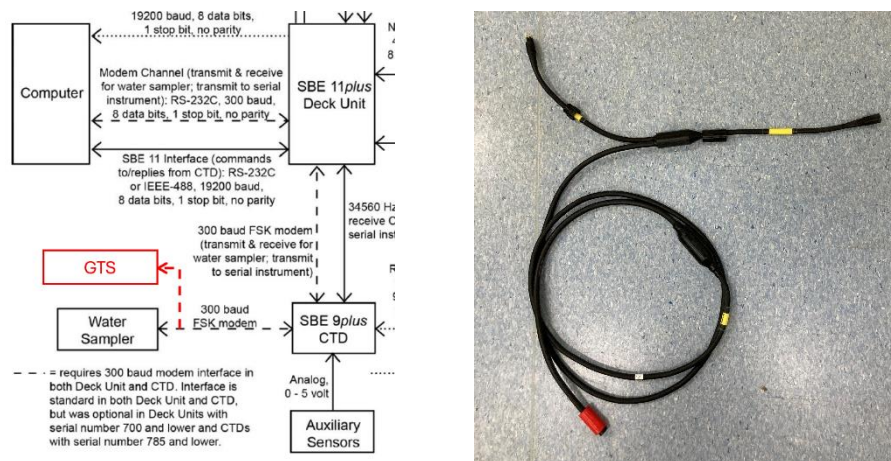


Figure 16.29: Part of the CTD system schematic (left); the spliced GTS CTD cable (right).

PAP-1 Buoy Deployment

Final GTS Preparations

Each GTS (S/N: 1-6) was prepared for deployment using the following steps:

- Inserted the decanting nipple into the inlet valve and connected to a blood bag of Milli-Q.
- Connected the exhaust port to the same Milli-Q blood bag.
- Plugged the sampler into the 12V power supply and connected to the computer via USB.
- Opened the GTS GUI and connected to the device.
- Set the device's real-time clock to GMT using the 'Set to computer time' function.
- Ran 'Prime Sampler' followed by 'Capture Sample'. This was repeated three times.
- Ran one final 'Prime Sampler' operation and dried the mercuric chloride cavity with a paper towel.
- Used the 'Configure RS232 Settings' to set the correct settings for PAPHub deployment (*Figure*).
- Used the check box to put the GTS in its deployed state.
- Disconnected the device from both the USB/power cable and fluid hoses.
- Transferred the sampler to the fume hood and added 200 μ L of mercuric chloride to the poison cavity using a pipette.
- Filled the inlet valve coupling with Milli-Q water using a second pipette.
- Inverted the valve slowly in order to maintain water tension and screwed the valve into the top cap.
- Tightened the valve using an adjustable spanner.
- Installed the phosphor bronze inlet filter.
- Placed the sampler bottle into its assigned slot within the PAP basket.
- Oriented each bottle so the exhaust faced outward for easy access for the air bleeding and exhaust filter installation.

Since the GTSHub was already in place and powered on, once all the samplers were fitted, the top cap of the PAP frame could be fitted over the samplers and secured using seven M6 screws. Where accessible, each screw was backed with a locking nut. The two screws which couldn't be backed were fitted with spring washers.

Due to the compression of the frame by the four bolts which were securing it to the PAP buoy skirt, the bolts had to be temporarily loosened to allow the samplers to be dropped in. After all samplers were seated and the top cap was installed, the bolts were re-tightened.

Each GTS was then connected to the GTSHub using a 4-way to 8-way SubConn cable. Both ends were greased liberally with Molykote 44 Medium, and locking caps were used to secure the connectors. Zipties were applied to tidy and restrain the cables, and lengths of braided PVC hose were added where needed to protect against abrasion on exposed edges.

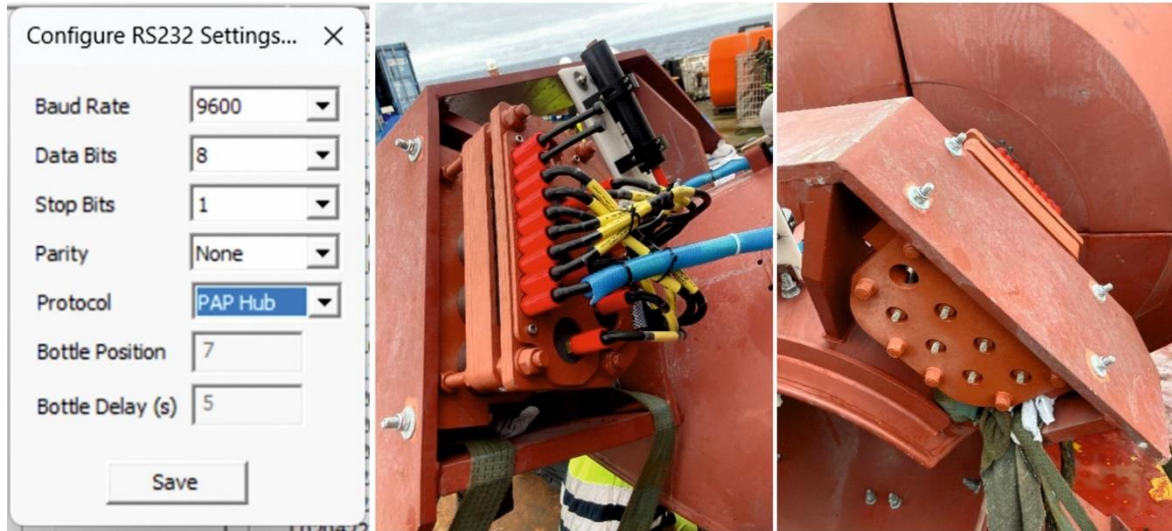


Figure 16.30: RS232 settings for deploying with GTSHub (left); All six samplers and the GTSHub secured into the PAP frame (centre and right).

Sampling Schedule

The GTS samples will be taken at night to avoid the diurnal variability of pCO₂ in the surface ocean. Sampling will occur every two months, alternating between following (within 10 minutes) a measurement taken by each of the two Pro-Oceanus CO₂-Pro sensors on the buoy. The sampling schedule is as follows:

Table 16.11: PAP-1 buoy GTS firing schedule

GT S/N	Date	Time
1	1 Jul 2025	00:30
2	1 Sep 2025	02:05
3	1 Nov 2025	00:30
4	1 Jan 2026	02:05
5	1 Mar 2026	00:30
6	1 May 2026	02:05

To program the schedule into the GTSHub a USB cable (MacArtney UK10188 Rev A) was connected to the GTSHub's USB port, and the GUI was loaded. First the 'Test Bottles' feature was used to turn each sampler port on, allowing the sampler ID and status to be checked and confirmed. The GTSs are required to be in a deployed-but-not-fired state before deployment. Next the firing schedule was configured using the 'Configure Sampling' function, following the schedule described in **Error! Reference source not found.** After that, the GTSHub voltage input was checked to confirm it was still receiving 13.7 V from the buoy's lithium batteries. Finally, the GTSHub schedule was enabled using the button in the main GUI interface. Enabling the device triggers the internal countdown to the first firing time. Back at NOCS a status message confirming that the scheduling was active was received via the Iridium link.

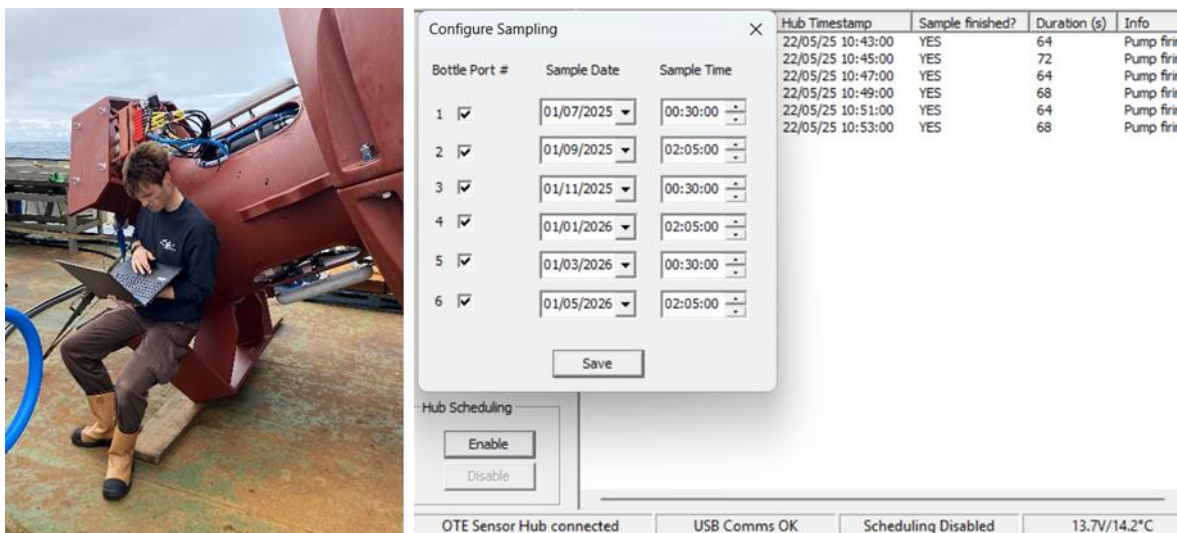


Figure 16.31: Scheduling the GTSHub (left); 'Configure Sampling' function in the GTSHUB_1_3 GUI (right).

The final operation before deployment was to purge any trapped air from each sampler's pump manifold. To do so a syringe of Milli-Q was connected to the exhaust port of each sampler, and a negative pressure was drawn using the syringe. This draws out any air bubbles trapped in the pipework and replaces the space with water from the syringe. After purging, the phosphor bronze exhaust filters were inserted and tightened using pliers.

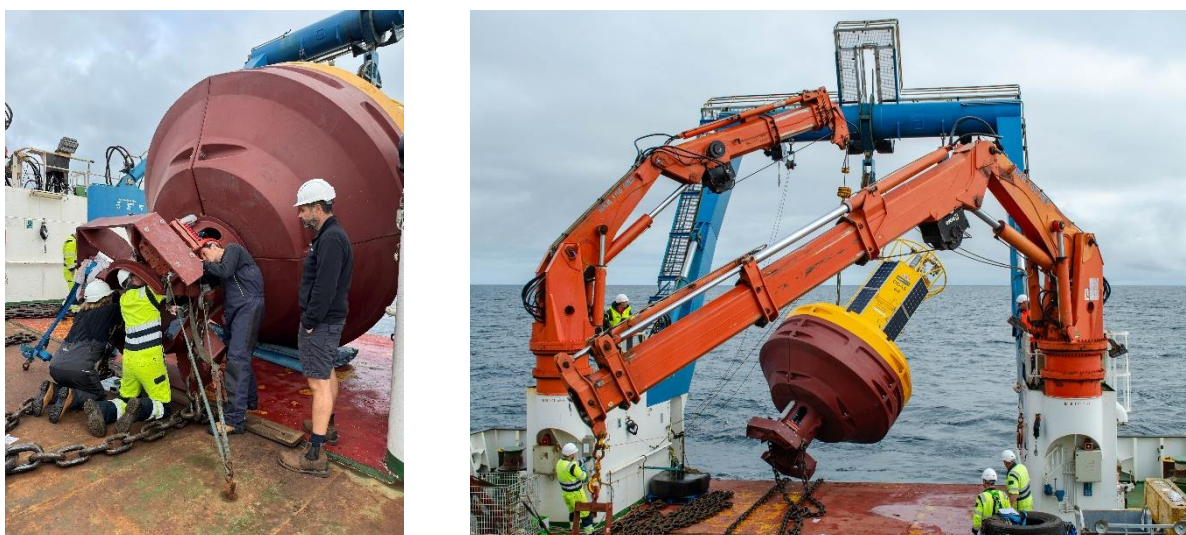


Figure 16.32: Final purging operations being carried out on the GTs (left); PAP-1 buoy deployment (right).

CTD Deployments

GTS7 & GTS8 were prepared for deployment on the CTD using the following steps:

- Inserted the decanting nipple into the inlet valve and connected to a blood bag of Milli-Q.
- Connected the exhaust port to the same Milli-Q blood bag.
- Plugged the sampler into the 12V power supply and connected to the computer via USB.
- Opened the GTS GUI and connected to the device.
- Ran 'Prime Sampler' followed by 'Capture Sample'. This was repeated three times.
- Ran one final 'Prime Sampler' operation and dried the mercuric chloride cavity with a paper towel.
- Used the 'Configure RS232 Settings' to set the correct settings for 'Bottle' deployment (*Figure*) and input the correct Niskin bottle number.
- Used the check box to put the GTS in its deployed state.
- Disconnected the device from both the USB/power cable and fluid hoses.
- Transferred the sampler to the fume hood and added 200 μL of mercuric chloride to the poison cavity using a pipette.
- Filled the inlet valve coupling with Milli-Q water using a second pipette.
- Inverted the valve slowly in order to maintain water tension and screwed the valve into the top cap.
- Tightened the valve using an adjustable spanner.
- Wrapped two bands of self-amalgamating tape around the diameter of the device
- Purged trapped air from the pump manifold using a syringe.
- Using two jubilee clips, the GTS was securely strapped to the upright structure of the NMF CTD frame between Niskin bottles 7 & 8.
- Disconnected the SBE 32 cable from the JT7 port on the SBE 9plus.
- Connected the GTS CTD cable to JT7, the SBE 32 cable and the GTS. Molykote 44 grease was used on the SubConn connectors and a spray silicone grease on the Impulse connectors.
- Zipties were used to neatly fasten the cables at various points along the CTD frame.

N.B. As can be seen in Figure 16.33, the connection to the SBE 32 Carousel Water Sampler uses a 300 baud modem to transmit and receive RS232 serial messages. This is an unusually low data transmission rate but must be set correctly within the GTS_1_11 GUI otherwise no decipherable serial messages will be received, and the sampler will fail to fire.

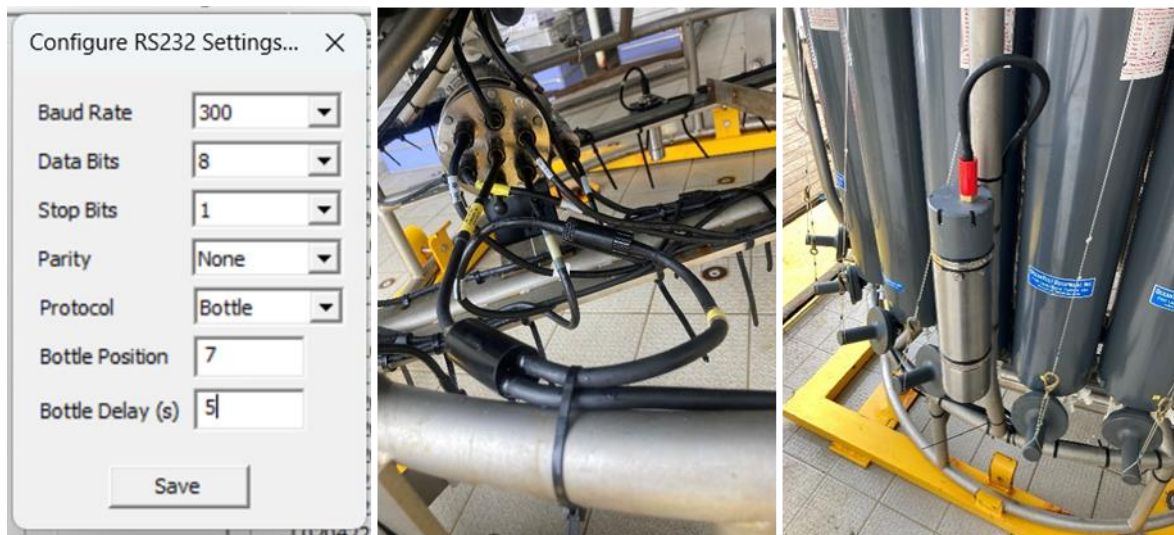


Figure 16.33: (left to right) Example RS232 configuration settings for a CTD deployment; GTS CTD cable inserted in line between SBE 9Plus and SBE 32; GTS fastened with jubilee clips to the CTD frame.



Figure 16.34: GTS 7 & 8 being deployed on the CTD frame

Table 16.12: The details of the two CTD deployments to test the GTS

Station No.	GTS S/N	Niskin Bottle	Depth (msw)	Date	Fire Time
JC289-044	7	1	200	15 Jun 2025	13:14
JC278-056	8	7	200	18 Jun 2025	13:58

Upon recovery of the CTD, each GTS was processed with the following steps:

- Removed from the jubilee clips on the CTD frame and unplugged from the GTS CTD cable.
- Plugged the sampler into the 12V power supply and connected to the computer via USB.
- Opened the GTS GUI and connected to the device.
- Checked the diagnostics page to make sure readable serial Niskin firing codes had been received.
- Checked the GTS was reading as Fired and Completed in the status bar at the bottom of the interface.
- Using the 'Configure Proximity Sensor' menu both proximity sensors were powered on, and it was checked that PS_DATA was larger than PS_THDH. This confirms that the piston has reached the end of the withdraw stroke.
- Disconnected the device from both the USB/power cable and fluid hoses.
- Used electrical tape and marker to make a note of the details of the deployment on the sampler.
- Placed the sampler on a stand in the temperature-controlled lab.

The temperature in the temperature-controlled lab was measured with a Hanna temperature probe at 11.7°C, whilst the wall mounted thermometer read at 12°C, showing close agreement.

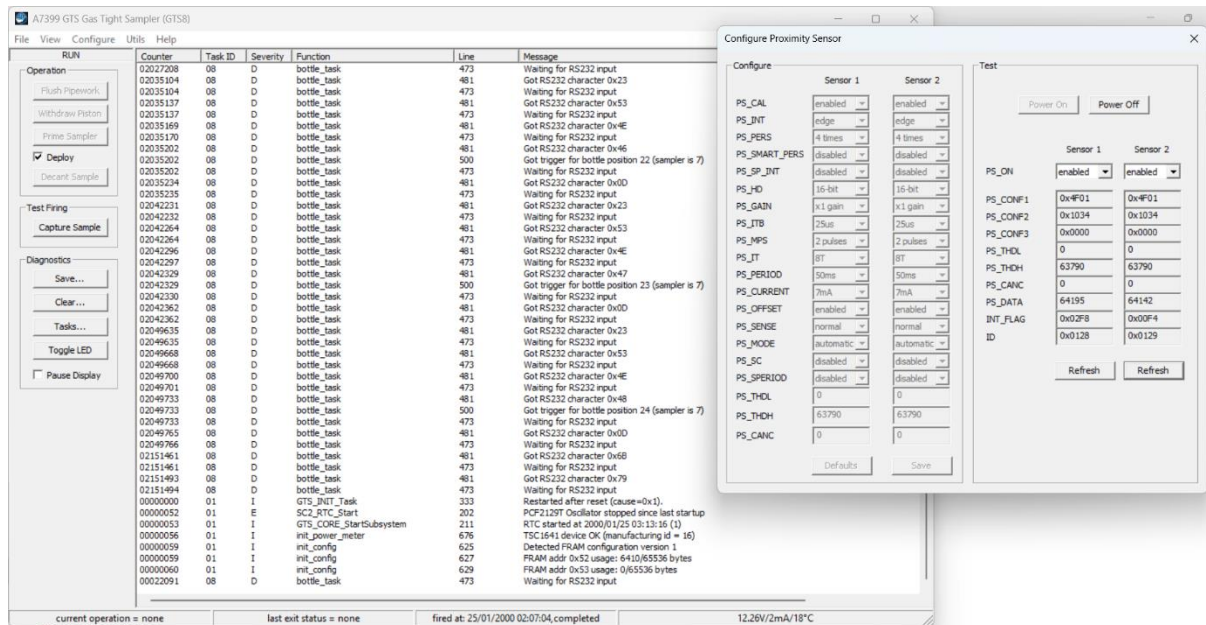


Figure 16.35: GTS GUI on recovery from CTD.



Figure 16.36: GTs (S/N: 7, 8) stored in the temperature-controlled lab (left); Wall mounted thermometer showing the temperature at approx. 12°C (right).

17. Passive acoustic monitoring of soundscapes of PAP and Whittard Canyon

Principal investigators: Dara Farrell (onboard), Emma Gregory (ashore), Gaye Bayrakci (ashore)

Marine mammal observations: Bridge crew (Declan Morrow, Lewis Hopkins, Oliver Clayton), Petr Slavik, Andrew Gates, Sophie Clayton, Susan Hartman, Jethro Reading, Victoria Hastings Rafferty, Allison Schapp, Jade Garner, Martin Yeomans, Dipin Ghosh, Jen Durden, and Dara Farrell

Marine mammal ID confirmation (when possible): Petr Slavik

17.1 Introduction

Eight hydrophones were deployed during JC278 to record the ocean soundscape and marine mammal activity at both Whittard Canyon and the Porcupine Abyssal Plain Sustained Observatory (PAP-SO): the Whittard Canyon mooring (one in-line hydrophone), the PISCES 2 mooring (one in-line hydrophone), a standalone acoustic lander (four hydrophones), the PAP 3 mooring (one in-line hydrophone), and one hydrophone mounted on a lander at the PAP site in partnership with Ifremer. An overview of these deployment locations is shown in Figure 17.1 and detailed in Table 17.1. The placement of the instruments reflects the exploratory nature of the passive acoustic monitoring experiment, which attempts to provide initial data to guide future investigations.

The hydrophone deployments from JC278 are expected to provide first-of-their-kind measurements of deep-water soundscapes at both sites, which present opportunities to explore different (but complementary) scientific questions. The PAP-SO site offers a very well characterised location to provide baseline monitoring of deep-sea soundscapes, analogous to deep-sea mining locations, and a unique opportunity to tie noise levels to a wide array of other meteorological and oceanographic measurements. Whittard Canyon is a dynamic shelf edge and continental margin environment, which is a hub for ocean life across trophic levels, enabling the detection and monitoring of soniferous wildlife from crabs to fish to marine mammals. As a popular fishing ground, the detection of marine noise pollution from vessels and its impact on marine life can also be investigated, especially in relation to the mooring's location adjacent to The Canyons and South-West Deeps Marine Conservation Zones. Furthermore, the canyon system hosts large turbidity currents which will generate an acoustic signature.

Data from these deployments were not transferrable in real time and will only be downloaded and analysed upon recovery (currently scheduled for DY200 in September/October 2025 and the 2026 annual PAP-SO expedition).

Prior to deployment, an M351 Calibrator Box was used to provide a field measurement of the sensitivity of each hydrophone. The M351 is a battery-operated precision hydrophone field calibrator, which is used to validate hydrophone accuracy and sensitivity prior to deployment. Calibrations done pre-deployment at sea may be unreliable due to vibration of the ship, and have been included here as an appendix for completeness only. The effects of ship vibration on hydrophone calibration results will be investigated on recovery of the instruments on cruise DY200. System sensitivity and the recorder settings for each location are noted in Table 1.2. Further deployment details for each site are given in Section 2 (for Whittard Canyon) and Section 3 (for PAP-SO).

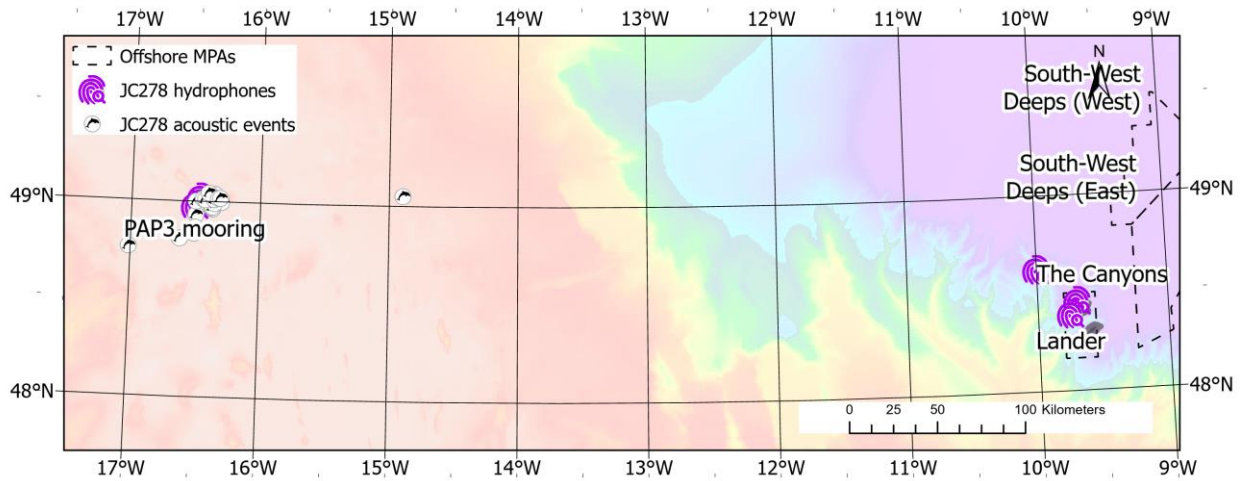


Figure 17.1 Overview map of hydrophone deployment locations and opportunistic observations of acoustic events noted from 06/06/2025 to 20/06/2025 (primarily marine mammal sightings). The marine protected areas (MPAs) in the vicinity of the hydrophones deployed at Whittard Canyon are also shown.

Table 17.1 Hydrophone deployment locations (obtained from Bridge log).

Gear (Location)	Station Number	Latitude	Longitude	Instrument Depth (m)	Water Depth (m)
PISCES 2 (Whittard Canyon)*	JC278-005	48.44845	-9.68764	1078	1165
Lander (Whittard Canyon)	JC278-007	48.38416	-9.7406	350	350
Whittard mooring (Whittard Canyon)*	JC278-011	48.61682	-9.99064	1565	1585
PAP3 mooring (Porcupine Abyssal Plain)*	JC278-020	48.97232	-16.49888	3033	4812
EGIM (Porcupine Abyssal Plain)*	JC278-031	49.01334	-16.45479	4844	4844

*for triangulated seabed position refer to station list

Table 17.2 Summary of settings for deployed instruments.

Acoustic Recorder and Site	Instr. Depth (m)	Hydrophone type	Set system sensitivity (dB re V/ μ Pa)	Sampling rate (kHz)	Sampling schedule	Deployment date and time (UTC)	Planned deployment duration
		Geospectrum					
RS AQUA ORCA 72-D 6000 m rated LANDER; TR-3-1R0-128 WHITTARD CANYON	350	Ch 1: M36-600 (sync); K000073 Ch 2: M36-900; C001534 Ch 3: M36-900; D000716 Ch 4: M36-900; D000714	Ch 1: nom -178.7+15 dB gain = -163.7 Ch 2: nom -164.7 +15 dB gain = 149.7 Ch 3: nom -165.1 + 15 dB gain = 150.1 Ch 4: nom -165.0 +15 dB gain = 150	96	30 mins on 30 mins off	2025-06-01 16:09:07	3 to 4 months
RS AQUA PORPOISE 84-D 750 m rated LANDER; TR-12-1R4-492 WHITTARD CANYON	350	M36-600 (sync); K000073	-173.7	192	Continuous	2025-06-01 16:09:07	3 to 4 months
RS AQUA PORPOISE 84-D 7 SERIES TITANIUM-2500 m rated PISCES 2; TR-12-1R4-504 WHITTARD CANYON	1078	M36-600; J004849	-162.1	192	Continuous	2025-06-01 10:18:18	3 to 4 months
RS AQUA PORPOISE 84-D 6000 m rated WHITTARD; TR-12-1R4-232 WHITTARD CANYON	1565	M36-600; J004848	-162.6	Dual SR 96/64	Alternate days (1 min off)	2025-06-02 12:42:06	1 year
RS AQUA PORPOISE 84-D 6000 m rated PAP 3; TR-12-1R4-231 PORCUPINE ABYSSAL PLAIN	3033	M36-600; K000074	-161.6	Dual SR 96/64	Alternate days (1 min off)	2025-06-06 14:35:56	1 year
EGIM IcListen HF PORCUPINE ABYSSAL PLAIN	4844	icListen HF	-171	256	Continuous	12/06/2025 08:47:47	1 year

17.2 Whittard Canyon Area

The Celtic Margin is characterised by high-energy hydrodynamics, such as spring tides and storm surges, which influence the transport of sediment across the slope and into submarine canyons (Amaro et al., 2016). Surface sediments (0–1 cm) are fine-grained, primarily composed of 95–98% silt and clay, with <5% sand and then transitions to coarse material (sand/fine sand) (Duineveld et al., 2001). Shallow depths (<500 m) are dominated by coarser sediments (e.g. sand, mixed substrata, and gravel) overlying silty sediment (Stewart et al., 2013). Similarly, the interfluvial areas are characterised by mixed substratum comprising both lithogenic and biogenic components, such as coral rubble and shell hash. Deeper areas, such as the upper part of the canyon system on the continental shelf, are characterised by soft sediments (e.g. mud and sandy mud), indicative of higher silt/clay content (Pearman et al., 2020). Whittard Canyon is also known to support cold-water coral habitats (Huvenne et al., 2011), with mini-mounds (up to 3 m in height and a base diameter of 50–150 m) occurring in water depths between 250–410 m.

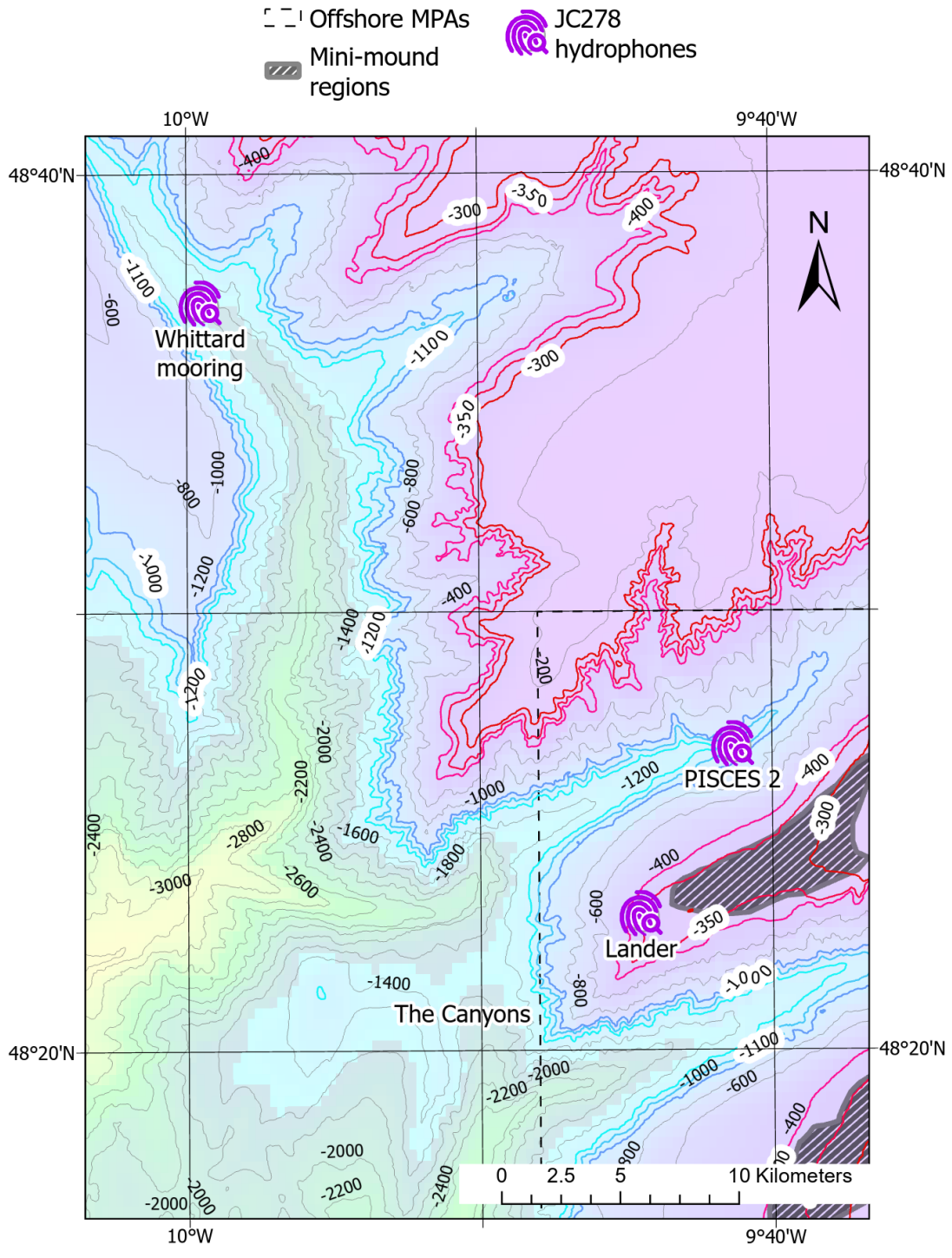


Figure 17.2 Map of hydrophone deployment locations in Whittard Canyon with selected contours highlighting the range of deployment depths.

PISCES 2 mooring (also see Sensors and Moorings section): Station JC278-005

The PISCES 2 mooring was situated in the Explorer Canyon, and included one hydrophone connected to one acoustic recorder (RS Aqua PORPOISE-84D). The recorder was secured in a bespoke stainless-steel frame and mounted vertically in line with the other instruments on the mooring at a depth of 1078 m. Figure 17.3 shows a preliminary schematic of the mooring (Figure 17.3 a) as well as a picture of the recorder unit in its mounting frame prior to deployment (Figure 17.3 b). The choice of positioning on the mooring was dependent on logistical considerations of the size and weight of the unit, as well as the other jointly mounted instruments (e.g. ADCPs). This location is expected to enable capture of sediment flow in the canyon along with general characterisation of the underwater ambient noise environment over the deployment period.

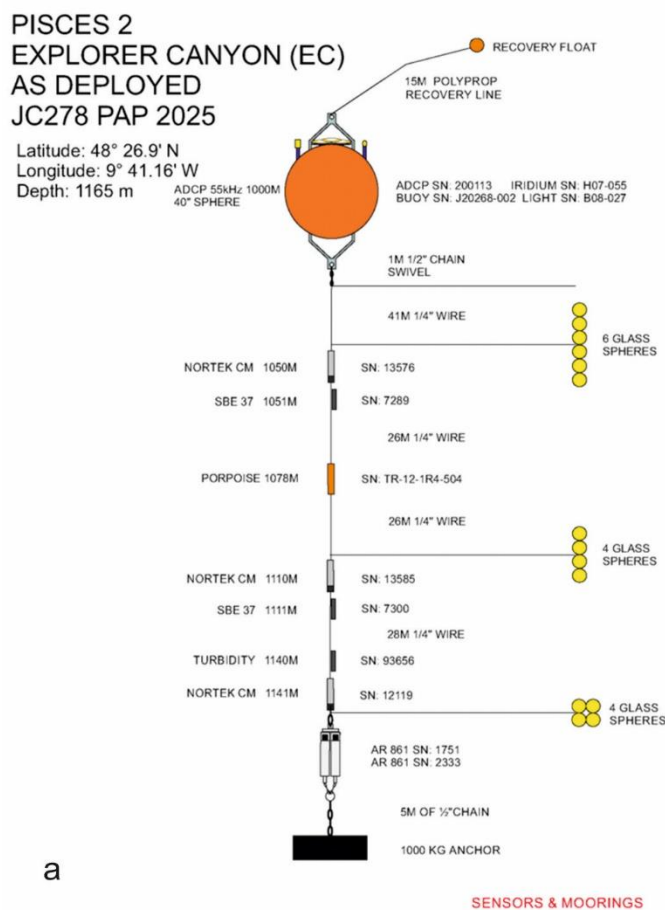


Figure 17.3 PISCES 2 mooring (a) initial schematic of planned mooring—not to scale and (b) picture of recorder mounted in frame (contracted by RS Aqua from MC Engineering) prior to deployment.

Whittard Lander: JC278-007

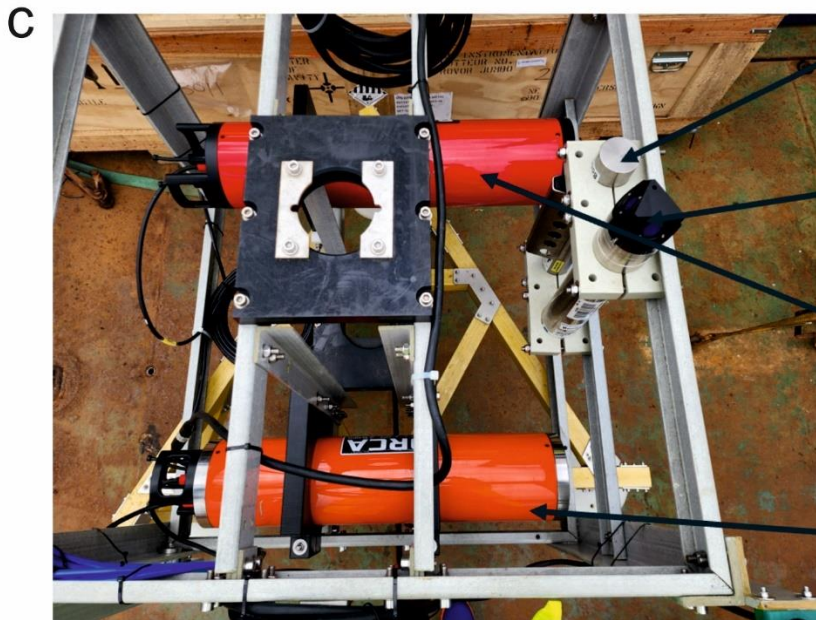
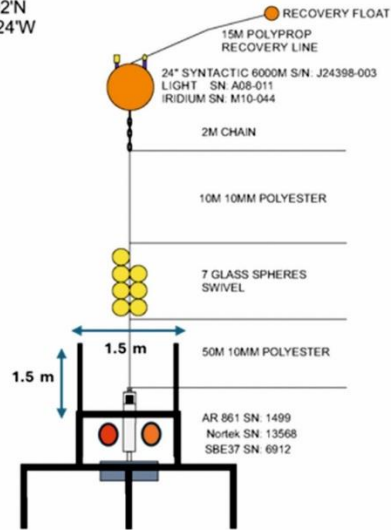
The lander was sited on the Explorer Interfluve and hosted four hydrophones connected to two acoustic recorders (RS Aqua PORPOISE- And RS Aqua ORCA). Two hydrophones (recording to channels 2 and 4 on the ORCA) were mounted diagonally at an approximately 1.5 m vertical offset from the two hydrophones (recording to channels 1 and 3 on the ORCA) that were mounted diagonally at the corners of the main frame. The channel 1 hydrophone mounted on the main frame was connected to both the PORPOISE and the ORCA recorders (see Figure 17.4 a and b) to enable synchronisation across instruments since the ORCA was configured for a 30 min on/30 min off duty cycle. Its configuration was designed to enable exploration of localisation of signals.

This relatively shallow and flat (<4° slope) location for the lander was chosen to enable measurement of surface phenomena, such as wind and wave activity, potential marine mammal vocalisations, and parallel observations of sediment flow with the hydrophone mounted on the PISCES 2 mooring at a depth of 1078 m. Additionally, its placement near the coral mini-mound region may allow capture of features of the ambient environment that may impact coral ecosystems. Deployment on the seafloor within the canyons thalwegs was considered to be too high-risk considering the shape of the lander and the powerful turbidity currents in this area.

In addition to the hydrophones and their accompanying recorders, the lander was outfitted with a current meter (Nortek) and a CTD (SBE 37-SM MicroCat, Sea-Bird Scientific), as shown in Figure 17.4 c. Further deployment details (such as method of deployment) are available in the Sensors and Moorings section of this cruise report.

a HYDROPHONE
LANDER
AS DEPLOYED
JC278 PAP 2025

Latitude: 48° 23.02'N
Longitude: 9° 44.24'W
Depth: 350m



CTD

CURRENT
METER

PORPOISE

ORCA

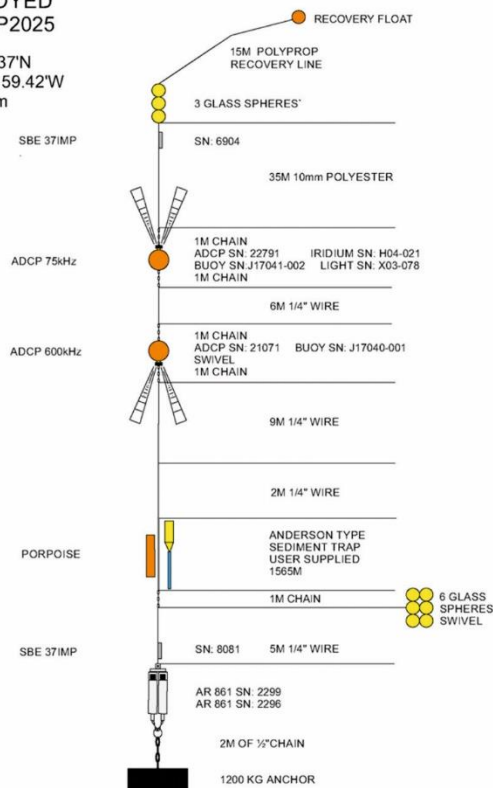
Figure 17.4 Whittard lander (a) schematic of the planned lander, (b) channel mapping, and (c) layout of instruments on the acoustic lander. The vertically mounted hydrophones were approximately 1.5 m above the hydrophones on the main frame (diagonal distance ~1.5 m).

Whittard Canyon Mooring: Station JC278-011

The main Whittard Canyon mooring is located in the Eastern Branch of Whittard Canyon, and included one hydrophone connected to a PORPOISE recorder. The recorder was securely clamped to a bar mounted alongside an Anderson-type sediment trap and this assembly was mounted vertically in line at a depth of 1565 m with the other instruments on the mooring. This mounting system was selected as both a matter of practicality and to provide an opportunity to test a range of mounting options (i.e., bars and clamps vs. frame). Figure 17.5 shows a preliminary schematic of the mooring (Figure 17.5a) as well as a picture of the recorder unit prior to deployment (Figure 17.5 b). The ultimate placement of the unit on this mooring was chosen to both avoid the 75 kHz ADCP (as this will cause noise within the frequency band of interest) and balance logistical deployment constraints. This location is well-placed to potentially capture sediment flow measurements along with overall ambient noise observations. Its year-long deployment should allow for a seasonal characterisation of the soundscape and comparison with the measurements from the hydrophone deployed at the Porcupine Abyssal Plain.

WHITTARD CANYON AS DEPLOYED JC278 PAP2025

Latitude: 48° 37'N
Longitude: 9° 59.42'W
Depth: 1585m



a

SENSORS & MOORINGS



Sediment
Trap

Distance from top of
trap – 59 cm

PORPOISE

b

Figure 17.5: Whittard Canyon Mooring (a) initial schematic of planned deployment (please see Sensors and Moorings section for as-deployed schematic) and (b) picture of the mounted recorder. The distance from the top of the sediment trap to the top of the hydrophone (when mounted) was approximately 59 cm. The funnel of the sediment trap is 95 cm long and 31 cm in diameter at the top tapering to 9 cm at the bottom. The collection tube is 9 cm in diameter and 116 cm long.

17.3 Porcupine Abyssal Plain

The PAP-SO was originally chosen as a study site for sustained oceanography monitoring because of the absence of major topographic features, and its substantial distance from the potential influences of both the continental margin and the Mid-Atlantic Ridge (Billett et al., 1983, Billett and Rice, 2001). The area has an extensive layer of fine, muddy sediment, which is typical of pelagic carbonate ooze derived from the remains of plankton falling through the water column. The sediment grain-size distribution in the upper 5 cm is bimodal (Durdan et al., 2015), with a median grain size of approximately 8 μm and a secondary coarse silt peak near 23 μm ; the dominant sediment types are fine silt and clay.

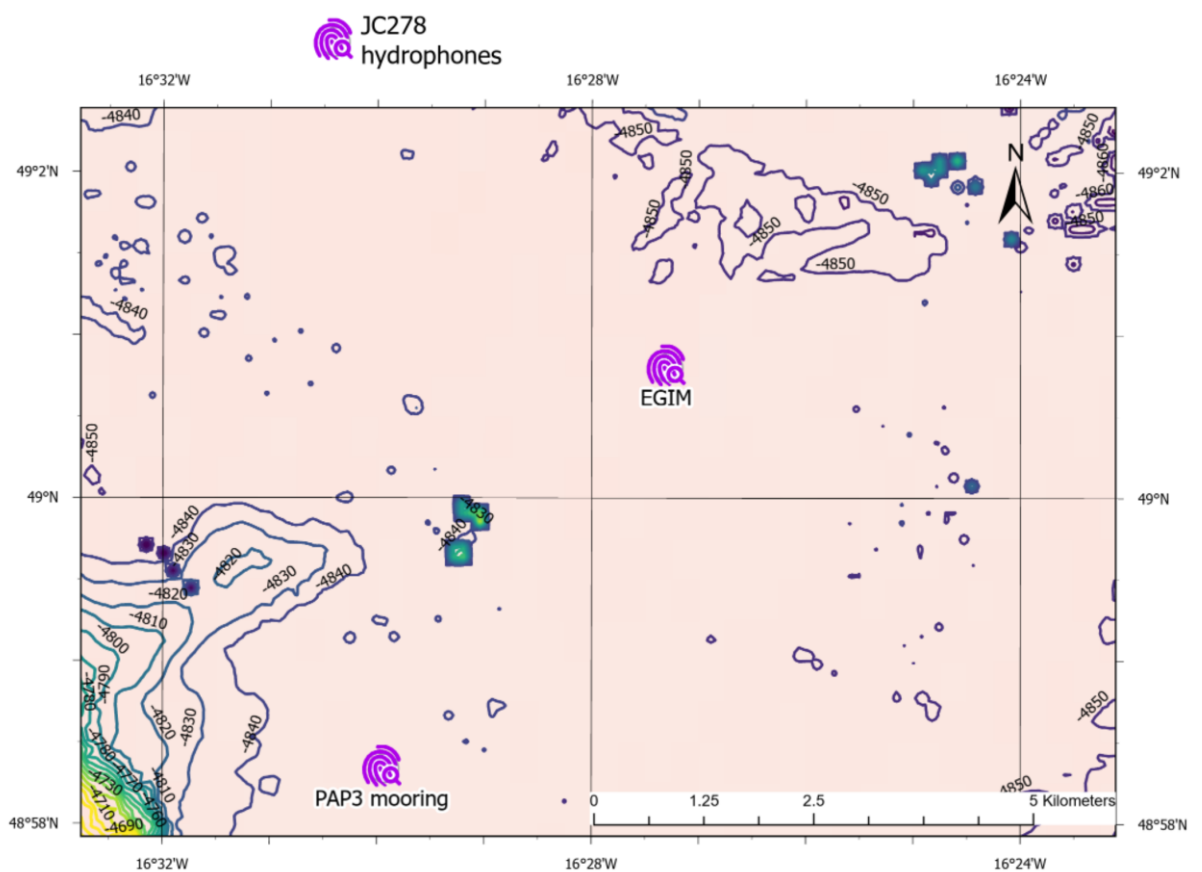


Figure 17.6: Map of autonomous hydrophone deployment locations.

PAP-3 mooring: Station JC278-020

The PAP3 mooring (Section 13) is located in the Porcupine Abyssal Plain, and included one hydrophone connected to a PORPOISE-84D recorder, mounted in a bespoke stainless steel frame at a depth of 3033 m. The in-line placement of the hydrophone on the PAP 3 mooring allows for a unique opportunity to add to multidecadal observations of other ocean variables at the site over a year, enabling measurement of seasonal changes in the soundscape at the PAP site. The placement of the instrument on this mooring balanced the requirements of other instruments on the mooring,

deployment logistics, and achieving as shallow a depth as possible to attempt to capture marine mammal vocalisations.

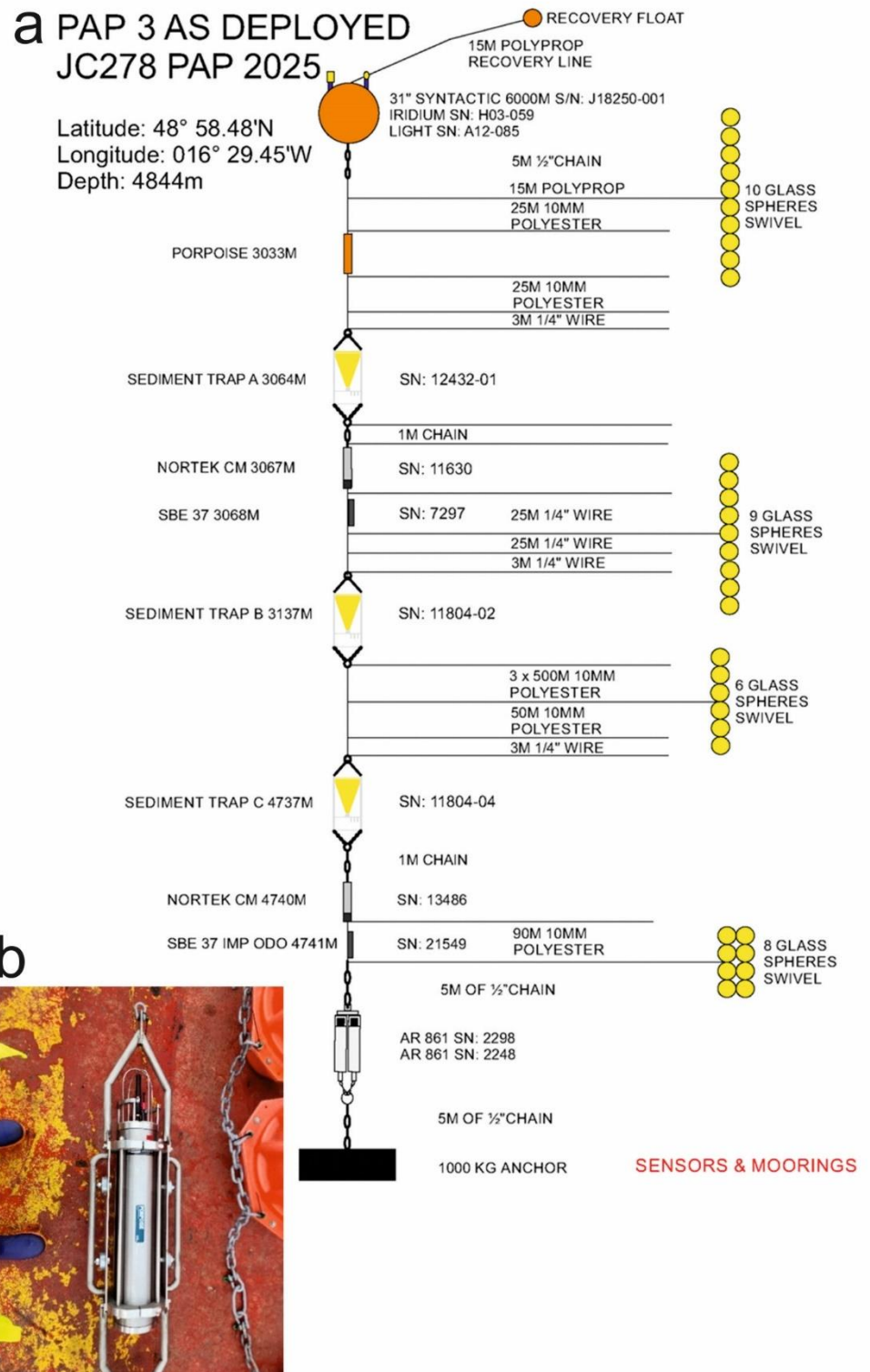


Figure 17.7: PAP 3 mooring (a) initial schematic of planned deployment (please see Sensors and Moorings section for as-deployed schematic) and (b) image of the recorder in its frame prior to deployment.

EGIM lander: Station JC278-031

One icListen HF smart hydrophone was attached and powered by the EGIM, which was bottom-mounted at a depth of 4851 m. The instrument was set to record continuously beginning on 21/06/2025. The quantity of data collected from this unit on this deployment is limited by its internal storage capacity (128 GB). This is equivalent to 72 hours of measurements, which will overlap with measurements from the PORPOISE mounted on the PAP 3 mooring.



icListen HF

Figure 17.8: icListen HF hydrophone on EGIM lander.

Acoustic Events

During JC263 in 2024, five one-hour test deployments of passive acoustic monitoring equipment were carried out in preparation for the JC278 deployment. At that time, opportunistic observations included ship-related noise and vocalisations attributed to pilot whales. During JC278, sightings of numerous marine mammals, such as pilot whales, minke whales, and baleen whales, were reported both during transit and while onsite at both locations. Where possible, these are shown on the map in Figure 3.3 and have been recorded in Table 3.1. In instances where sighting reports were close in time, they were recorded as separate observations, although it is acknowledged that these reports may refer to the same animal.

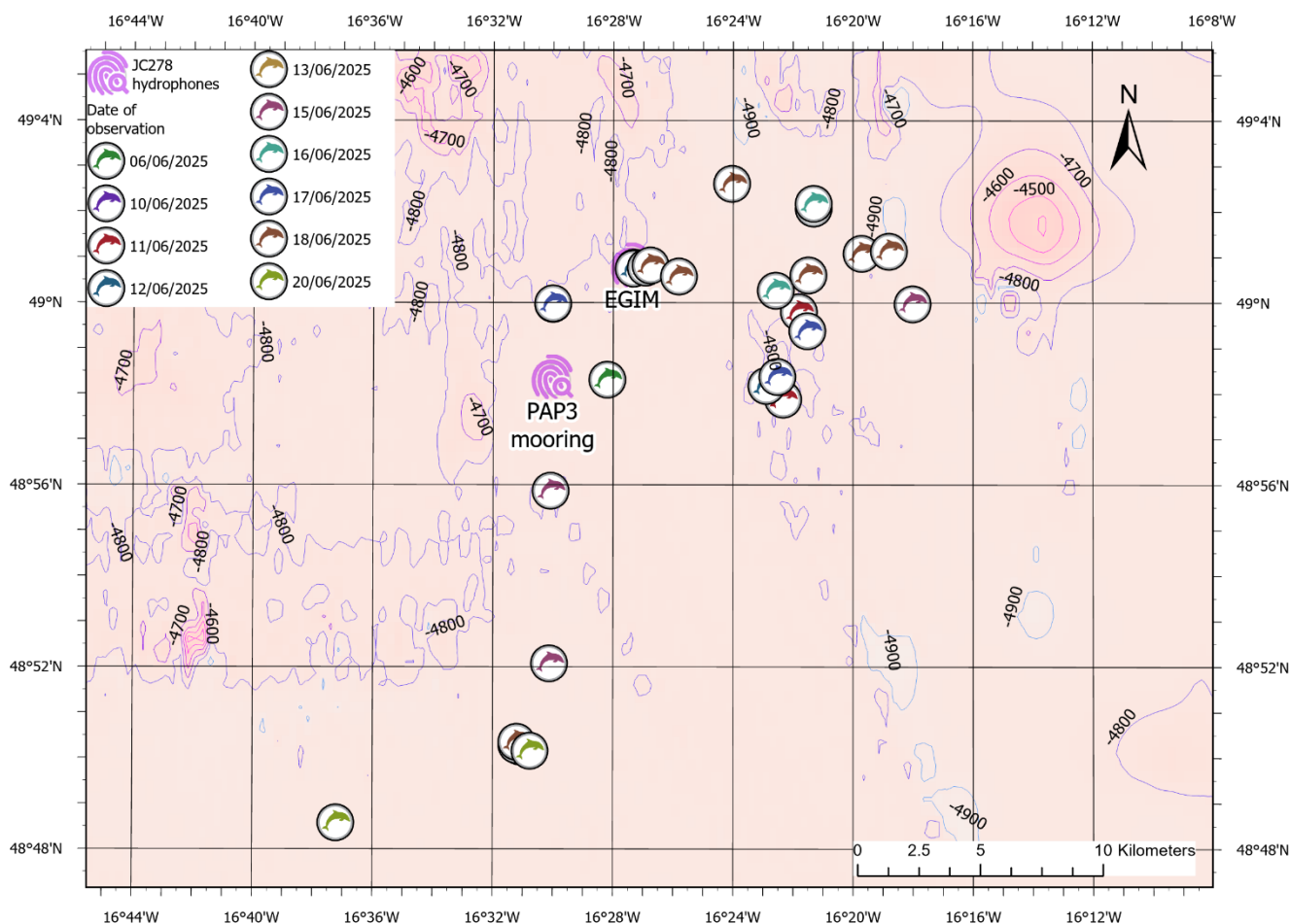


Figure 17.9: Map of acoustic observation events at PAP-SO. These events occurred from 06/06/2025 to 20/06/2025

Table 17.3: Reported acoustic events from 06/06/2025 to 20/06/2025 at PAP-SO (continued overleaf)

Date	Time (UTC)	Latitude	Longitude	Heading (Ship)	Heading (Animal)	Observer	Notes
06/06/2025	12:00	48.972215	-16.469685			A. Gates	Photo credit: Andrew Gates
10/06/2025	20:28	49.0517	-14.893	262	210	Bridge Crew	Long, black, small dorsal, no tail in dive, blow, blow, breach, maybe minke; starboard 90
11/06/2025	07:50	48.997	-16.363	STOPPED	270	Bridge Crew	Big, long, black, small fin
11/06/2025	11:00	48.965	-16.372	192	210	Bridge Crew	Photo credit: Andrew Gates; starboard 90
12/06/2025	05:50	48.970007	-16.381166			S. Clayton	Right next to PAP-1 buoy
12/06/2025	15:50	49.013345	-16.454777			P. Slavik	Fin whale (single)
12/06/2025	11:20	49.013	-16.455	275	95	Bridge Crew	Whale (too far for ID); portside 60.
13/06/2025	16:00	48.839641	-16.519766			S. Clayton	Minke whale; Photo credit: Andrew Gates
13/06/2025	16:14	48.839641	-16.519766			P. Slavik	Minke whale
13/06/2025	18:30	48.838	-16.518	STOPPED 270	NORTH	Bridge Crew	Whale, big black with small fin; Photo credit: Andrew Gates; starboard side
13/06/2025	18:49	48.838569	-16.519765			P. Slavik; J. Reading	Minke whale; Photo credit: Jethro Reading
15/06/2025	10:00	48.931533	-16.501104			S. Hartman	Close to CTD8 location
15/06/2025	05:10	49	-16.3	STOPPED 250	EAST	Bridge Crew	Big, small fin
15/06/2025	07:30	48.999992	-16.499993			D. Ghosh	Close to CTD13 location
15/06/2025	07:50	49	-16.3	STOPPED 250	EAST	Bridge Crew	2 whales, spouts spotted
15/06/2025	08:31	48.868333	-16.501667	SOUTH	EAST	Bridge Crew	1 whale, 200 m away; starboard side
16/06/2025	08:00	49.035	-16.355	STOPPED	various	Bridge Crew	Multiple whales & dolphins all around from 08:00 to 12:00
16/06/2025	10:10	49.004966	-16.376027			S. Hartman	Whale blows at PAP-3 station starboard
16/06/2025	11:30	49.036778	-16.354905			V. Hastings Rafferty	2 minke whales and 6 pilot whales portside
16/06/2025	12:25	49.0366667	-16.355	STOPPED 202	310	Bridge Crew	2 whales, dark fins pilot whales; Photos (Socrates Loucaides)
17/06/2025	04:45	49	-16.5	STOPPED 240	NE	Bridge Crew	Whale (starboard)

Date	Time (UTC)	Latitude	Longitude	Heading (Ship)	Heading (Animal)	Observer	Notes
17/06/2025	04:50	49.000071	-16.499984			J. Garner	2 large whales (starboard) near CTD
17/06/2025	11:53	48.9733333	-16.375	TURNING SHIP 210	175	Bridge Crew	1 large fin (portside)
17/06/2025	16:14	48.99	-16.3583333	STOPPED 210	WEST	Bridge Crew	2 whales
18/06/2025	06:00	49.0133333	-16.4483333	STOPPED 250	NE	Bridge Crew	2 or 3 whales; starboard side
18/06/2025	07:15	49.014069	-16.445859			M. Yeomans	Whale
18/06/2025	10:00	49.01	-16.43	STOPPED 233	NE	Bridge Crew	1 whale (bow)
18/06/2025	10:00	48.839641	-16.519766			A. Gates & A. Schaap	At station 46; a few pilot whales behind the ship and 2 larger (Baleen) whales
18/06/2025	11:45	49.010499	-16.357975			S. Hartman	Whale blow (starboard)
18/06/2025	17:45	49.0439167	-16.4002667			D. Farrell	Cargo vessel NINGBO Express in transit ; approx. 49.174, -16.2
18/06/2025	19:00 to 20:00	49.0183333	-16.3283333	STOPPED 195		Bridge Crew	Multiple spouts in area
18/06/2025	19:30	49.019267	-16.312972			J. Durden	Whale
20/06/2025	09:00	48.836299	-16.512591			V. Hastings Rafferty, S. Loucaides, S. Clayton	Whale
20/06/2025	11:13	48.81	-16.62	259	80	Bridge Crew	2 whales
20/06/2025	16:05	48.762263	-17.013911			V. Hastings Rafferty	Whale, large, long; dark, small fin (starboard side)

ACKNOWLEDGEMENTS

Although observations have typically been credited to those who first notified the co-PI onboard, events were often noted by several persons. The PIs extend their gratitude to all who participated in marine mammal observations and sincerely appreciate the enthusiasm and generosity demonstrated by all observers.

The PIs are grateful for financial support from the AtlantiS project and the National Oceanography Centre (Southampton), which made this project and cruise participation possible.

REFERENCES

- Duineveld, G., Lavaleye, M., Berghuis, E., & De Wilde, P. (2001). Activity and composition of the benthic fauna in the Whittard Canyon and the adjacent continental slope (NE Atlantic). *Oceanologica acta*, 24(1), 69–83.
- Durden, J.M., et al. (2015). Abyssal hills – hidden source of increased habitat heterogeneity, benthic megafaunal biomass and diversity in the deep sea. *Progress in Oceanography*, 137, 209–218. <https://doi.org/10.1016/j.pocean.2015.06.006>
- Amaro, T., Huvenne, V. A. I., Allcock, A. L., Aslam, T., Davies, J. S., Danovaro, R., ... & Wilson, A. M. (2016). The Whittard Canyon—A case study of submarine canyon processes. *Progress in Oceanography*, 146, 38–57.
- Huvenne, V.A.I., Tyler, P.A., Masson, D.G., Fisher, E.H., Hauton, C., Hühnerbach, V., Le Bas, T.P., Wolff, G.A., 2011. A picture on the wall: innovative mapping reveals cold-water coral refuge in submarine canyon. *PLoS ONE*. 6, e28755.
- Pearman, T. R. R., Robert, K., Callaway, A., Hall, R., Iacono, C. L., & Huvenne, V. A. (2020). Improving the predictive capability of benthic species distribution models by incorporating oceanographic data—Towards holistic ecological modelling of a submarine canyon. *Progress in Oceanography*, 184, 102338.
- Stewart, H. A., Davies, J. S., Guinan, J., & Howell, K. L. (2014). The Dangeard and Explorer canyons, South Western Approaches UK: Geology, sedimentology and newly discovered cold-water coral mini-mounds. *Deep Sea Research Part II: Topical Studies in Oceanography*, 104, 230–244.

Passive acoustics - APPENDIX

Field Calibrations

An M351 field calibrator (GTI Inc.) was used to perform a pre-deployment field calibration of the hydrophones while onboard the ship in motion. **These calibration results are included for completeness only and should not be used in analyses.** The field calibration was performed in automatic mode:

1. The mode switch was set to “Auto”
2. A gain setting of 20 dB was selected
3. The V/C switch was set to V (volts)
4. The Start button was then pressed to begin the calibration
5. When prompted to save to the EEPROM when calibration was completed, a numerical ID for each hydrophone was entered using the frequency/gain dial, and the Start button was pressed to save the measurements to the internal memory of the calibrator.
6. Then the calibrator was then set to administration mode by holding down the Start button while pushing the power switch to the “On” position. The provided USB-A to USB-B cable was used to connect the calibrator to a computer where the GTI Connection software provided by the manufacturer was installed. After clicking “Connect” the measurements were obtained from the screen (shown in the screenshot below).

The screenshot shows the 'GTI HFC Connection v1.5' software window. It features a 'Connect' button and an 'Update Firmware...' button. Below these is a table displaying calibration data for various hydrophones. The table has 15 columns representing different parameters for each hydrophone, such as ID, gain, and frequency. The data is organized into groups, with the first 10 hydrophones having a gain of 35 and the last 5 having a gain of 20.

Hydrophone ID	Gain (dB)	Frequency (Hz)	Gain (dB)	Frequency (Hz)	Gain (dB)	Frequency (Hz)	Gain (dB)	Frequency (Hz)	Gain (dB)	Frequency (Hz)	Gain (dB)	Frequency (Hz)	Gain (dB)	Frequency (Hz)	Gain (dB)	Frequency (Hz)
25 1	27	17	13	V	30	33333	25	1	-200.66	-200.32	-200.29	-200.28	-200.08	-200.33	-200.26	
25 1	27	17	14	V	30	33333	25	1	-200.68	-200.33	-200.29	-200.28	-200.07	-200.33	-200.26	
25 1	27	17	14	V	30	33333	25	1	-200.70	-200.33	-200.29	-200.27	-200.06	-200.33	-200.26	
25 1	27	17	15	V	35	44444	25	1	-200.57	-200.34	-200.29	-200.27	-201.71	-200.64	-200.65	
25 1	27	17	16	V	35	44444	25	1	-200.55	-200.35	-200.29	-200.28	-201.71	-200.64	-200.65	
25 1	27	17	17	V	35	44444	25	1	-200.54	-200.32	-200.30	-200.29	-201.72	-200.63	-200.65	
25 1	27	17	18	V	35	44444	25	1	-200.58	-200.28	-200.29	-200.29	-201.71	-200.63	-200.64	
25 1	27	17	19	V	35	44444	25	1	-200.59	-200.35	-200.30	-200.27	-201.73	-200.65	-200.66	
25 1	27	17	20	V	35	44444	25	1	-200.58	-200.36	-200.30	-200.28	-201.72	-200.65	-200.66	
25 1	27	17	20	V	35	44444	25	1	-200.58	-200.30	-200.30	-200.28	-201.74	-200.64	-200.65	
25 1	27	17	21	V	35	44444	25	1	-200.56	-200.38	-200.31	-200.29	-201.71	-200.65	-200.67	
25 1	27	17	22	V	35	44444	25	1	-200.57	-200.39	-200.30	-200.29	-201.71	-200.65	-200.67	
25 1	27	17	23	V	35	44444	25	1	-200.57	-200.33	-200.31	-200.29	-201.72	-200.64	-200.66	
25 1	27	17	24	V	35	44444	25	1	-200.57	-200.31	-200.31	-200.30	-201.72	-200.64	-200.66	
25 1	27	17	25	V	35	44444	25	1	-200.58	-200.33	-200.31	-200.28	-201.71	-200.64	-200.65	
25 1	27	17	25	V	35	44444	25	1	-200.57	-200.33	-200.30	-200.30	-201.72	-200.64	-200.66	
25 1	27	17	26	V	35	44444	25	1	-200.56	-200.30	-200.30	-200.28	-201.71	-200.63	-200.64	
25 1	27	17	27	V	35	44444	25	1	-200.58	-200.28	-200.30	-200.29	-201.70	-200.63	-200.64	
25 1	27	17	28	V	35	44444	25	1	-200.56	-200.31	-200.31	-200.28	-201.73	-200.64	-200.65	
25 1	27	17	29	V	35	44444	25	1	-200.58	-200.33	-200.31	-200.29	-201.73	-200.65	-200.66	
25 1	27	17	30	V	35	44444	25	1	-200.57	-200.35	-200.32	-200.29	-201.70	-200.65	-200.66	
25 1	27	17	31	V	35	44444	25	1	-200.57	-200.37	-200.30	-200.31	-201.72	-200.65	-200.67	
25 1	27	17	31	V	35	44444	25	1	-200.56	-200.31	-200.33	-200.30	-201.71	-200.64	-200.66	
25 5	31	19	4	V	20	73	25	5	-182.05	-182.33	-183.23	-183.31	-180.16	-182.22	-182.25	
25 5	31	19	12	V	20	153	25	5	-176.55	-176.40	-177.85	-177.89	-178.62	-177.46	-177.54	
25 5	31	19	17	V	20	1534	25	5	-176.61	-176.40	-177.84	-177.88	-178.63	-177.47	-177.64	
25 5	31	19	23	V	20	716	25	5	-176.53	-176.43	-177.87	-177.91	-178.64	-177.48	-177.67	
25 5	31	19	27	V	20	714	25	5	-176.38	-176.40	-177.88	-177.93	-178.61	-177.44	-177.65	
25 5	31	19	53	V	35	714	25	5	-172.29	-168.07	-167.47	-167.42	-167.03	-168.46	-167.69	
25 5	31	19	56	V	35	1534	25	5	-172.57	-168.31	-167.64	-167.57	-167.03	-168.62	-167.83	
25 5	31	19	59	V	35	716	25	5	-172.30	-168.11	-167.55	-167.44	-167.03	-168.49	-167.72	
25 5	31	20	26	V	20	4849	25	5	-183.71	-183.84	-184.75	-184.87	-180.99	-183.63	-183.62	
25 6	2	6	43	V	20	74	25	6	-181.79	-182.40	-183.27	-183.24	-180.05	-182.15	-182.22	
25 6	2	7	49	V	20	4848	25	6	-183.60	-183.88	-184.78	-184.81	-181.00	-183.61	-183.62	

Instruments

The study utilised two broadband underwater acoustic recorders manufactured by Turbulent Research and purchased through RS Aqua: the TR-Porpoise 84-D and the TR-ORCA 72-D. Both instruments support autonomous and real-time operation, but differ in complexity, channel capacity, storage, and power demands.

The TR-Porpoise 84-D is a single-channel acoustic recorder powered by 84 D-cell or lithium batteries. It records to internal SD cards (expandable up to 8 TB) and is configured using the accompanying TRAC software provided by Turbulent Research. Deployment configurations range from fully autonomous archival recordings to real-time Ethernet-linked monitoring. Sampling rates are user-selectable up to 150 kHz effective bandwidth, with optional high-pass filtering to exclude low-frequency noise.

The TR-ORCA 72-D supports up to five synchronous hydrophone channels. It includes a standard 500 GB solid-state drive (expandable to 4 TB) in addition to dual SD card slots. This allows for multi-channel, high-sampling-rate recording (24–384 kHz). Power is provided by 72 internal D-cell or lithium batteries or external sources, and the system supports advanced scheduling, real-time streaming, and in-situ noise analysis.

Battery life is strongly dependent on sampling and number of channels (see power/memory tables). For example:

- At **24 kHz, 1 channel**, ORCA on alkaline D-cells can run ~52 days; on lithium ~155 days.
- At **96 kHz, 5 channels**, duration drops to ~40 days (alkaline) or ~121 days (lithium).
- At the highest rates (192–384 kHz, multi-channel), use of SSD and duty cycling is mandatory; otherwise, memory or power limits are quickly exceeded.

ORCA Memory Consumption Table

Storing to Internal SD Cards Continuously								
Sampling Rate	Enabled Channels	Gbytes per day consumed	Days of Autonomous Continuous Operation - Internal Pack	Days of Autonomous Continuous Operation - 72 D Cell Alkaline	Days of Autonomous Continuous Operation - 72 D Lithium Primary	Max Memory Required GB (Internal battery)	Max Memory Required GB (72 D alkaline battery)	Max Memory Required GB (72 D Lithium Primary battery)
24000	1	4.1472	3.6	51.6	154.8	14.9	214	642
24000	2	8.2944	3.4	49.5	148.4	28.2	410.6	SSD Required or Duty Cycling Required
24000	3	12.4416	3.3	47.5	142.4	41.1	591	SSD Required or Duty Cycling Required
24000	4	16.5888	3.2	45.6	136.9	53.1	756.4	SSD Required or Duty Cycling Required
24000	5	20.736	3.1	44	131.9	64.3	912.4	SSD Required or Duty Cycling Required
48000	1	8.2944	3.6	51.3	153.8	29.9	SSD Required or Duty Cycling Required	SSD Required or Duty Cycling Required
48000	2	16.5888	3.3	48.2	144.6	54.7	SSD Required or Duty Cycling Required	SSD Required or Duty Cycling Required
48000	3	24.8832	3.2	45.5	136.4	79.6	SSD Required or Duty Cycling Required	SSD Required or Duty Cycling Required
48000	4	33.1776	3	43	129	99.5	SSD Required or Duty Cycling Required	SSD Required or Duty Cycling Required
48000	5	41.472	2.8	40.8	122.4	116.1	SSD Required or Duty Cycling Required	SSD Required or Duty Cycling Required
96000	1	16.5888	3.6	51.3	153.8	59.7	SSD Required or Duty Cycling Required	SSD Required or Duty Cycling Required
96000	2	33.1776	3.3	48	144.1	109.5	SSD Required or Duty Cycling Required	SSD Required or Duty Cycling Required
96000	3	49.7664	3.1	45.2	135.6	154.3	SSD Required or Duty Cycling Required	SSD Required or Duty Cycling Required
96000	4	66.3552	3	42.7	128	199.1	SSD Required or Duty Cycling Required	SSD Required or Duty Cycling Required
96000	5	82.944	2.8	40.4	121.2	232.2	SSD Required or Duty Cycling Required	SSD Required or Duty Cycling Required
192000	1	33.1776	3.4	48.8	146.3	112.8	SSD Required or Duty Cycling Required	SSD Required or Duty Cycling Required
192000	2	66.3552	3.1	44.4	133.3	205.7	SSD Required or Duty Cycling Required	SSD Required or Duty Cycling Required
192000	3	99.5328	SSD Required	SSD Required	SSD Required	SSD Required	SSD Required	SSD Required
192000	4	132.7104	SSD Required	SSD Required	SSD Required	SSD Required	SSD Required	SSD Required
192000	5	165.888	SSD Required	SSD Required	SSD Required	SSD Required	SSD Required	SSD Required
384000	1	66.3552	3.1	44.4	133.3	205.7	SSD Required or Duty Cycling Required	SSD Required or Duty Cycling Required
384000	2	132.7104	SSD Required	SSD Required	SSD Required	SSD Required	SSD Required	SSD Required
384000	3	199.0656	SSD Required	SSD Required	SSD Required	SSD Required	SSD Required	SSD Required
384000	4	265.4208	SSD Required	SSD Required	SSD Required	SSD Required	SSD Required	SSD Required
384000	5	331.776	SSD Required	SSD Required	SSD Required	SSD Required	SSD Required	SSD Required
Storing to Internal SSD Continuously								
Sampling Rate	Enabled Channels	Gbytes per day consumed	Days of Autonomous Continuous Operation - Internal Pack	Days of Autonomous Continuous Operation - 72 D Cell Alkaline	Days of Autonomous Continuous Operation - 72 D Lithium Primary	Max Memory Required GB (Internal battery)	Max Memory Required GB (72 D alkaline battery)	Max Memory Required GB (72 D Lithium Primary battery)
24000	1	4.1472	1.9	26.7	80	7.9	110.7	331.8
24000	2	8.2944	1.7	24.7	74	14.1	204.9	613.8
24000	3	12.4416	1.6	22.9	68.8	19.9	284.9	856
24000	4	16.5888	1.5	21.4	64.3	24.9	355	1066.7
24000	5	20.736	1.5	21.1	63.2	31.1	437.5	1310.5
48000	1	8.2944	1.9	26.7	80	15.8	221.5	663.6
48000	2	16.5888	1.7	24.7	74	28.2	409.7	1227.6
48000	3	24.8832	1.6	22.9	68.8	39.8	569.8	1712
48000	4	33.1776	1.5	21.4	64.3	49.8	710	2133.3
48000	5	41.472	1.5	21.1	63.2	62.2	875.1	2621
96000	1	16.5888	1.5	21.1	63.2	24.9	350	1048.4
96000	2	33.1776	1.4	20.8	62.4	46.4	690.1	2070.3
96000	3	49.7664	1.4	20.6	61.7	69.7	1025.2	3070.6
96000	4	66.3552	1.4	20.3	61	92.9	1347	4047.7
96000	5	82.944	1.4	20.1	60.3	116.1	1667.2	5001.5
192000	1	33.1776	1.5	21.1	63.2	48.8	700	2096.8
192000	2	66.3552	1.4	20.6	61.9	92.9	1366.9	4107.4
192000	3	99.5328	1.4	20.3	40.2	139.3	2020.5	Memory Limited Duty Cycling Required
192000	4	132.7104	1.4	19.9	30.1	185.8	2640.9	Memory Limited Duty Cycling Required
192000	5	165.888	1.4	19.5	24.1	232.2	3234.8	Memory Limited Duty Cycling Required
384000	1	66.3552	1.5	21.1	60.3	99.5	1400.1	Memory Limited Duty Cycling Required
384000	2	132.7104	1.4	20.5	30.1	185.8	2720.6	Memory Limited Duty Cycling Required
384000	3	199.0656	1.4	19.9	20.1	278.7	3961.4	Memory Limited Duty Cycling Required
384000	4	265.4208	1.3	15.1	15.1	345	Memory Limited Duty Cycling Required	Memory Limited Duty Cycling Required
384000	5	331.776	1.3	12.1	12.1	431.3	Memory Limited Duty Cycling Required	Memory Limited Duty Cycling Required

Porpoise Memory Consumption Tables

CONTINUOUS RECORDING													
Sample Rate (kpsps)	Memory Usage (GB - per hr)	Memory Usage (GB - per day)	Average Power Consumption (mW/Hr)	Average Power Consumption (W/Day)	Porpoise-500m: Days Recording on internal AAAs (Observed with batteries)	Porpoise-36D:		Porpoise-36D:		Porpoise-84D:		Porpoise-84D:	
						Days Recording on internal D-Cells (Estimated)	Estimated Memory Usage (GB)	Days Recording on internal D-Cells (Estimated)	Estimated Memory Usage (GB)	Days Recording on internal D-Cells (Estimated)	Estimated Memory Usage (GB)	Days Recording on internal D-Cells (Estimated)	Estimated Memory Usage (GB)
2	0.02	0.52	294.4	7.1	3.7	101.2	53	282.8	147	236.1	123	659.8	343
6	0.07	1.56	294.5	7.1	3.7	101.2	158	282.7	441	236.0	368	659.6	1029
8	0.09	2.07	294.6	7.1	3.7	101.1	209	282.6	585	235.9	488	659.4	1365
16	0.19	4.45	297.6	7.1	3.7	100.1	445	279.7	1245	233.6	1039	652.7	2905
24	0.26	6.22	310.9	7.5	3.5	95.8	596	267.8	1666	223.6	1391	624.8	3886
32	0.35	8.29	305	7.3	3.6	97.7	810	273.0	2263	227.9	1889	636.9	5280
48	0.52	12.44	324.8	7.8	3.3	91.7	1141	256.3	3189	214.0	2662	598.1	7440
64	0.69	16.59	325.7	7.8	3.3	91.5	1517	255.6	4240	213.4	3541	596.4	9894
96	1.04	24.88	346.6	8.3	3.1	85.9	2138	240.2	5976	200.5	4990	560.4	13944
128	1.38	33.18	344.8	8.3	3.2	86.4	2867	241.4	8011	201.6	6689	563.4	18693
192	2.07	49.77	395.6	9.5	2.7	75.3	3748	210.4	10474	175.7	8745	491.0	24438
256	2.77	66.36	448.6	10.8	2.4	66.4	4407	185.6	12315	154.9	10282	433.0	28735
384	4.15	99.53	477.6	11.5	2.3	62.4	6208	174.3	17349	145.5	14486	406.7	40481
			Ultimate Lithium			Procell D Cell		Saft - Lithium Primary		Procell D Cell		Saft - Lithium Primary	

DUTY CYCLING - 12 Hours On & 12 Hours Off													
Sample Rate (kpsps)	Memory Usage (GB - per hr)	Memory Usage (GB - per day)	Average Power Consumption (mW/Hr)	Average Power Consumption (W/Day)	Porpoise-500m: Days Recording on internal AAAs (Observed with batteries)	Porpoise-36D:		Porpoise-36D:		Porpoise-84D:		Porpoise-84D:	
						Days Recording on internal D-Cells (Estimated)	Estimated Memory Usage (GB)	Days Recording on internal D-Cells (Estimated)	Estimated Memory Usage (GB)	Days Recording on internal D-Cells (Estimated)	Estimated Memory Usage (GB)	Days Recording on internal D-Cells (Estimated)	Estimated Memory Usage (GB)
2	0.02	0.26	294.4	3.5	7.4	202.4	53	565.6	147	472.2	123	1319.6	343
6	0.07	0.78	294.5	3.5	7.4	202.3	158	565.4	441	472.1	368	1319.2	1029
8	0.09	1.04	294.6	3.5	7.4	202.2	209	565.2	585	471.9	488	1318.7	1365
16	0.19	2.23	297.6	3.6	7.3	200.2	445	559.5	1245	467.1	1039	1305.4	2905
24	0.26	3.11	310.9	3.7	7.0	191.6	596	535.5	1666	447.2	1391	1249.6	3886
32	0.35	4.15	305	3.7	7.1	195.3	810	545.9	2263	455.8	1889	1273.8	5280
48	0.52	6.22	324.8	3.9	6.7	183.4	1141	512.6	3189	428.0	2662	1196.1	7440
64	0.69	8.30	325.7	3.9	6.7	182.9	1517	511.2	4240	426.8	3541	1192.8	9894
96	1.04	12.44	346.6	4.2	6.3	171.9	2138	480.4	5976	401.1	4990	1120.9	13944
128	1.38	16.59	344.8	4.1	6.3	172.8	2867	482.9	8011	403.2	6689	1126.7	18693
192	2.07	24.89	395.6	4.7	5.5	150.6	3748	420.9	10474	351.4	8745	982.1	24438
256	2.77	33.18	448.6	5.4	4.8	132.8	4407	371.2	12315	309.9	10282	866.0	28735
384	4.15	49.77	477.6	5.7	4.6	124.7	6208	348.6	17349	291.1	14486	813.4	40481
			Ultimate Lithium			Procell D Cell		Saft - Lithium Primary		Procell D Cell		Saft - Lithium Primary	

DUTY CYCLING - 8 Hours On & 16 Hours Off													
Sample Rate (kpsps)	Memory Usage (GB - per hr)	Memory Usage (GB - per day)	Average Power Consumption (mW/Hr)	Average Power Consumption (W/Day)	Porpoise-500m: Days Recording on internal AAAs (Observed with batteries)	Porpoise-36D:		Porpoise-36D:		Porpoise-84D:		Porpoise-84D:	
						Days Recording on internal D-Cells (Estimated)	Estimated Memory Usage (GB)	Days Recording on internal D-Cells (Estimated)	Estimated Memory Usage (GB)	Days Recording on internal D-Cells (Estimated)	Estimated Memory Usage (GB)	Days Recording on internal D-Cells (Estimated)	Estimated Memory Usage (GB)
2	0.02	0.17	294.4	2.4	11.1	303.6	53	848.3	147	708.3	123	1979.4	343
6	0.07	0.52	294.5	2.4	11.1	303.5	158	848.0	441	708.1	368	1978.8	1029
8	0.09	0.69	294.6	2.4	11.1	303.4	209	847.8	585	707.8	488	1978.1	1365
16	0.19	1.48	297.6	2.4	11.0	300.3	445	839.2	1245	700.7	1039	1958.2	2905
24	0.26	2.07	310.9	2.5	10.5	287.5	596	803.3	1666	670.7	1391	1874.4	3886
32	0.35	2.76	305	2.4	10.7	293.0	810	818.9	2263	683.7	1889	1910.7	5280
48	0.52	4.15	324.8	2.6	10.0	275.2	1141	768.9	3189	642.0	2662	1794.2	7440
64	0.69	5.53	325.7	2.6	10.0	274.4	1517	766.8	4240	640.3	3541	1789.2	9894
96	1.04	8.29	346.6	2.8	9.4	257.8	2138	720.6	5976	601.6	4990	1681.3	13944
128	1.38	11.06	344.8	2.8	9.5	259.2	2867	724.3	8011	604.8	6689	1690.1	18693
192	2.07	16.59	395.6	3.2	8.2	225.9	3748	631.3	10474	527.1	8745	1473.1	24438
256	2.77	22.12	448.6	3.6	7.3	199.2	4407	556.7	12315	464.8	10282	1299.0	28735
384	4.15	33.18	477.6	3.8	6.8	187.1	6208	522.9	17349	436.6	14486	1220.2	40481
			Ultimate Lithium			Procell D Cell		Saft - Lithium Primary		Procell D Cell		Saft - Lithium Primary	

18 Whittard Canyon Mooring

Andrew Gates (onboard), Mike Clare & Morgan Wolfe (Ashore)

One of the objectives of JC278 was the continued maintenance of the Atlantis Whittard Canyon Mooring to make detailed field measurements of turbidity currents within the Eastern Branch of Whittard Canyon, a land-detached submarine canyon (Heijnen et al., 2022) in the Irish EEZ. The work was carried out under diplomatic clearance Note No. DC 234/25.

Recovery

The release command for the Whittard Canyon Mooring with Anderson sediment trap (JC263-007) was sent at 09:44 on 2nd June 2025 but the mooring failed to ascend. To allow as much time as possible to determine if the mooring would surface, a decision was made to deploy the replacement mooring at a new location. In discussion with the PI ashore this was located 1000m down canyon from the original site. With no sign of JC263-007 we had to continue to PAP. However, 17 hours after initial release command was sent, and during our transit to PAP, the mooring was confirmed to be on the surface. We turned to recover the mooring, requiring a further 12 hours to reach the location. On deck the releases were found to have fishing line around them which may explain the delay to the surfacing.

Time on the surface caused the mooring to tangle, during recovery the recovery line parted at a knot within the tangle of chain and spheres. The second attempt at recovery used a snap hook to the frame of the ADCP buoy. After close to 24 hours at the surface the Anderson trap was likely washed out but the trap was maintained upright and returned to the BOSCORF team should any material be salvageable.

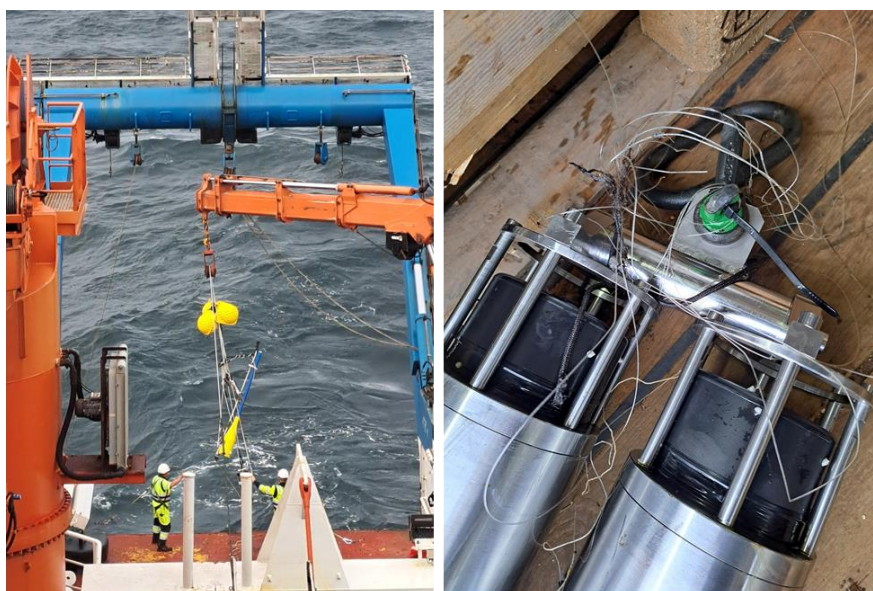


Figure 18.1: Whittard Canyon mooring recovery (JC263-007). Left, Anderson trap tangled with mooring rope and floats, right, fishing line wrapped around the paired releases.

Impressions

The 75kHz ADCP recorded only two hours for data from 21/05/24 for two hours. It is not clear what the issue was at the time of writing. However, the 600 kHz data look good on first impression. The data several turbidity currents, including a period of a couple of days in May when there were three in very swift succession. The data look good with no obvious change in pressure throughout and a coherent view down to seafloor.

Deployment (JC278-011)

As described above the replacement WCM could not be deployed at the same location as it has previously because the existing mooring had not surfaced. In discussion with the PI ashore this was located 1000m down canyon from the original site.

- Setup Distance: 500m
- Over run: 100m
- Deployment Duration: 23 minutes

The recovery line, first three glass and 35m of rope were deployed by hand. The two ADCPs were deployed simultaneously using both starboard and port cranes. Some sacrificial rope was connected to the bottom of the 6 glass spheres and run through the eye on the deck winch wire. The winch was used to take the weight of the 6 glass, Hydrophone and Anderson trap with a slip to the acoustic releases ready for the load transfer. The anchor was deployed using the starboard crane and SeaCatch.

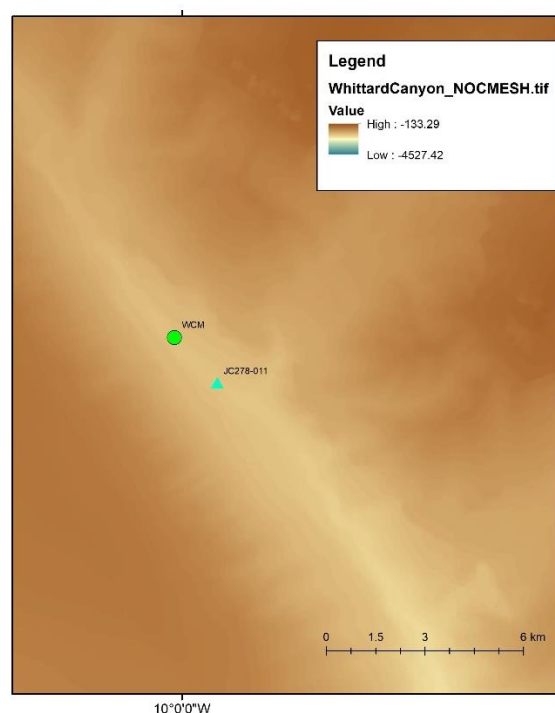


Figure 18.2: New location for the WCM in the Eastern Branch of Whittard Canyon (previous location in green)

References:

Heijnen, M. S., F. Mienis, A. R. Gates, B. J. Bett, R. A. Hall, J. Hunt, I. A. Kane, C. Pebody, V. A. I. Huvenne, E. L. Soutter and M. A. Clare (2022). "Challenging the highstand-dormant paradigm for land-detached submarine canyons." Nature Communications **13**(1): 3448.

19 Outreach and Engagement

GEORGE's high-tech adventure at the Porcupine Abyssal Plain

Dr Socratis Loucaides (Friday 20th June 2025)

The ocean absorbs nearly a quarter of the carbon dioxide released by human activity, playing a vital role in regulating our Earth's climate. But to understand and respond to climate change, we need much more precise, continuous and wide-reaching data about how the ocean stores and cycles carbon.

Ocean robotics, with advanced sensing capability, can help us do just this and at the National Oceanography Centre (NOC), as part of the GEORGE project, we're leading the charge.

We've set sail, as part of the 40th anniversary research expedition on the NOC-run Porcupine Abyssal Plain Sustained Observatory (PAP-SO – one of the world's few long-term deep-ocean monitoring sites) to test an ambitious suite of new autonomous sensing capabilities.

During our four-week voyage on the RRS James Cook to PAP-SO, we'll be deploying autonomous and remote platforms including SeaExplorer underwater gliders, special biogeochemical Argo Floats, a multi-sensor instrumentation module (the EMSO Generic Instrument Module, or EGIM, and a surface mooring.

On the way, we'll be joined by a Sailbuoy uncrewed surface vessel (USV), deployed out into the Northeast Atlantic from shore.

A new era of ocean observation

The goal? Enabling high-resolution biogeochemical observations, from the seabed to surface.

It's a key part of the Horizon Europe-funded GEORGE project, which is working on new ways to observe the ocean in a way that's more systematic, long-term, sustainable and better integrated across existing ocean research infrastructures.

It's about next generation instruments, tools and methods for observing the ocean in a higher resolution than we've ever been able to before.

That means bringing together academia and industry and major European Research Infrastructure Consortia (ERICs) like Euro-Argo (focused on profiling floats), the European Multidisciplinary Seabed Observatory and the Integrated Carbon Observation System (of which PAP-SO is a member station), to develop and harmonise these new technologies.

GEORGE is about next generation instruments, tools and methods for observing the ocean in a higher resolution than we've ever been able to before.

Why do we need better, lower-cost sensors?

Currently, reliable, high-performance, low-cost autonomous sensors for key carbon parameters, particularly dissolved inorganic carbon and total alkalinity, are lacking.

These are essential for understanding carbon cycling, ocean acidification and the exchange of CO₂ between the ocean and the atmosphere. Without this data, there can be large uncertainties in the calculations we make about the carbon system.

So, our goal is to develop and validate new autonomous sensors and observing approaches to better measure these crucial ocean variables.

Real-world testing at PAP-SO

A critical step is putting them to the test in the real world, which is where PAP-SO is ideal. The site's long history – it's the world's longest abyssal time-series – makes it an ideal "testbed" for new sensors and platforms.

We are able to compare the new data against reliable past observations to confirm their accuracy, performance and reliability in the challenging deep-sea environment.

A particularly unique and exciting aspect of this deployment is that it will bring together multiple autonomous platforms (moorings, USVs, gliders, floats, seabed landers and the research vessel) at the same location, measuring the ocean carbon system across the water column in time and space.

This will allow scientists to contrast surface measurements with those taken at the seabed, and throughout the 5,000 m water column.

But it will not be a walk in the park. PAP-SO is in the deepest part of the Atlantic, at nearly 5 km deep, and is regularly exposed to harsh conditions, including large waves and winter storms.

This makes it a real test for autonomous equipment!

Understanding the data, validating the sensors

The data we collect using the new sensors during this expedition will be carefully validated against measurements taken directly from the research ship and using "gold standard" analytical techniques, as well as the historical data at PAP-SO to evaluate their performance and robustness in a real world environment.

While we'll bring most of the platforms back, the sensors and samplers we deploy as part of the GEORGE project on the EGIM and PAP mooring will remain on site, collecting observations, until the next, annual, PAP-SO visit in June 2026.

Future plans – a connected ocean

The ultimate goal is to one day enable cross-platform communication and autonomous decision making. Although this is beyond the project's objectives it is hoped that lessons learned from the PAP-SO expedition will inform how this could be done in the future. This new capability will enable platforms to adapt their observing behaviour dynamically, according to what they sense and what other platforms around them are sensing..

Generating results

We can't wait to deploy all these cutting-edge technologies at the PAP-SO and see the results that will be generated during the mission and over the next year.

Our efforts are supporting the GEORGE project and the European ocean observing community, paving the way for more sustainable, cost-effective and high-quality ocean carbon monitoring.

By advancing autonomous technologies and making data more accessible and usable, we're supporting better climate models, smarter policies and wider public engagement in climate action.

Revealing the hidden soundscapes of the deep North Atlantic

Dr Dara Farrell (Tuesday 17th June 2025)

What does the deep ocean sound like? Is it truly silent or have we just not been listening closely enough? And what could those sounds tell us about the ocean?

A pioneering new project led by the National Oceanography Centre (NOC), supported by the NERC-funded Atlantis programme, is setting out to explore these questions.

Using highly sensitive underwater microphones known as hydrophones, scientists will listen in at two key sites in the Northeast Atlantic, including the unique Porcupine Abyssal Plain Sustained Observatory (PAP-SO), which marks 40 years as a sentinel of deep-sea science this year.

By capturing sounds beyond the reach of sight or conventional instruments, researchers hope to reveal a hidden layer of ocean life—offering fresh insight into biodiversity, human impact and the true nature of this remote environment.

While NOC scientist Dr Dara Farrell is out at sea helping to deploy the instruments, Dr Emma Gregory, supporting from onshore explained more.

Challenging acoustic assumptions in the deep ocean

Until the last century, it was thought that the deep ocean contained little life. Vast swathes of the deep ocean floor were considered deserts.

Today, we know a lot more through deep-sea expeditions, and the long-term deployment of visual, physical, chemical and biological sensors.

But there's one significant dimension we've not yet given a great deal of attention to; the soundscape of the deep ocean.

Now, a project led by NOC will find out just what can be heard, from the UK's continental slope down to the deep abyssal seafloor far out in the northeast Atlantic Ocean, evolving our understanding of the ocean depths and impacts of human activities.

Recording new deep sea soundscapes

Funded by NOC and the UK's Natural Environment Research Council (NERC) funded Atlantis programme, the project is setting out to listen to the ocean at two sites in the northeast Atlantic Ocean, PAP-SO, a nearly 5,000 m deep site, about 800 km west of Lands End, and the Whittard Canyon, on the continental slope.

The goal is to monitor the influence of local and distant shipping, fishing, natural processes like turbidity currents (fast, underwater flows of sediments) and storms, as well as the presence and movement of elusive marine mammals like beaked whales.

“Surprisingly, there's very little we know about what it sounds like at these depths,” says Dr Gregory. “By adding acoustic sensors to a long-term deep-sea monitoring site like PAP-SO, we're taking a significant step forward in long-term deep-sea acoustic monitoring. This could offer promising new insights into both environmental change and the rich, largely unexplored soundscapes of the deep ocean.”

Recording a baseline for new insights

A total of seven hydrophones are being deployed across the PAP-SO and Whittard Canyon sites for up to a year, by scientists onboard the RRS James Cook. One will be installed on a mooring at PAP-SO, a site that's about mid-way between the continental shelf and the mid-Atlantic Ridge, making it as far from anywhere in the deep North Atlantic as you can get.

This will be deployed for a full year. The goal is to get a baseline for this deep abyssal setting that can then be looked at alongside all the existing measurements made at PAP-SO.

It is hoped this will become one of the long-term sensors at PAP-SO, expanding the ways we can monitor and track changes in this type of deep-sea environment.

Listening to the continental slope

Three sets of hydrophones will also be deployed at the Whittard Canyon site, about 250 miles southwest of Ireland at the edge of the continental shelf, which drops away to around 2,000 m deep, making it a very dynamic environment.

One will be on the main Whittard mooring, also for a full year and hopefully longer term after that. This will be the same type of hydrophone as the one at the PAP-SO site, allowing the team to compare the data directly.

This means they will be able to see differences between the two locations and correlate these with other data also collected at both sites, bringing previously unknown insights.

The other two hydrophone sites will be in the Canyons Marine Protected Area (MPA), an area known for its unique biodiversity. One of these will be on a mooring within a smaller canyon.

The second is an exciting pilot project, consisting of four hydrophones connected together on a lander – a structure used to house instruments on the seabed. This will allow the team to locate and then track where sounds come from as they move through the water, such as from marine mammals as they pass. This will be deployed for four months, from June to September.

New insights into turbidity currents

“An exciting element of the Whittard Canyon site is the potential to ‘listen to’ and therefore monitor turbidity currents,” says Dr Gregory. “These are fast-moving sediment flows – underwater avalanches of muddy water and sediment that rush down the slopes of the ocean floor – that are important for nutrient and carbon transfer and more.” But the scientists are also keen to find out what they can hear from all and any marine life, as well as ‘hearing’ what impact ships and other sound sources have on life in the ocean.

Hydrophones are usually deployed around the coastline to monitor marine mammals, such as the COMPASS network along the coast of west Scotland. But longer-term monitoring at deep sea sites is less common, so there’s a lot we don’t know.

“By having hydrophones at Whittard and PAP-SO, we’re hoping to see what else we can learn, both about the deep abyssal environment far from the coast, but also an active, potentially noisy, canyon on the continental slope,” says Dr Gregory.

“Across both, there’s very little we know about what the soundscape is like, whether shipping noise reaches both, what other sounds we might hear. Between the two sites there are different processes and species that we could learn about, so it should be a really interesting project.”

A lander loaded with hydrophones ready for deployment. It's in front of a winch able to deploy more than 5,000 m of rope.

A lander loaded with hydrophones ready for deployment. It's in front of a winch able to deploy more than 5,000 m of rope.

Listening for beaked whales

Another interesting part of the project is a collaboration with the University of Southampton to detect elusive beaked whales in the Whittard Canyon area.

These creatures, which can dive to very deep depths, are hard to monitor as they avoid coastal areas and other areas of the ocean where there is human activity. They also have a specific frequency range and very focused calls, making them hard to detect acoustically.

Hydrophones need to be set to record a high frequency and even then, they need to be located in the narrow beam of the beaked whale’s call, and for the whale to be relatively close by in order to record these animal’s sounds.

Entering the unknown

As the hydrophones settle into the silence of the deep, they set to open a new channel of discovery—one that listens rather than looks.

In doing so, they promise to unveil the rhythms and signals of a world still largely unknown, offering a richer understanding of the deep North Atlantic and the life it sustains.

This project marks not just a technological step forward, but a shift in how we tune in to the ocean's story—one echo at a time.

Seeing the ocean in a new light

Dr Sophie Clayton (Friday 13th June 2025)

It's an exciting time for ocean science. New, cutting-edge technologies, advances in machine learning and collaboration are bringing us new ways to study the changing life in our ocean.

We're excited to be adding one of these new tools on this year's expedition on the Royal Research Ship (RRS) James Cook to the Porcupine Abyssal Plain Sustained Observatory (PAP-SO).

Marking 40 years of continuous research this year, PAP-SO, coordinated by NOC, is among the longest-running deep ocean monitoring efforts globally—offering a unique platform for testing cutting-edge technologies.

The latest is an Imaging FlowCytobot (IFCB), an advanced imaging technology that will, used alongside machine learning techniques, help us unlock new insights into phytoplankton – the organisms that form the basis of the marine food chain and the ocean's ability to store carbon.

This instrument will be at the centre of an ambitious machine learning-powered project to allow us to capture, process and analyse images of these tiny but mighty organisms in near real-time, as they're collected at sea.

All science is a journey and this is no exception

It's funny how science can follow us! The IFCB was originally developed at Woods Hole Oceanographic Institution (WHOI) and I was lucky enough to see an early prototype of it in action during the first summer of my PhD studies there.

In fact, I used IFCBs as part the Bio-GO-SHIP, which I helped lead and which was recently recognised with the 2024 National Oceanographic Partnership Program (NOPP) Excellence in Partnering Award, a wonderful reflection of the collaboration and innovation at its heart.

Bio-GO-SHIP is a project to integrate biological measurements into the longstanding GO-SHIP (Global Ocean Ship-based Hydrographic Investigations Program), an international effort to systematically measure and understand the physical and chemical state of the global ocean.

GO-SHIP provides high-quality, repeat hydrographic data—like temperature, salinity, oxygen, nutrients and carbon—across key transects of the world's oceans, and researchers at NOC already play a key role in maintaining that part of the program, such as Yvonne Firing and Elaine McDonough, supporting ocean physics research.

But until the Bio-GO-SHIP project was started, it didn't include regular biological measurements.

Why do biological measurements matter?

Without biology, we're only seeing part of the picture. Adding biological sampling to GO-SHIP helps build a more complete and predictive understanding of the ocean's role in Earth's climate system, including the critical role of phytoplankton in that.

Phytoplankton are the base of the marine food chain and a key part of the carbon cycle. They remove CO₂ from the atmosphere and convert it into organic matter, supporting life throughout the ocean. But different groups—such as silica-forming diatoms or calcium carbonate-producing coccolithophores—interact with the climate system in different ways.

So, understanding which types dominate and how they change over time and space, is vital for predicting how the ocean responds to environmental stress.

This is where the IFCB comes in. Every 30 minutes, the instrument images up to 5,000 single cells (phytoplankton being single cell organisms) collected in 5 ml seawater samples.

Because it does this as we travel across the ocean, it means we can create a detailed record of this microscopic life, including cell taxonomy, size, shape and even begin to unravel interactions like grazing or viral infection.

Charting new horizons

The deployment on this year's PAP-SO expedition is part of an ambitious project to supercharge this capability by integrating the instrument into a broader digital ecosystem, with the aim of serving up plankton images in real time.

This will allow researchers to track changes in community structure and function as they happen—something traditional sampling methods simply can't match.

Looking ahead, the data collected through this approach will support machine learning models trained to automatically classify different types of plankton.

Over the next two to three years, we'll gather millions of images from the North Atlantic. The goal is to build robust classification tools that can help us understand not just which species are present, but how they vary in size, abundance and ecological role.

As well as that, I'm continuing work on the Bio-GO-SHIP programme to expand the biological data gathered during GO-SHIP expeditions.

I'm also using the same tools and approaches we're now adopting for PAP-SO for the TRICUSO Horizon Europe project, which focuses on reducing uncertainty in the Southern Ocean carbon sink. So these types of projects do have a wider global impact, beyond the projects we first test them out on.

New perspectives in ocean science

While the project with the IFCB has taken me full circle, so is another part of this work.

Before I started my PhD, I was studying the arts. So it's great that we're involved in a project which will see selected samples collected during the PAP-SO expedition processed using scanning electron microscopy (SEM), the results of which will be used by an artist as part of a collaboration.

It's a nice full-circle moment. The intersection of science and creativity can help us see the ocean—and the life within it—in new and inspiring ways.

This deployment of the IFCB is a first step, but an important one. With real-time imaging, digital archives, and new tools for automation and analysis, we're opening a new chapter in how we observe and understand ocean ecosystems.

Passing the torch: three generations of amphipod science in the Northeast Atlantic

Ben Walker (10th June 2025)

When you think "marine scientist," your mind might drift to someone tagging dolphins or following the gentle rise of a surfacing whale. But there's a whole other breed of ocean explorer – ones set on the more mysterious residents of the deep ocean.

Meet the amphipods: tiny, deep-sea crustaceans often nicknamed the ocean's scavengers. Most are just 10 mm long, but some grow to 34 cm.

While not the most well-known marine species, these creatures play a big role in helping us understand how life survives – and adapts – 5,000 m beneath the waves.

Forty years of amphipod science at PAP

A key way we've been exploring these creatures is through the Porcupine Abyssal Plain Sustained Observatory (PAP-SO) – the world's longest-running time series of life on an abyssal plain, operated by the National Oceanography Centre (NOC).

It all began in 1985, when, onboard the RRS Challenger, Mike Thurston led the first expedition to PAP pursuing a fascination with its curious crustacean residents. Find out how Mike got hooked on amphipods here.

It's a passion he has passed down – researcher to researcher – right up to today, with a new generation setting sail to continue the mission.

Carrying on a legacy – Dr Tammy Horton

One of those researchers is Dr Tammy Horton. When she arrived at NOC in 2001, Mike had officially retired – but hadn't stopped showing up. Tammy was fresh from a PhD on isopods, but Mike's enthusiasm – and depth of knowledge for amphipods – set her on a new track.

“It made sense,” she says. “He was the world authority on deep sea amphipod taxonomy, surrounded by a wealth of literature and able to teach me everything he could about them, so of course we just started working together.”

Tammy dove in, juggling big research projects and motherhood, before the PAP time series came calling. When her first PhD student, Grant Duffy, took on the mountain of unsorted amphipod samples from PAP, they realised just how much untapped data they had on their hands.

“At first it was overwhelming,” Tammy recalls. “There were just so many samples. But that's when I saw the potential.

“Over time, through student projects, building and comparing datasets, supported by students Zoe Gutteridge (2011-2012), Rhianna Vlierboom (2013) and Daiki Yamamoto (2017-2019), slowly we began to build up a picture.”

Tracking changes in the abyss

“It was then that the changes in amphipods at PAP became apparent. We were witnessing a switching of the dominant species. It was exciting to recognise what had only been hinted at before then.

“What surprised us was that these changes were occurring between two species of the same genus. When we started molecular work, we found there were more species than we realised, which is another story for another day.”

The result of Tammy's work is not only reinvigorating the PAP amphipod time series, but also making it thrive – innovating in taxonomy and helping to discover new species and patterns.

Mentoring new scientists, emphasizing the importance of detail, observation and accuracy (as well as labels!), has also been a big feature of Tammy's amphipod work. One of her latest mentees is Ben Walker.

Ben Walker: the next generation

Ben is diving into his amphipod adventure headfirst, including joining the latest PAP expedition, which will be his first time on the open ocean.

A masters student in marine biology and oceanography at the University of Southampton, Ben spends his spare time volunteering at the NOC-hosted Discovery Collections, under the guidance of Dr Tammy Horton.

What does that mean in practice? Hundreds of tiny amphipods, hours spent sorting samples from the deep, and a growing passion for creatures most people have never even heard of.

It all started thanks to a friend who was already volunteering with Tammy, cataloguing deep-sea specimens. Ben tagged along once – and never left.

“It's inspiring seeing the diversity of deep-sea life preserved in the Discovery Collections,” says Ben. “From sea pens and giant sea spiders to deep-sea anglerfish – it's like stepping into a vault of natural history.”

Some of those specimens are older than he is, collected during the very first PAP-SO expeditions in the 1980s. “There’s something special about working with them,” he says. “It really connects you to the decades of research and the people who made it possible. Now, being part of that process myself is a real honour.”

A fascination with scavengers of the deep

Just like Mike and Tammy, Ben has a fondness for amphipods.

“They’re so fascinating, from their diverse forms and structures (what we call morphologies in science) to the complexity of their body parts and the important ecological functions they carry out.

“I also love that I can spend a day in the laboratory, sorting amphipods from 4,800 m deep in the ocean abyss, and then head to a local beach or freshwater stream, turn over a few stones or bits of wood, and find them there too.

“Deep-sea scavenging amphipods are especially intriguing to me as they live in environments so far removed from anything I’ve ever experienced. I can imagine them scuttling and swimming about on the abyssal seafloor, seeking out a delicious carcass of sunken fish, then swarming all over the carcass until it’s nothing but bone.

“It would be cool to spend a day as one to see what they really get up to down there.”

A first time on the open ocean

While Ben will not be able to spend a day at the seabed, his participation in this year’s PAP expedition will give him an exciting opportunity to get more up close and personal with his amphipod friends.

“Knowing that you’re hundreds of kilometres from land, floating above nearly 5 km of deep water, will be truly humbling.

But what he’s most looking forward to? Seeing amphipods as they truly are.

“Preserved specimens lose their colours over time,” says Ben. “I’ve never seen deep-sea amphipods in their original, vibrant state. To see them fresh from the deep – with their true colours intact – is going to be amazing.”

Carrying the torch

Tammy and Ben’s stories are part of a much bigger story – a long chain of knowledge passed down from researcher to researcher. From Mike to Tammy to Ben, it’s a legacy built not just on science, but on mentorship, observation, and care.

“I’ve learned that the real reward isn’t just the final dataset,” Ben reflects. “It’s the process – the sorting, the counting, the slow building of understanding. I’ve genuinely enjoyed every part of it. And it’s shown me how much dedication – and patience – marine science really takes.”

A circle completed

This year, Mike, Tammy and Ben will jointly name the newly described amphipod species, first found at PAP on that inaugural PAP expedition Mike led 40 years ago.

It’s a fitting tribute to their shared journey. Their work is about more than just cataloguing life in the deep; it’s about understanding how climate and ocean processes shape our planet, but also about passing on knowledge, skills and passion to the next generation.

As the RRS James Cook sets out once more, the story of PAP continues—one amphipod, one scientist and one generation at a time.

Forty years beneath the waves: remembering the dawn of deep-sea science at the Porcupine Abyssal Plain

Tammy Horton (3rd June 2025)

This year marks a major milestone in the story of deep-sea exploration: the 40th anniversary of the first dedicated scientific expedition to the Porcupine Abyssal Plain Sustained Observatory (PAP-SO).

Located some 800 km west of Lands End, PAP-SO is one of the most remote sites in the North Atlantic — but it's also one of the most important. Over four decades, it has become one of the world's longest-running deep-ocean monitoring programmes, offering rare and invaluable insights into life nearly 5,000 m below the surface.

The observatory's story began in 1985, when distinguished oceanographer Mike Thurston led the first in-depth scientific mission to the site. That expedition, onboard the Royal Research Ship (RRS) Challenger, laid the foundation for decades of research into deep-sea biology and ecology.

But Mike's path to that breakthrough moment started years earlier — sparked not by a grand vision of exploration, but by an unexpected fascination with some of the ocean's more overlooked residents: amphipods.

An unexpected passion – discovered at Flatford Mill

Mike's fascination with these small crustaceans was perhaps an unlikely encounter. He had studied botany and zoology at A-level. But, in 1956, when it came to choosing what to study at university, he had been at a loss and chose organic chemistry. By the end of the first term, he had decided it wasn't for him.

He got back on the right path after what – to others – was a gruelling six-hour exam to get onto a marine biology degree at University College London (UCL). UCL's exam wasn't based on the standard A-level syllabus, making it hard for others. But for Mike, it covered areas close to his own interests, so he got in.

There, during a first-year, self-organised field trip at the picturesque location of Flatford Mill – Constable country – in Suffolk, he and a group of students were tasked with sampling freshwater weed for amphipods.

The challenge of sexing these creatures sparked an unexpected and enduring interest. Despite the fact that most of his peers likely forgot about the experience, Mike didn't.

It was a pivotal experience: "It hit me behind the left ear. It was unexpected. I was fascinated by amphipods. It was an important part of biological training and became the focus of many subsequent field trips. I spent most of my time looking at amphipods rather than the whole formal assemblage on subsequent field trips at Bangor and Plymouth."

In 1959, after graduating, Mike joined Falkland Islands Dependencies Survey (FIDS – now British Antarctic Survey), which meant setting aside amphipods for emperor penguins over two years on the ice at Halley Bay.

A move to NIO

Emperor penguins hadn't cut it with Mike. So, in 1965, when a research fellowship at the Natural History Museum offered the opportunity to focus on amphipods, he jumped at it.

At the time, amphipods were considered "a very specialized group". "Today, we're looking at there being in excess of 10,000 amphipod species," he says. "Back then, the total number known was between 3,000 and 4,000."

In 1968, at the end of the fellowship, he then got a role at the National Institute of Oceanography (NIO, a precursor to the National Oceanography Centre), then still at Wormley, in Surrey.

Moving onto the Porcupine Abyssal Plain

The timing was ripe for moving into deeper waters.

NIO's focus had been mid-water sampling in narrow depth strata down to around 2,000 m water depth and more in the East and North Atlantic, says Mike. Then, in the 1970s, the focus gradually shifted to the Porcupine Seabight, on the continental margin, where depths reached closer to 4,000 m deep - running on to the Porcupine Abyssal Plain itself.

"We gradually extended our sampling range into deeper water," says Mike, ultimately leading to the 1985 expedition.

It was a success, with an experimental amphipod trap capturing samples at nearly 5,000 m water depth out in the North Atlantic. It returned 28 specimens, including the giant amphipod then identified as *Eurythenes gryllus*.

This was the start of what has now become four decades of intensive research into scavenging amphipods in more than 4,800 m water depth on the Porcupine Abyssal Plain (PAP).

A long-term observatory

It has been four rich decades of amphipod science, with well over 5,000 specimens of giant amphipods sampled at PAP-SO in the Discovery Collections, in no small part thanks to Mike.

Over the first 30 years alone, there were 19 major sampling efforts and more than 106,000 specimens across 16 taxa identified.

This time series study, which is among the longest and most comprehensive in the deep sea, provides critical insights into how abyssal communities respond to environmental and climatic variability.

Ongoing work at PAP-SO continues to inform international efforts in deep-sea monitoring and climate-linked ecological research.

While the science at PAP-SO has been extended into other areas and from the seabed right up through the water column to the sea surface and air/ocean interaction, for Mike, it's always – and is still – about amphipods.

While he retired in July 1997, during his final expedition, (having completed around 30 expeditions over 30 years), he's still a regular at NOC.

He continues to work, alongside Dr Tammy Horton, who took up the amphipod mantle, as well as the next generation of scientists who are fascinated in these scavenging amphipods.

Can you spot Mini diver?

Dr Sue Hartman 4th (June 2025)

We're at sea onboard the Royal Research Ship (RRS) James Cook as part of JC278, the 40th anniversary expedition to the Porcupine Abyssal Plain Sustained Observatory (PAP-SO).

As well as the more than 30 scientists onboard, we've been joined by our Lego figure, Mini diver!

She's been having great fun touring the ship and the many scientific instruments we have onboard that are helping us to learn more about this site.

Can you spot her on her tour? Take a close look at each images to see if you can find her.

Her first visit was to the ship's chemistry laboratory, where a ship-board instrument measures dissolved gas in the surface seawater while we are at sea.

It does this by sucking in seawater from under the ship and passing this through instruments, helping us to learn how the flux of carbon dioxide into the water changes along our route.

Meeting a buoy!

Mini diver is also hiding on the large UK Met Office buoy that we will install and then leave at the PAP-SO site, 800 km west of Lands End in the Northeast Atlantic Ocean, during this voyage.

It will make similar measurements as our ship-board instruments, but it will do this throughout the year, because it stays here.

This buoy is multi-purpose. It contributes to our weather forecasts, and we have added instruments to measure ocean biology and chemistry, including oxygen and carbon dioxide gas.

Because it's there, year-in, year-out, it means we have a long timeseries of measurements, spanning over different seasons and over years and even decades.

From this timeseries we can ask how does the surface carbon dioxide level change compared with temperature and ocean life and how does it change from year to year?

Mini diver meets GEORGE

Next Mini diver visited an instrument that will sit at the bottom of the ocean for an entire year. This is called an EGIM and it makes similar year-round measurements of ocean chemistry, at nearly 5 km depth!

This is part of a project called GEORGE, which you will hear more about from the group working on it onboard the RRS James Cook in a future blog!

Discovering the role of the CTD

The next stop was our CTD rosette. This is a real work horse on board the ship! CTD means conductivity (used to calculate salinity, or how salty the sea is), temperature and depth (i.e. pressure). The rosette is a circular frame that holds the water sampling bottles we use to take these measurements – they're also known as Niskin bottles. They're configured to be remotely triggered at specific depths to collect water samples for analysis in our floating laboratory, as well as back on shore for more detailed analysis.

With this and our ship-board and seabed instruments, we have a full set of surface to seabed measurements that we can compare and study.

Underwater imaging

We're also keen to see and monitor life at the seabed. Mini diver met HyBis, the instrument we use to do this! It is an underwater camera system, towed by – and remotely operated from – the ship, helping us to explore the water and seabed, including all the life we find there.

I hope you enjoyed coming on the tour with our voyage companion Mini diver, that I won from Knight Optical (my family were happy to build the much larger set that Mini diver escaped from to come on JC278 with us!).

The case of the primordial slime – and how deep-ocean science takes time

Dr Brian Bett (28th May 2025)

When it comes to studying how our planet works and the life it supports, the deep ocean is one of the most mysterious and difficult environments to explore.

Simply reaching the deep ocean is a challenge in itself, which is one reason why exploration of these dark, cold, high-pressure realms is a relatively recent scientific pursuit.

One of the longest-running open-ocean observatories is located on the Porcupine Abyssal Plain—a site some 500 km west of Ireland in the northeast Atlantic, sitting 4,850 m (3 miles) below the surface. This year, it turns 40.

Thanks to ongoing research at this site, coordinated by National Oceanography Centre (NOC) scientists, we've made major strides in understanding life and processes in the deep ocean. But this wasn't always the case.

The discovery of primordial slime

Take the British biologist and anthropologist Thomas Henry Huxley. A towering figure in 19th-century science, Huxley played a key role in advancing public understanding of evolution and defending Charles Darwin's theory of natural selection.

In 1868, he believed he'd made a remarkable discovery. While examining mud, collected from the deep Atlantic seafloor, he concluded it contained a living substance—a kind of “primordial slime”, where the first forms of life originated from – that blanketed the ocean floor.

He named it *Bathybius haeckelii*, in honour of German biologist Ernst Haeckel, who had proposed the idea of Urschleim, or original slime—a protoplasm from which he believed all life originated.

This supposed living mat sparked interest in the ocean that was then fuelled by the pioneering deep-sea expeditions of HMS Lightning and HMS Porcupine (1868-1870) and ultimately the great HMS Challenger Expedition (1872 – 1876), a global circumnavigation of the world's oceans, which laid the foundations of oceanography and described more than 4,000 species new to science.

It is thanks to the Challenger Expedition that the primordial slime theory was dismissed when it was recognised that the substance was probably a by-product created from the act of preserving samples in alcohol.

But, during 1977-1986, seafloor biologists from the Institute of Oceanographic Sciences (IOS, now NOC) began intensive studies in the Porcupine Seabight – a deep-sea area adjacent to the Porcupine Abyssal Plain.

Their greatest discovery was phytodetritus, a greenish goo that sometimes carpeted the seabed - was this the real Bathybius?

The discovery of phytodetritus

Further research showed that phytodetritus was the decomposing remains of surface ocean phytoplankton (microscopic plants) that had sunk to the deep.

Crucially, this phytodetritus was found to occur seasonally each year, suggesting an active and ongoing link between life at the surface and life in the deep.

And importantly, it was recognised as a pathway for the descent of carbon from the surface ocean, providing a periodic food source for deep pelagic and benthic communities.

In other words, phytodetritus isn't just a food source for seafloor animals—it's a vital component of how the ocean captures and stores carbon.

Why long-term monitoring matters

This discovery prompted the creation of a long-term monitoring site on the Porcupine Abyssal Plain, to better understand these deep-sea carbon fluxes over time.

So began the Porcupine Abyssal Plain Sustained Observatory (PAP-SO).

The first benthic PAP expedition—a pioneering European collaboration—took place in 1985, at a location halfway between the IOS Porcupine Seabight programme and the German Institut für Hydrobiologie und Fischereiwissenschaft's BIOTRANS programme (BIOlogical vertical TRANSport and energetics in the benthic boundary layer of the deep sea).

Since then, the Porcupine Abyssal Plain has become a key long-term deep-ocean observatory, vital to our understanding of seasonal, interannual and decadal change in oceanic processes.

The discoveries continue

From carbon cycling and climate connectivity to high precision monitoring of atmospheric and surface ocean CO₂ concentrations, research at this site continues to reshape our understanding of the deep, and even 40-years on we continue to discover species new to science.

Each year, tools and techniques are refined, with new technologies tested and adopted—from benthic landers and robotic vehicles to high-resolution sensors.

This year, NOC researchers will deploy cutting-edge robotics, new environmental sensors, and—for the first time— we will attempt to record a year’s worth of the grunts, clicks and beeps that make up the deep-sea soundscape.

Forty years young

Forty years may seem like a long time. But in the deep ocean—where processes can unfold over decades or longer—we’re only just beginning to understand what lies beneath.

40 years of scientific observations at abyssal depths

Dr Andrew Gates (2nd June 2025)

After months of planning we have set sail on our latest expedition on the RRS James Cook to continue our long-term study of ecological change at abyssal depths of the north east Atlantic Ocean and maintain ocean observations throughout the water column.

This year marks the 40th anniversary of science at the Porcupine Abyssal Plain Sustained Observatory (PAP-SO). Our international team on board are reflecting on the importance of long-term observations and looking to how we can maintain and enhance the science in future.

Joining the National Oceanography Centre team are scientists and engineers from the Horizon Europe ‘GEORGE’ project (Next Generation Multiplatform Ocean Observing Technologies for Research). GEORGE will demonstrate novel technologies for ocean observations alongside the established methods we currently use at PAP-SO. We will also be deploying sensors to listen to the soundscape of the ocean.

The lead up to our departure was very busy with final preparations for the science alongside some media interest from the BBC South. Members of the team were interviewed for TV news, radio and online reports about the long-running scientific programme.

Read the BBC article [here](#):

20 Station List

GEAR	Description	Metadata notes
ATRAPx	Amphipod trap, "DEMAR" type, four near-bottom, double parlour traps, plus barrel 'letter box' trap at c. 15 mab	Times given are estimated arrivals / departures from seabed
CTD	Conductivity, temperature, depth etc. instrument	Time and position refer to start and end of cast, depths refer to min. and max. of profile
MgCxx+y	Bowers & Connelly Megacorer fitted with xx 10 cm tubes and y 5 cm tubes	Time, position, and depth refer to point of bottom contact by the gear (and are based on gear-mounted USBL beacon data when available)
PAP1	ODAS buoy and instrument frame	Position given is location of release at surface.
PAP3	Sediment trap array	
WP2	Zooplankton net (200 um mesh)	
WCM(A)	Whittard Cayon mooring type 2 (Anderson sediment trap, 2 microcats, 2 ADCPs)	Triangulated position at deployment
BSNAP	Bathysnap time lapse camera lander	Times given are estimated arrivals / departures from seabed
CTS-5	CTS-5 design Biogeochemistry Argo float	
PAM Lander	Passive Acoustic Monitoring device	
GLIDER	Autonomous underwater glider	
GLIDER-drift	Survey using underway sensors alongside gliders drifting at surface to validate data	
Benthic Lander		

	Station	Unique deployment identifier "JC", RRS James Cook, "278" consecutive cruise number, "-xxx" consecutive deployment number during cruise. Note that recoveries of moored or drifting systems retain the number of the initial deployment.
	Gear	Abbreviated name of deployed equipment
"Start"	Date	DD/MM/YYYY format date beginning of sample or data acquisition
	Time	HH:MM format UTC time beginning of sample or data acquisition
Latitude	dd	WGS84 latitude degrees beginning of sample or data acquisition
	mm.mmm N	WGS84 latitude minutes beginning of sample or data acquisition
Longitude	ddd	WGS84 longitude degrees beginning of sample or data acquisition
	mm.mmm W	WGS84 longitude minutes beginning of sample or data acquisition
	Depth	Minimum water depth of sample or data acquisition
"End"	Date	DD/MM/YYYY format date end of sample or data acquisition
	Time	HH:MM format UTC time end of sample or data acquisition
Latitude	dd	WGS84 latitude degrees end of sample or data acquisition
	mm.mmm N	WGS84 latitude minutes end of sample or data acquisition
Longitude	ddd	WGS84 longitude degrees end of sample or data acquisition
	mm.mmm W	WGS84 longitude minutes end of sample or data acquisition
	Depth	Maximum water depth of sample or data acquisition
	Sounding (m)	Typical water depth of seafloor during sample or data acquisition
	Comment 1	General comment on sample or data acquisition
	Comment 2	General comment on sample or data acquisition - only applied when "End" metadata are given

Station	Gear	"Start" Date	Time	Latitude dd	mm.mmm N	Longitude ddd	mm.mmm W	Depth	Sounding	Comment
JC263-007	WCM(A)	23/05/2024	12:04	48	37.495	010	0.124	1580	1580	Triangulated position
		02/06/2025	09:44	48	37.495	010	0.124	1580	1580	Time of release. Delay to surfacing
JC263-016	PAP3	26/05/2024	14:00	49	0.282	016	22.624	4848	4848	Position not triangulated
		16/06/2025	08:35	49	0.282	016	22.624	4848	4848	
JC263-043	PAP1	31/05/2024	15:54	48	58.620	016	21.920	0	4835	Start time, weight released from ship
		24/11/2024	09:03	48	58.518	016	19.920	0	4835	End time, last data on PAP location
JC263-072	BSNAP	08/06/2024	12:30	49	0.512	016	27.051	4836	4836	start time = when arrived at seabed
		05/06/2025	13:06	49	0.512	016	27.051	4844	4844	ascent rate 47 m/min
JC278-001	CTD	31/05/2025	09:15	49	5.466	007	10.442	0		CTD-1. test CTD.
		31/05/2025	09:40	49	5.466	007	10.442	117	125	
JC278-002	CTD	31/05/2025	20:06	48	24.240	009	41.700	0	337	CTD-2. Hybis svp / REDRESS CTD
		31/05/2025	20:26	48	24.240	009	41.700	331		
JC278-003	HYBIS	01/06/2025	00:07	48	24.121	009	41.514	389	330	Hybis-001 / REDRESS
		01/06/2025	02:58	48	24.561	009	41.980	430		Explorer interfluve, coral mounds.
JC278-004	CTD	01/06/2025	06:00	48	26.309	009	44.660	0	1304	CTD-3. release test, PISCES moorings
		01/06/2025	07:27	48	26.309	009	44.659	1295		4 depths. 5 minute long stops.
JC278-005	PISCES-2	01/06/2025	10:17	48	26.900	009	41.160	1175	1175	deployed without incident
JC278-006	PISCES-1	01/06/2025	13:52	48	21.410	009	32.610	955	955	deployed without incident
JC278-007	Hydrophone	01/06/2025	16:47	48	23.038	009	44.399	351	351	deployed without incident
JC278-008	HYBIS	01/06/2025	20:13	48	16.567	009	39.065	362	362	Hybis-002 / REDRESS
		01/06/2025	23:11	48	16.942	009	39.702	386		Dangaard interfluve, coral mounds.
JC278-009	HYBIS	02/06/2025	01:11	48	24.044	009	41.916	327	327	Hybis-003 / REDRESS.
		02/06/2025	03:00	48	24.267	009	42.131	357		Explorer interfluve, coral mounds.
JC278-010	CTD	02/06/2025	06:00	48	26.309	009	44.662	0	2147	CTD-4. WCM CTD
		02/06/2025	08:30	48	30.660	009	55.880	2130		5 depths

JC278-011	WCM(A)	02/06/2025	13:05	48	37.000	009	59.420	1585	1585	Trilaterated position.
JC278-012	MgC08+0	05/06/2025	00:37	48	50.226	016	31.111	4849	4849	Megacore-001. 8/8 tubes
JC278-013	CTD	05/06/2025	04:35	48	59.993	016	30.006	0	4847	CTD-5
		05/06/2025	08:26	48	59.993	016	30.006	4827		18 bottles at 5 depths
JC278-014	CTD	05/06/2025	10:10	49	0.329	016	28.469	0	4849	CTD-6 GEORGE Glider calibration
		05/06/2025	14:11	49	0.329	016	28.469	1000		3 depths. 1000 m sample failed.
JC278-015	CTS-5	05/06/2025	17:10	48	55.230	016	25.109	0	4851	CTS-5 Argo Float GEORGE Project
JC278-016	MgC08+0	05/06/2025	20:30	48	50.241	016	31.250	4850	4850	Megacore-002. 4/8 tubes
JC278-017	MgC08+0	06/06/2025	01:27	48	50.353	016	31.035	4849	4849	Megacore-003. 6/8 tubes
JC278-018	Glider	06/06/2025	08:56	48	2.300	016	31.260	0	4848	Glider SEA38
		13/06/2025	10:44	49	1.602	016	18.356	1000		Recovered as slow progress to PAP1
JC278-019	Glider	06/06/2025	09:29	48	2.352	016	31.228	0	4848	Glider SEA30
		13/06/2025	11:21	49	4.734	016	19.225	1000		Recovered as slow progress to PAP1
JC278-020	PAP-3	06/06/2025	15:43	48	58.480	016	29.450	4846	4846	Triangulated Position.
JC278-021	MgC08+0	06/06/2025	19:56	48	50.191	016	31.348	4847	4847	Megacore-004. 6/7 tubes
JC278-022	MgC08+0	06/06/2025	01:09	48	50.431	016	31.363	4848	4848	Megacore-005. 6/8 tubes
JC278-023	CTD	07/06/2025	04:55	49	0.000	016	30.002	0	4829	CTD-7 Full depth.
		07/06/2025	08:52	49	0.000	016	30.002	4820		19 depths
JC278-024	GLIDER-drift	07/06/2025	11:31	49	6.219	016	15.015	0	4447	Glider surface drift - data validation
		07/06/2025	12:41	49	5.767	016	15.622	0		300 m to Sea038, 600 m to Sea030
JC278-025	BSNAP	07/06/2025	16:22	49	0.402	016	26.984	4846	4846	Descent rate: 70 m/min.
		12/06/2025	14:35	49	0.402	016	26.984			
JC278-026	MgC08+0	07/06/2025	19:53	48	50.067	016	31.267	4849	4849	Megacore-006. 8/8 tubes
JC278-027	CTD	11/06/2025	04:13	48	55.901	016	22.901	0	4848	CTD-8
		11/06/2025	05:11	48	56.264	016	22.705	1000		24 bottles at 11 depths
JC278-028	PAP-1	11/06/2025	14:36	48	55.616	016	22.978	0	4848	Initial position is anchor drop location.
JC278-029	HYBIS	11/06/2025	20:07	48	50.478	016	31.349	4845	4845	HyBIS-004.
		12/06/2025	01:03	48	50.507	016	31.428	4844		Start at H5A, end at H4A.
JC278-030	CTD	12/06/2025	05:01	48	58.200	016	22.871	0	4849	CTD-9. 500 m fromPAP1
		12/06/2025	06:12	48	58.200	016	22.871	1000		12 depths

JC278-031	EGIM	12/06/2025	14:17	49	0.912	016	27.319	4848	4848	Start time is time at seabed.
JC278-032	HYBIS	12/06/2025	21:15	48	50.474	016	31.008	4845	4849	HyBIS-005.
		13/06/2025	01:30	48	50.510	016	31.066	4850		Start at H10A, end at H9A
JC278-033	CTD	13/06/2025	04:08	48	50.494	016	31.123	0	4849	CTD-10.
		13/06/2025	05:16	48	50.494	016	31.123	1000		Argo validation. 12 depths
JC278-034	CTS-5	13/06/2025	05:32	48	50.492	016	129.000	1000	4849	CTS-5 Argo Float (NOC)
JC278-035	Benthic Chamber	13/06/2025	06:38	48	55.333	016	30.096	4847	4847	Deployment position.
		15/06/2025	09:27	48	57.124	016	29.575	4747		Recovered position
JC278-036	ATRAP	13/06/2025	09:00	48	55.367	016	28.695	4847	4847	Deployment position. 55 m min-1 descent rate. Start time is estimated time at bottom.
		15/06/2025	14:25	48	57.588	016	27.519	4847		Recovered position
JC278-037	GLIDER-drift	13/06/2025	09:18	48	59.45.07	016	19.012	0	4847	drift commenced while ship approaching
		13/06/2025	10:13	49	1.142	016	18.567	0		drift ended with decision to recover glider.
JC278-038	CTD	13/06/2025	12:17	49	2.178	016	19.062	0	4846	CTD-11. Glider validation
		13/06/2025	13:25	49	2.178	016	19.062	1000		12 depths
JC278-039	Glider	13/06/2025	14:50	48	53.347	016	23.937	0	4848	Sea038
		17/06/2025	10:55	49	7.436	016	18.174	1000		recovered by boat.
JC278-040	HYBIS	13/06/2025	19:16	48	50.486	016	31.094	4847	4847	HyBIS-006
		14/06/2025	01:30	48	50.158	016	31.192	4848		Start H8A, end mid H7A
JC278-041	CTD	14/06/2025	04:56	48	57.772	016	23.011	0	4849	CTD-12. Near PAP1
		14/06/2025	06:05	48	57.772	016	23.011	1000		12 depths
JC278-042	Glider	14/06/2025	09:49	48	53.352	016	23.873	0	4848	Sea030
		17/06/2025	10:34	49	8.781	016	20.529	1000		recovered by boat.
JC278-043	CTD	15/06/2025	04:11	49	0.000	016	30.000	0	4848	CTD13. Science deep CTD.
		15/06/2025	08:09	49	0.000	016	30.000	4835		20 depths
JC278-044	CTD	15/06/2025	13:02	48	58.213	016	22.679	0	4848	CTD14. GEORGE Sampler
		15/06/2025	13:34	48	58.213	016	22.679	200		4 depths.

JC278-045	HYBIS	15/06/2025	23:00	48	30.442	016	31.260	4848	4844	HyBIS-007
		16/06/2025	01:16	48	49.970	016	31.232	4846		Lines 6 and 7. Cable failure on recovery
JC278-046	Benthic Chamber	16/06/2025	14:33	49	0.601	016	25.890	4847	4847	deployment time is time off deck
		18/06/2025	08:40	49	2.727	016	25.607	4849		recovered 2km from deployment
JC278-047	ATRAP	16/06/2025	15:48	49	0.616	016	24.650	4847	4847	deployment time is time off deck
		18/06/2025	15:08	49	0.616	016	24.650	4846		
JC278-048	BSNAP	16/06/2025	19:45	49	0.260	016	26.850	4851	4851	Start time is estimated time at seabed.
JC278-049	MgC08+0	16/06/2025	23:12	48	50.202	016	31.521	4849	4849	Megacore-007. 8/8 tubes
JC278-050	CTD	17/06/2025	04:06	49	0.005	016	29.999	0	4830	CTD-15. Deep Science CTD.
		17/06/2025	07:45	49	0.005	016	29.999	0		16 depths.
JC278-051	GLIDER-drift	17/06/2025	08:40	49	4.862	016	20.172	0	4768	100 m from SEA038 3 km from SEA030
		17/06/2025	09:46	49	7.186	016	18.185	0		
JC278-052	CTD	17/06/2025	12:38	48	58.384	016	22.607	0	4847	CTD-16 1000 m glider calibration CTD
		17/06/2025	16:31	48	58.384	016	22.607	1000		6 depths
JC278-053	MgC08+0	17/06/2025	21:16	48	50.456	016	31.428	4848	4848	Megacore-008. 8/8 tubes
JC278-054	MBES	18/06/2025	01:52	48	51.883	016	27.976	4843	4843	PAP Central MBES
		18/06/2025	03:03	48	52.960	016	31.234	4846		
JC278-055	CTD	18/06/2025	04:13	49	0.688	016	27.106	0	4848	CTD 17 at EGIM site
		18/06/2025	07:54	49	0.812	016	26.927	4830		7 depths.
JC278-056	CTD	18/06/2025	13:45	48	58.450	016	22.621	0	4849	CTD 18. GEORGE Sampler test.
		18/06/2025	14:16	48	58.450	016	22.621	200		4 depths.
JC278-057	MgC08+0	19/06/2025	00:30	48	50.268	016	31.523	4846	4846	Megacore-008. 8/8 tubes
JC278-058	CTD	20/06/2025	18:06	48	34.415	016	56.683	0	4637	CTD 19
		20/06/2025	19:42	48	34.415	016	56.683	2000		Argo validation

