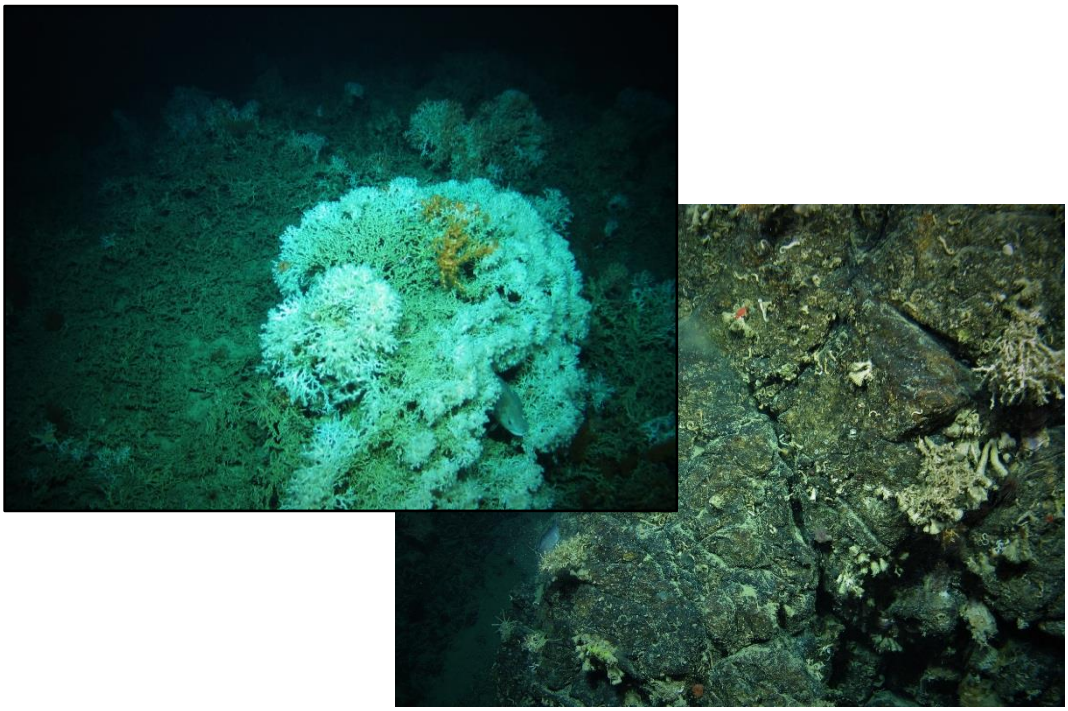
Controls of Cold-Water Coral Habitats in Submarine Canyons (CoCoHaCa)

Survey RH17002

ILV Granuaile



Galway – Porcupine Bank Canyon - Galway

17th June to 29th June 2017

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1 Executive Summary

A ROV based survey of the upper Porcupine Bank Canyon was undertaken to further explore and sample the cold-water coral (CWC) habitats of the canyon. Previous surveys had identified this habitat as forming coral carbonate mound in the rim of the southern margin of the canyon with coral habitat extending into the canyon including on vertical bedrock cliffs.

This survey quantified the habitat and define its limits by running a series of regularly spaced, but randomly located, video transects up the canyon flank and over the rim. 53km of video transects were run between 568 and 1426 m water depth. To the east, a series of transects revealed the up-canyon limited coral habitats. Within the CWC habitat zone, coral cover was not continuous with black corals occurring at deeper depths and calcareous *Madrepora* and *Lophelia* occurring high up. Areas of dead calcareous corals are also common. Corals are more common on topographic spurs and less common in gullies where downslope sediment chutes are also more prevalent. Two giant carbonate mounds in the western limit of the study area were also surveyed and contained abundance dense coral coppices on their northern flanks and summit. 49 CTD profiles were run, mainly at the start and end of ROV deployments, to characterise the water mass properties with respect to the coral habitat.

A new ROV-based vibrocoring rig was successfully trailed during this survey and 10 vibrocores collected in the coral habitats on and off mounds to retrieve an archive of habitat change through time. Total core length retrieved was 8.46 m with the longest core being 1.02 m long.

A successful trial of the ROV rockdrill in deep water was also undertaken with 2 rock plugs recovered sampling, for the first time, the rocks into which the canyon has incised. This information is very useful for understanding the deeper geology of the bank due to the paucity of existing data and is also proof of concept of the rock drill abilities.

A series of ROV-based multibeam echosounder profiles up the canyon flank was not possible due to technical difficulties.

2 Background

The framework-building cold-water corals (CWC's) have a reef forming capacity generating positive topographic features on the seabed (reefs or carbonate mounds). These contain unique palaeoenvironmental archives (Thierens et al., 2010; 2012). These CWC autogenic, mound-building biota (Correa et al., 2012) form in areas with adequate hydrographic (temperature, surface productivity, pH, enhanced current speeds, salinity and food supply) and sedimentological attributes (substratum and sediment supply) (Dorschel et al., 2007; Foubert et al., 2011: Wheeler et al., 2007: 2011; Fink et al., 2012) in Ireland often found along continental margins at intermediate water depths (Dorschel et al., 2007). Knowledge of these specific environmental conditions not only allows an understanding of their contemporary occurrence but it also allows to reconstruct marine environmental change through time (Roberts et al., 2009).

Not only do CWC flourish in Irish waters today, but have done so for millions of years e.g. the Challenger Mound (Kano et al., 2007; Thierens et al., 2010). The continued favourable marine environmental conditions off the Irish continental margin has led to successive reef development. Subsequently, Irish water is home to some of the largest and most dense coral carbonate mounds in the world (Roberts et al., 2009).

Geologically, the subject of reef initiation has been relatively poorly documented and examined with only two papers directly addressing this: Squires (1964) and Wilson (1979a). Despite some work concerning reef initiation and development in more recent studies including Wheeler et al. (2011), Foubert et al. (2011), Dorschel et al. (2005) and Frank et al. (2005), these research are primarily concerned with the environment of reef initiation and development rather than the initiation process itself. Thus, with more advanced marine surveying techniques and data available, advance on both Wilson (1979a) and Squires' (1964) work are overdue. Core data from this survey will help provide key information and materials to better understand mound development processes.

Furthermore, cold-water coral carbonate mounds and reefs contain records of palaeoenvironmental, palaeocenographic and palaeoclimatic change. Although the corals live in areas of relatively strong benthic currents, the coral frameworks capture sediment (Wheeler et al., 2011). This is one of the ways in which coral mounds grow. The fact that the corals form topographic features is a result of the high accumulation rates in the mound sediments relative to the surrounding seabed. A consequence of this is that coral mounds are relatively high resolution archives of environmental change in areas where sedimentation rates or low or dominated by non-deposition or erosion (Thierens et al., 2010). The mound records can also, however, contain hiatuses or erosive layers. The corals themselves are archive records of

environmental change in annual growth rings in the corals (Mouchi et al., 2014). Elemental variations across growth rings can reveal proxies for temperature and pH.

In 2014, the QuERCi survey discovered a cold-water coral habitat on the Porcupine Bank in Irish waters where cold-water corals were see colonising near-vertical exposed bedrock outcrops. Rough estimates suggest that this habitat, that is only a line on a map, may infact cover 500 km^2 and therefore proves highly significant (RTE 9 O'Clock News, 16.06.2014). However, we know very little about this habitat. Studies of deep-sea submarine cliffed habitats (Huvenne et al., 2011; Van Rooij et al., 2010) suggest they have distinct benthic assemblages and fauna associations that are rich and diverse dominated by suspension feeders.

The Porcupine Bank Canyon is a poorly explored and understood canyon system. This research tea has run three surveys in the canyon before now (WicPro, QuERCi I and QuERCi II) although they have concentrated on only a part of the SE margin of the canyon. Prior to this, Mazzini et al (2012) explored with a video tow and OKEAN side-scan sonar some mounds further to the west also on the southern margin and note phosphatic accumulations. A drop camera and multibeam survey was also completed by Royal NIOZ as part of the CARBONATE survey on the easternmost northern margin.

Submarine canyons in general are noted locations of high bio-productivity as they are sites where POM is captured by along slope currents and pumped to the deep ocean. They are also dynamic environments where tidal currents are funnelled and topographic effects can intensify local hydrodynamics. There are also conduits for episodic cold-water cascades and turbidity currents.

This survey is designed around a series of parallel video (and MBES- not completed) transects up the canyon flanks to cover the spatial diversity of the canyon margin in a non-biased survey design. Often, ROV video surveys are exploratory hunting out interesting features. As a result, a lot of our knowledge of a canyon can be biased towards these interesting features giving a biased appraisal. By run regular transects we hope to provide a quantifiable approach.

Furthermore, exposures of rock offer the opportunity to sample lithologies often buried deep within the seabed. Work undertaken in UCC (Murphy, 2015) identified where seismic stratigraphic units outcrop on the Porcupine Bank to target strategic sampling.

3 Survey Rationale and Objectives

The CoCoHaCa survey focusses exclusively on studying the cold-water coral habitats in the upper Porcupine Bank Canyon with the following .scientific objectives:

Objective 1: Detailed mapping of the upper canyon seabed environmental at arrange of scales from ROV-MBES to visual mapping to assess coral habitat limits and facies heterogeneity

Objective 2: Provision of cores through coral mounds, tallus and coral colonised seafloor to determine habitat, palaeoenvironmental and climate change over century to millennial timescales

Objective 3: Water mass characterisation to provide an environmental contextualisation of the coral habitats.

Objective 4: Provision of rock samples for geological mapping and sediment provenance work of relevance to the hydrocarbon sector using the novel rock-drill technology

To fullfil these objectives, the following operations were undertaken :

ROV multibeam mapping of the upper Porcupine Bank Canyon: 20% of the upper canyon has been mapped using the ship-based multibeam surveying (MBES) at an increase resolution where features can be seen (not possible on the INSS data). We suspect deep habitats that exist within the canyon include potentially more extensive vertical cliffed habitat as demonstrated in other canyons (e.g. Huvenne et al., 2011). A series of parallel ROV-based MBES surveys up the canyon margin in the coral habitable zone margin will map the canyon margin in high resolution This task will provide crucial data for further exploration and investigation as well as allowing a determination of seabed acoustic backscatter facies that may provide a link to coral habitat facies.

Delimitation and quantification of seabed facies association in the southern upper canyon margin coral habitats: A run a series of parallel ROV-video lines up the canyon margin down the middle of the MBES coverages to determine the spatial limits and habitat variability (faunal, live/dead coral, sedimentation, water quantity, slope, aspect, rugosity) with respect to slope, depth and location with the canyon.

ROV-based vibrocoring of the Querci and Ziggy cold-water coral carbonate mounds and associated coral habitats: the new ROV-based vibrocore will be trialled to

acquire long cores from two well studied coral mounds. We have not been able to retrieve cores from here with ship-based gravity cores. We anticipate that the ROV-based vibrocorer will perfom better in this substrate. The cores will be assessed to look at changing reef and environmental conditions over time and will be subjected to sedimentological, geochemical proxy studies and dating.

CTD measurements of the upper and middle Porcupine Bank Canyon: submarine canyons are hydrodynamically active and, due to their morphology, focus tidal energies. It is for this reason that canyons are so biodiverse and support large biomasses. The coral habitat is almost certainly driven by hydrodynamics. A series of strategically planned repeat CTD casts will enable an understanding of the watermass variability over time and provide important precursor information for future work.

Exploration for rock-outcrops on the canyon margin and sampling using the ROV-rock drill: Hydrocarbon reservoir porosity is partly determined by the nature of the source sediment. The Porcupine Bank provides the source rocks from which Irish Porcupine reservoir rocks are derived, yet we know little about what the bank is made of and have only a few small samples. We have located two rock outcrops (conjectured as a ?gniess and ?conglomerate) and may find others during CoCoHaCa. We will use the novel ROV-based rock drill to obtain samples for provenance and mineralogical studies of relevance to the Irish exploration industry.

4 Equipment

Research vessel - ILV Granuaile

The ILV Granuaile is an 80m multifunctional vessel designed to operate in difficult sea conditions. She has Class I dynamic positioning linked to the satellite-based navigation system DGPS, the vessel's primary function is to place and service our 150 offshore buoys, which warn mariners of the location of sand banks, reefs and other offshore hazards near shipping routes. The vessel is also an ideal platform for ROV operations with room to fit the ROV winch mid-ship for port deployment.

The ILV Granuaile

Holland I ROV

The Holland I is depth rated to 3000m and the entire system consists of an SMD Quasar work class Hydraulic ROV, A-Frame launch and recovery system and a deep-water winch. The ROV system is controlled from a 20 foot control room and comes with a fully equipped 20 foot workshop container.

The system has been equipped with a survey skid to accommodate a wide range of scientific equipment including various biological and sediment sampling systems. It has seven and five function manipulators and a high definition camera system (video and stills) as well as powerful lighting to ensure high quality observation and documentation of sea floor images. Deployment is in live boating mode.

The Holland I ROV entering the water

The Holland I was equipped with the following additional equipment:

MBARI Vibrocorer – Vibrocoring is a common technique used to obtain samples from water-saturated sediment. These corers work by attaching a motor that induces high frequency vibrations in the core liner that in turn liquefies the sediment directly around the core cutter, enabling it to pass through the sediment with little resistance. The vibrocorer was developed by MBARI and fixed to the front of the ROV. Up to 5 core barrels can be stored on the rig and are loaded by the ROV manipulator arms.

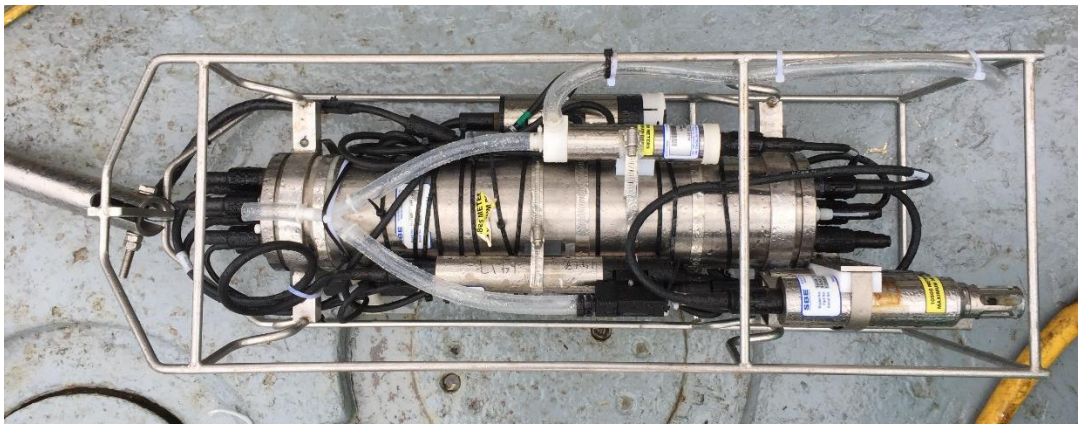
The vibrocorer mounted onto the front of the ROV

Rock drill – a bespoke hydraulic rock drill takes rock plugs from the exposed rock faces and is bracketed to the front of the ROV.

Holland I rockdrill

SBE 911 CTD

The SBE 911 CTD includes the following equipment: temperature and conductivity sensors, altimeter (for bottom detection), transmissometer and dissolved oxygen. The Sea-Bird 911*plus* CTD system consists of the SBE 9*plus* Underwater Unit and the SBE 11*plus* Deck Unit (for real-time readout using conductive wire). When a deck unit is employed, underwater unit power is supplied down the same single conductor armored wire used to carry data up to the surface. The deck unit decodes the serial data and passes it to a computer for display and logging to disk.



*The Seabird 911*plus *CTD*

The Sea-Bird underwater hardware consists of a main pressure housing comprising power supplies, acquisition electronics, telemetry circuitry, and a suite of modular sensors all mounted within a stainless steel guard cage. Surface hardware includes the SBE 11plus Deck Unit and a computer. The temperature sensor (model SBE 3plus) is a compact module containing a pressure-protected high speed thermistor and 'Wein bridge oscillator' interface electronics. The thermistor is the variable element in the Wein-bridge, while a precision Vishay resistor and two ultra-stable capacitors form the fixed components. The conductivity sensor (model SBE 4C) is similar in operation and configuration to the temperature sensor, except that the Wein-bridge variable element is the cell resistance. The Digiquartz® pressure sensor also provides a variable frequency output. The sensor frequencies are measured using high-speed parallel counters and the resulting digital data in the form of count totals are transmitted serially to the SBE 11*plus* deck unit. The deck unit reconverts the count totals to numeric representations of the original frequencies.

5 Technical Difficulties

All times are recorded as local time (GMT=UTC+1hr)

17th June 2017

The HAIN software in the INS was unable to accept the feed from the DVL Doppler Inertial Navigation System and therefore provide a reliable position for the ROV. The HAIN INS takes an ROV position from a USBL transponder beacon on the ROV communicating with a USBL transponder lowered below the ILV Granuaile through a mid-ship moonpool. The USBL data is fed to the INS HAIN through Seapath software which calculates absolute position from the vessel dGPS. The USBL position is then smoothed with feed from a DVL Doppler profiler, inertial navigation system and ROV gyro. This should allow centimetre accuracy required for MBES processing. The incompatibility in the software was explored via contact with the software developers in Norway and with the help of the Kongsberg engineer on-board to troubleshoot during mobilisation. This has caused a delay pushing back the vibrocorer trials to later tomorrow.

18th June 2017

Initial patch testing of the MBES was unsuccessful with the ROV position being very erratic. Water depth for test was 10m. It was decided to move to deeper water to redo the test in case water depth was an issue with the USBL. The ROV was redeployed at 18m water depth however erratic ROV positioning problems continued due to continued software problems. There is still a problem getting the HAIN INS software to accept the Doppler (DVL) as well as other software bugs. The software was uninstalled and an older version of the software uploaded with software patches. However, it was still not possible to accept the outputs from the DVL into the HAIM INS software. Vibrocorer trials delayed further.

19th June 2017

ROV deployed at 08.42 in 10 m of water and navigation comms including the DVL now working in the HAINS although the Seapath USLBL was not working (very erratic) due to the shallow water depth. This is very promising suggesting that the overnight software patches to the HAIN software may have worked. Test was re-performed in deeper water (20mwd). The HAIN position now appears stable and the USBL less erratic but the SIS MBES acquisition system is systematically erratic suggesting that it may be getting the wrong feed from the HAIN. We were unable to get a reliable stable feed from the HAIN to the SIS so unable to do the ROV MBES as planned. As downtime was accumulating with no confidence that we could get the HAIN to speak to the SIS it was decided to abandon the ROV MBES element of the survey at 13.30.

21st June 2017

ROV CTD failed during dive and would not initiate on way up. When the ROV was being mobbed for the next dive it was apparent that there was an internal

communications failure immobilising the high definition camera pan and tilt as well as other operations. The fault was traced to a shorted connector in a relay switch and fixed. However, this caused over 12 hrs of downtime.

At 09.50, a power failure to the CTD occurred whilst in the water. The deck unit showed an error with the underwater unit and sounded an alarm before the deck unit blew its fuse. The fuse was replaced and the deck unit still showed an error on the underwater unit with the alarm sounding. No signal coming in either. CTD recovered to deck and the fault was traced to a short-circuit in the winch to CTD cable probably at the termination. It was decided to re-terminate the CTD.

22nd June 2017

Weather conditions deteriorated all day with winds picking up and the swell rising. The ROV was recovered at 17.45 with strong winds. Winds were averaging 35 kts gusting to over 40 kts. It was decided to delay deploying the ROV at 19.00 as the weather was deteriorating. By midnight the wind speed had dropped to 30 kts and it was decided to continue to wait for the winds to fall further.

23rd June 2017

00.05 – Swell: 3.5m, Wind 30kts
01.30 – Swell: 3.0m, Wind 28kts
02.30– Swell: 3.5m, Wind 25kts
04.00– Swell: 2.0m, Wind 20kts

Wind speed had dropped to tolerable levels by early morning but the swell by this stage had dropped to 2m so it was decided to keep delaying until the swell dropped to tolerable limits. ROV eventually deployed at 05.20 after c.11 hours weather downtime.

25th June 2017

During transit from **RH17002_D12** to **RH17002_D13**, the USBL pole was raised but lowered at an angle by mistake. ROV navigation at the start **RH17002_D123** was erratic between 06.08 and 06.22 until it was realised the issue was not a software issue but a USBL 45^{o} physical offset.

26th June 2017

The ROV caught a rope in the canyon which pulled all the floats down the umbilical. The umbilical then sank and became caught under a rock ledge. This was observed by the ROV at 873m water depth at 23.30. The cable became unhooked and the cable showed a visible kink. The ROV was recovered to deck leaving the bottom at 23.41.

27th June 2017

ROV recovered to deck at 00.41. Some of the umbilical shielding was damaged. The ship's position was held steady while the umbilical was assessed. Umbilical was assessed by 01.30 and it was discovered that there was minimal damage to the armouring which was fixed. Umbilical repaired and ROV reployed at 02.18.

28th June 2017

00.43 – Swell: 2.5m, Wind 32kts
02.30 – Swell: 3.0m, Wind 38kts
03.40– Swell: 3.5m, Wind 38kts

ROV recovered at 03.30. Wind gusting 46 kts and averaging 38 kts, swell 3.0m. The aft deck is periodically awash. It was decided that it was too rough and dangerous on deck to deploy the CTD responsibly and certainly beyond the limits of the ROV. Wind then rose to 40 kts and gusting 50 kts (Force 9). End of survey. Transit was moved forward commencing 4 hrs ahead of schedule to head to calmer waters as operations were no longer possible.

6 Survey Narrative

All times are recorded as local time (GMT=UTC+1hr)

15th June 2017: Galway Dock

Commenced mobilisation in Galway Dock at 08.00 and proceeded all day.

16th June 2017: Galway Dock

Continued mobilisation in Galway Dock and proceeded all day.

17th June 2017: Galway Dock to Galway Bay
Partly cloudy, fresh in morning becoming calm.

Departed Galway Dock at 09.40 to Galway Bay. 12.40 ROV in water to perform ROV wet-tests. ROV on deck at 12.53. ROV relaunched at 14.00 for deployment of USBL beacon for USBL calibration. ROV recovered at 14.10. Ship commenced spins in DP to calibrate USBL. ROV deployed (18.35) to recover USBL at end of calibration at 19.00.

18th June 2017: Galway Bay
Cloudy to sunny, no wind or swell

ROV deployed to patch test MBES at 09.00 in 10m water depth. Recovered on deck at 10.00, patch test unsuccessful due to erratic ROV navigation (see technical issues). Move to deeper water and ROV MBES patch test retried. ROV in water at 11.25 in 18m water depth. Technical issues with the ROV navigation continued. ROV recovered at 18.40.

19th June 2017: Galway Bay
Sunny, calm

ROV deployed at 08.33 to wet test the ROV navigation again, test promising, ROV recovered at 08.55. Move to deeper water to redo test and perform a patch test for the ROV MBES. ROV deployed at 10.15 in 18.8m water depth and recovered on deck at 13.27. ROV MBES removed from the ROV and the vibrocorer fitted. ROV deployed for vibrocorer trial in sand at 18m water depth at 19.36 and recovered on deck at 20.38. Two vibrocores successfully retrieved. ROV deployed for a section test on a muddy substrate in 10m water depth at 21.21 and recovered on deck at 21.40. One vibrocore successfully retrieved. These were not kept as useful cores, just trials. CTD wet tested at 21.50, wet test ends at 22.22. Transit to the Porcupine Bank Canyon commenced at 22.50.

20th June 2017: Transit and Porcupine Bank Canyon
Overcast, low swell, following sea

Continued transit with a following sea a 10kts. Arrive on station at 21.40. ROV deployed in vibrocore mode at 22.31. Two vibrocores (**RH17002_VC1** & **RH17001_VC2**) were taken at 840m wd in a broad area of coral rubble and sand at 23.29 and 23.50 respectively. The vibrocores penetrated very quickly initially but then met a solid obstruction at 49cm and 46cm respectively. The two vibrocores were 70m apart. High definition video was taken of the area around the cores. **RH17002_VC1** recovered 0.39m of sediment, **RH17002_VC2** was discarded as the core was disturbed and short. The ROV then transited to the top of Ziggy Mound at 624m water depth.

21st June 2017: Porcupine Bank Canyon
Overcast, calm

Three vibrocores were taken. **RH17002_VC3** was taken off the summit at 00.59 and penetrated to 50 cm. **RH17002_VC4** and **RH17002_VC5** were taken at the summit at 612m water depth at 01.25 and 01.39 respectively adjacent to each other and gained full penetration of the barrels 123cm and 126cm respectively). High definition video was taken of the area around the core sites. ROV recovered back on deck at 02.21. ROV vibrocores recovered (**RH17002_VC3** was discarded as the core was disturbed and short, **RH17002_VC4** recovered 1.04m of sediment and **RH17002_VC5** recovered 71m of sediment). CTD was deployed at CTD site 2 (**RH17002_2CTD**) at 09.33 but failed at 633 m water depth (see technical difficulties). ROV repaired and deployed at 18.29 on the summit of a coral mound half way between the Ziggy and Querci Mounds. **RH17002_VC6**, **RH17002_VC7** & **RH17002_VC8** at 19.30, 19.55 and 20.11 respectively at 650m water depth. All cores reached full penetration (1.23m, 1.26m and 1.21m respectively) with 0.66m, 0.98m and 1.00m recovered respectively. ROV on-deck at 20.58. ROV redeployed at 21.58 for the final vibrocores on Querci Mound and a coral tallus slope. Three cores taken on the summit (**RH17002_VC9, RH17002_VC10** & **RH17002_VC11**) at 657m water depth at 22.44, 23.03 and 23.15 respectively. All cores reached full penetration (1.26m, 1.26m and 1.25m respectively) with 1.06m, 0.73m and 1.02m recovered respectively.

22nd June 2017: Porcupine Bank Canyon
Windy with a rising swell

The ROV completed a “blue water hop” to the final vibrocoring site at 1469m water depth in the upper canyon below the coral habitable zone. Two cores were taken (**RH17002_VC12** & **RH17002_VC13**) at 01.16 and 01.48. Depth of penetration into the seabed was 1.04m and 0.20m respectively in mud. **RH17002_VC12** recovered 0.42 m of core whilst **RH17002_VC13** only recovered 20cm of core and was not retained.

ROV recovered on deck at 02.49, the vibrocore rig disassembled and the ROV prepped for video dives with high definition forward facing and lower resolution downward facing cameras. ROV launched at 09.30 for the first video transect (**RH17002_D4).** Swell and wind direction are favourable for DP and launch and recovery. ROV recovered on deck at 17.45.

23rd June 2017: Porcupine Bank Canyon
Overcast, swell falling away

After the swell calmed down (see technical difficulties) the ROV was deployed at 05.20 and on seabed at 06.05 (**RH17002_D5**). ROV recovered on deck at end of **RH17002_D5** at 10.50. Transit to next dive location. ROV deployed at 12.47 for **RH17002_D6**. Attempt to deploy the GoPro at the start of the dive was unsuccessful. ROV recovered on deck at 18.45. Transit to next dive location. ROV deployed at 19.49 for **RH17002_D7** and back on deck at end of dive at 22.40. Transit to next dive location. ROV deployed for **RH17002_D8** at 23.46.

24th June 2017: Porcupine Bank Canyon
Partly cloudy with a low swell. Wind increased mid-day.

ROV recovered on deck at 03.17 at end of **RH17002_D8**. Transit to next dive location. ROV **RH17002_D9** deployed at 05.03 and GoPro deployed on seabed to film ROV at the start of the dive. ROV recovered at 09.13 at end of **RH17002_D9**. On deck at 09.38, transit to next dive location. ROV deployed at **RH17002_D10** at 11.30 and recovered on deck at 15.14. Transit to next dive location. ROV deployed at 16.45 for **RH17002_D11** and back on deck at 21.30. Transit to next dive location. ROV deployed at 22.45 for **RH17002_D12** but recovered at 23.30 due to positional error.

25th June 2017: Porcupine Bank Canyon
Overcast with a low swell

Redeployed ROV at 00.20 for **RH17002_D12**. ROV recovered at end of **RH17002_D12** at 03.00**. USBL pole lifted at** 03.25 for transit and replaced at 05.15 (see technical difficulties). ROV deployed at 05.20 for **RH17002_D13,** navigation issues at the start from 06.08 to 06.22 (see technical difficulties). Navigation issues resolved at 07.10 with the USBL adjusted. ROV recovered at 12.20 at end of **RH17002_D13.** Transit to next dive location. ROV deployed at 13.58 for start of **RH17002_D14** and recovered at end of dive at 20.03. Transit to next dive location. Dive **RH17002_D15** commenced at 20.58.

26th June 2017: Porcupine Bank Canyon
Overcast, rainy with 2m swell

ROV recovered at end of dive at 05.53 for dive **RH17002_D15**. Transit to next dive location. ROV deployed at 08.01 for start of **RH17002_D16** and ended 09.49 and a blue water hopped commenced to the start of the next dive site (no recovery on deck). **RH17002_D17** on station at 10.53 with the dive ending at 12.01. HD video was not recorded on **RH17002_D17**. A blue water with no recovery on deck was used to transit to **RH17002_D18**. **RH17002_D17** started at 13.11 and finished at 15.15. A blue water with no recovery on deck was used to transit to **RH17002_D19** with the dive starting at 16.48 and finishing at 17.53. The ROV was recovered to deck at the end of this dive at 18.44. Transit to next station. ROV deployed at 19.42 for **RH17002_D20.** Dive finished at 20.29. ROV did a blue water hop to **RH17002_D21** arriving on station at 22.53. ROV dive aborted at 23.39 due to problems with the umbilical after catching a rope (see technical difficulties).

27th June 2017: Porcupine Bank Canyon
Partly cloudy and calm

ROV recovered to deck at 00.41 and damage to umbilical assessed. Umbilical repaired at **RH17002_D21** continued from where it was aborted and call **RH17002_D21a. RH17002_D21a** commenced at 01.18 finishing successfully at 02.58. Blue water hop undertaken to **RH17002_D22** arriving on station at 04.45. **RH17002_**D22 completed at 05.55. Blue water hop undertaken to **RH17002_D23**. On station at **RH17002_D23** at 07.22. ROV recovered to deck at 08.55 and reconfigured for rockdrilling. Transit to **RH17002_CTD40**. **RH17002_CTD40** in taken at 10.13 (downcast) and the upcast **RH17002_CTD41** taken at 11.34 to a depth of 1794m in the middle of the upper canyon. Transit to next station. **RH17002_CTD42** in taken at 13.02 (downcast) and the upcast **RH17002_CTD43** taken at 13.22 to a depth of 1180m next to the southern cliffed margin. Transit to the first rockdrill station. ROV deployed at 15.32 for rockdrill ROV dive **RH17002_D24**. Rockdrilling was unsuccessful due to steep slopes at the base of the rock exposures prohibiting the placement of the ROV at a site where drilling was possible. ROV dive **RH17002_D25** started at 19.00 and rockdrill **RH17002_R1** successfully collected from 970m water depth between 20.07 and 20.34. ROV recovered to deck at 22.23.

28th June 2017: Porcupine Bank Canyon to Galway Bay
Rainy and gales

ROV deployed at 00.50 for **RH17002_D26** for another rockdrill attempt at a different station. ROV recovered on deck at 03.30 at the end of **RH17002_D26** with the successful recovery of **RH17002_R2**. Weather too bad to redeploy ROV or CTD (see technical difficulties). Vessel riding the waves. USBL pole raised at 04.40. Commence

transit at 04.45 for Galway in heavy and rising sea (Gale Force 9) with waves beam on.

29th June 2017: Galway
Cloudy

Arrive in Galway at 09.00. Survey ended.

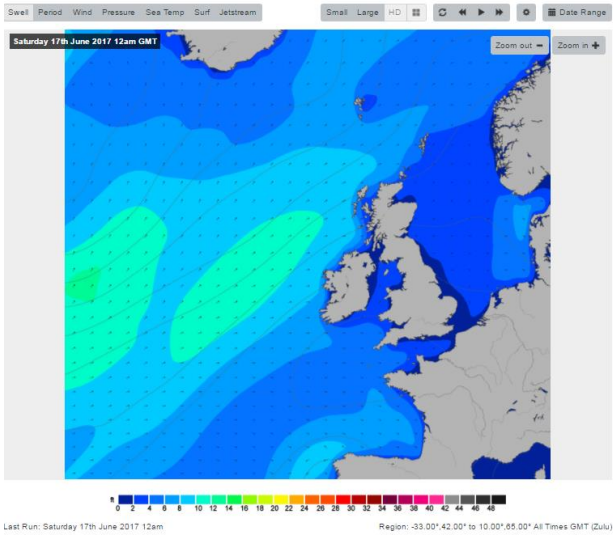
7 Weather Report

All times are recorded as local time (GMT=UTC+1hr)

15th March 2017 – Galway Dock
04.00 – Wind SW, Force 5, 1004 mbar, 14°C, calm
08.00 – Wind SW, Force 4, 1002 mbar, 15°C, calm
12.00 – Wind SW, Force 4, 1002 mbar, 16°C, calm
16.00 – Wind SW, Force 5, 1007 mbar, 16°C, calm
20.00 – Wind SW, Force 5, 1014 mbar, 16°C, calm
23.59 – Wind SW, Force 4, 1017 mbar, 12°C, calm

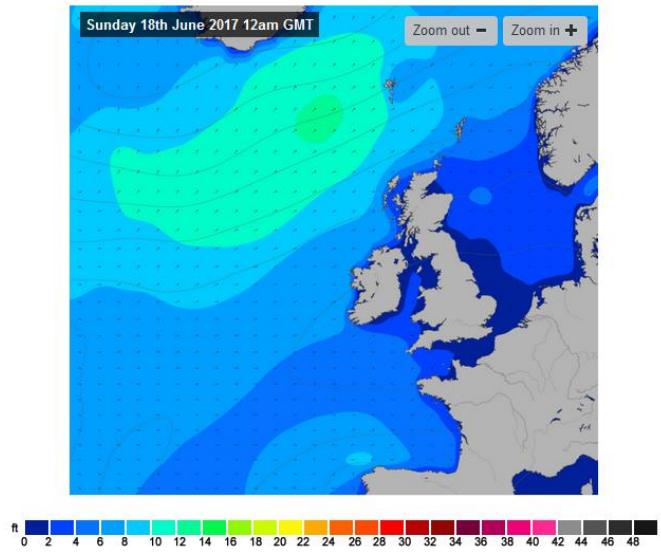
16th March 2017 – Galway Dock
04.00 – Wind SW, Force 4, 1018 mbar, 14°C, calm
08.00 – Wind SW, Force 4, 1020 mbar, 14°C, calm
12.00 – Wind SW, Force 5, 1022 mbar, 14°C, calm
16.00 – Wind SW, Force 4, 1024 mbar, 14°C, calm
20.00 – Wind SW, Force 3, 1024 mbar, 14°C, calm
23.59 – Wind SW, Force 3, 1024 mbar, 14°C, calm

17th March 2017 – Galway Dock to Galway Bay
04.00 – Wind SW, Force 4, 1024 mbar, 14°C, calm
08.00 – Wind SW, Force 4, 1024 mbar, 15°C, calm
12.00 – Wind SW, Force 4, 1024 mbar, 16°C, partly cloudy
16.00 – Wind SW, Force 3, 1024 mbar, 18°C, partly cloudy
20.00 – Wind SW, Force 5, 1023 mbar, 15°C, cloudy
23.59 – Wind SW, Force 4, 1023 mbar, 14°C, calm



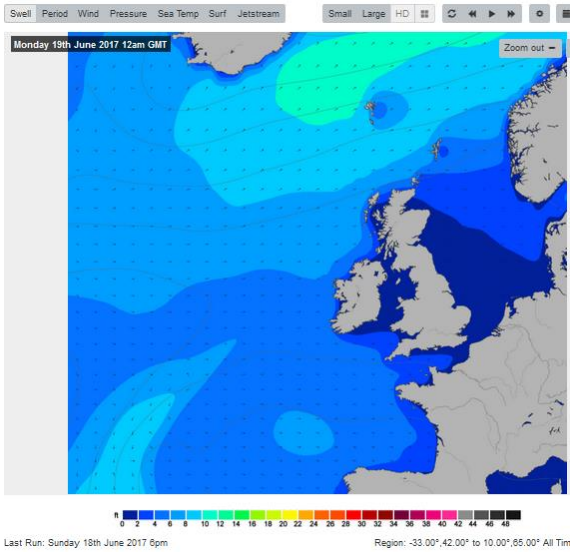
18th March 2017 – Galway Bay

04.00 – Wind SW, Force 2, 1023 mbar, 15°C, calm
08.00 – Wind SSE, Force 2, 1023 mbar, 15°C, calm
12.00 – Wind SSW, Force 1, 1022 mbar, 18°C, partly cloudy
16.00 – Wind SSW, Force 2, 1021 mbar, 20°C, partly cloudy
20.00 – Wind SW, Force 2, 1020 mbar, 21°C, blue sky
23.59 – Wind SW, Force 1, 1019 mbar, 17°C, blue sky

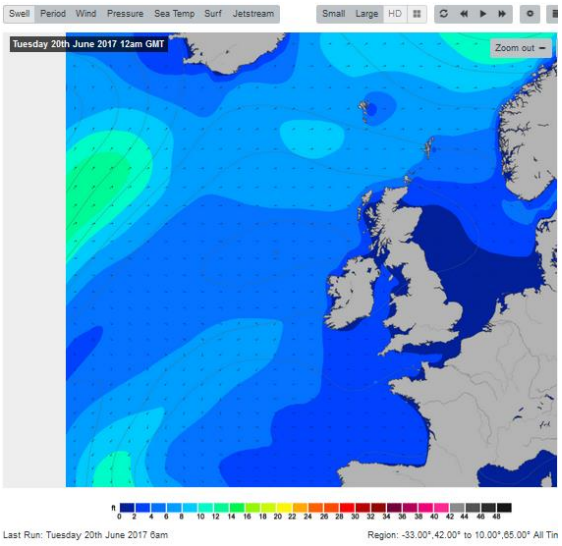


19th March 2017 – Galway Bay

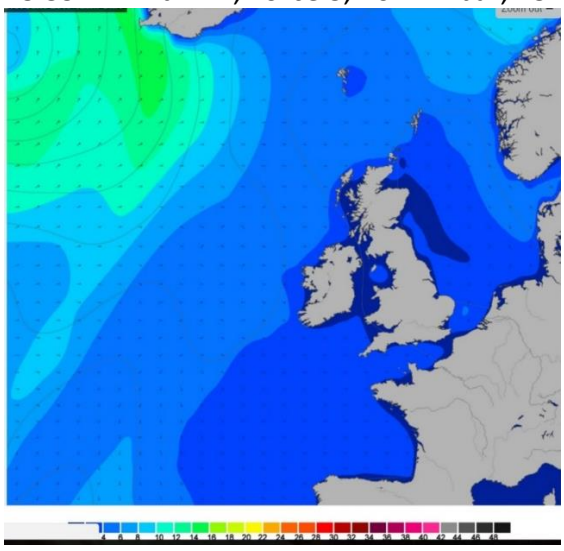
04.00 – Wind light, Airs, 1070 mbar, 15°C, blue sky
08.00 – Wind light, Airs, 1020 mbar, 18°C, blue sky
12.00 – Wind light, Airs, 1020 mbar, 21°C, blue sky
16.00 – Wind N, Force 3, 1019 mbar, 20°C, blue sky
20.00 – Wind NW, Force 4, 1019 mbar, 19°C, blue sky
23.59 – Wind NW, Force 5, 1019 mbar, 18°C, blue sky



20th March 2017 – Galway Bay to Porcupine Bank Canyon
04.00 – Wind NE, Force 3, 1019 mbar, 16°C, overcast
08.00 – Wind NE, Force 5, 1017 mbar, 18°C, overcast
12.00 – Wind NE, Force 5, 1015 mbar, 18°C, overcast
16.00 – Wind SE, Force 4, 1013 mbar, 18°C, overcast
20.00 – Wind SE, Force 5, 1010 mbar, 17°C, overcast
23.59 – Wind SE, Force 5, 1010 mbar, 16°C, overcast

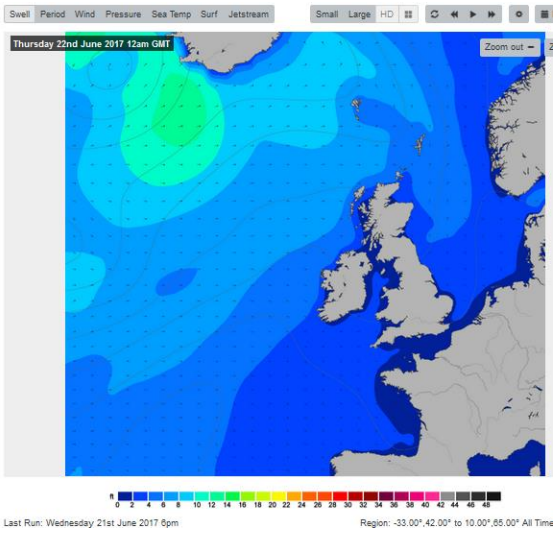


21st March 2017 – Porcupine Bank Canyon
04.00 – Wind SSW, Force 3, 1009 mbar, 14°C, overcast.
08.00 – Wind W, Force 3, 1010 mbar, 16°C, overcast.
12.00 – Wind NW, Force 4, 1015 mbar, 18°C, partly cloudy
16.00 – Wind NW, Force 3, 1012 mbar, 16°C, overcast.
20.00 – Wind WNW, Force 4, 1014 mbar, 13°C, cloudy
23.59 – Wind NW, Force 3, 1014 mbar, 13°C, overcast.



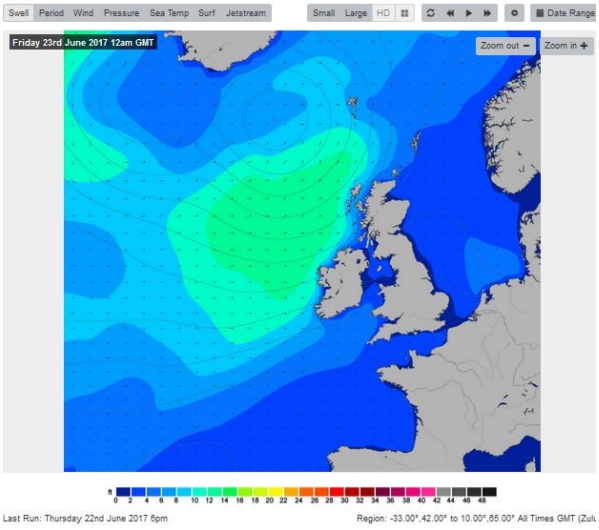
22nd March 2017 – Porcupine Bank Canyon

04.00 – Wind SW, Force 3, 1014 mbar, 14°C, overcast.
08.00 – Wind SSW, Force 5, 1012 mbar, 14°C, overcast.
12.00 – Wind SW, Force 6, 1012 mbar, 13°C, partly cloudy
16.00 – Wind SW, Force 8, 1009 mbar, 13°C, overcast.
20.00 – Wind SSW, Force 8, 1009 mbar, 13°C, gale.
23.59 – Wind SSW, Force 8, 1009 mbar, 13°C, overcast.



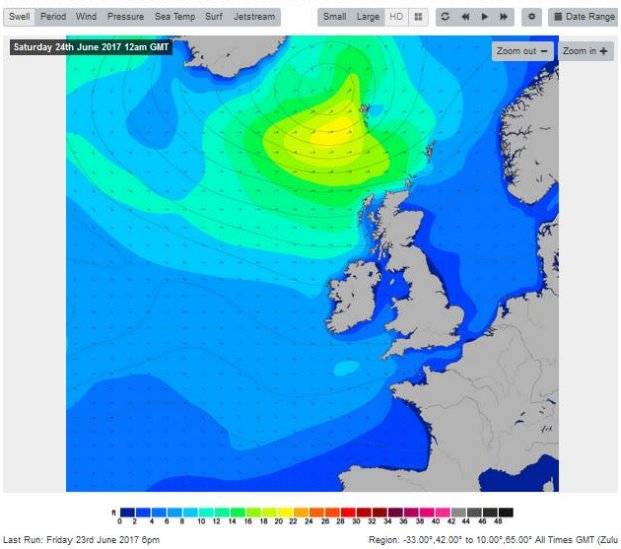
23rd March 2017 – Porcupine Bank Canyon

04.00 – Wind SW, Force 6, 1008 mbar, 13°C, overcast.
08.00 – Wind W, Force 4, 1010 mbar, 14 °C, overcast
12.00 – Wind WSW, Force 3/4, 1012 mbar, 16 °C, partly cloudy
16.00 – Wind SW, Force 2, 1013 mbar, 16°C, overcast
20.00 – Wind NW, Force 5, 1013 mbar, 14°C, overcast
23.59 – Wind W, Force 5, 1012 mbar, 12°C, overcast



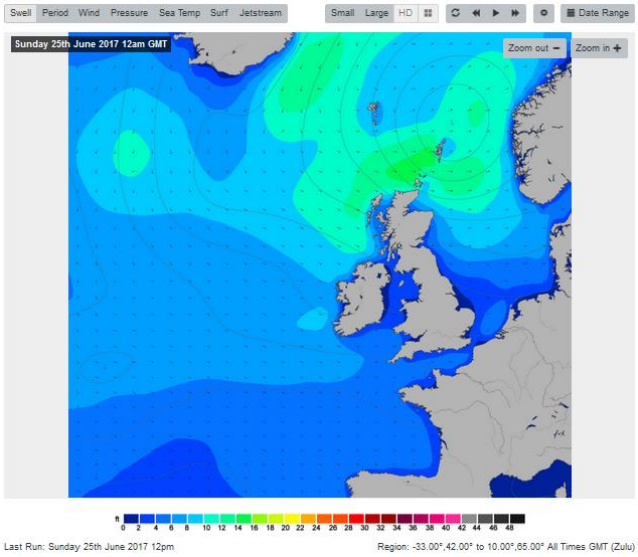
24th March 2017 – Porcupine Bank Canyon

04.00 – Wind NW, Force 6, 1012 mbar, 12°C, overcast
08.00 – Wind WSW, Force 5, 1012 mbar, 14°C, overcast
12.00 – Wind SW, Force 6, 1012 mbar, 14°C, overcast
16.00 – Wind SW, Force 5, 1012 mbar, 14°C, overcast
20.00 – Wind W, Force 5, 1012 mbar, 14°C, overcast
23.59 – Wind W, Force 6, 1012 mbar, 14°C, overcast

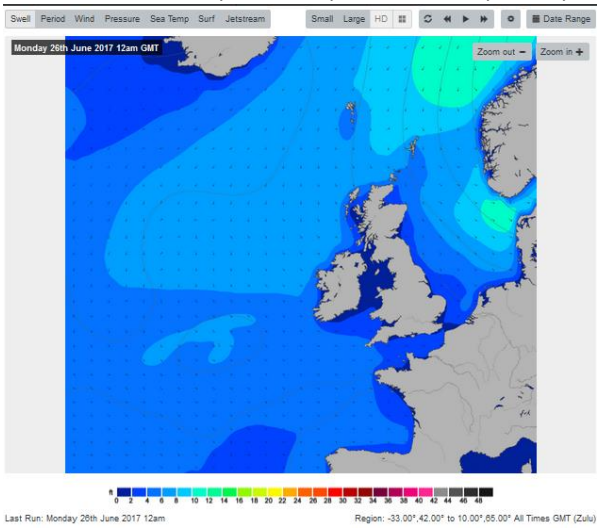


25th March 2017 – Porcupine Bank Canyon

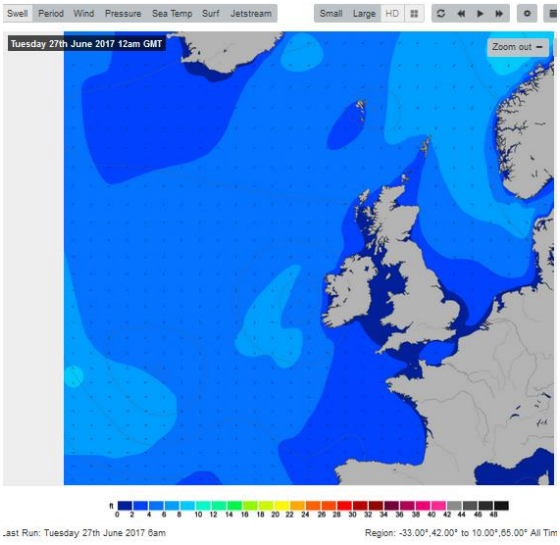
04.00 – Wind NW, Force 5, 1012 mbar, 14°C, overcast
08.00 – Wind Light airs, 1014 mbar, 14°C, cloudy
12.00 – Wind N, Force 2, 1015 mbar, 15°C, partly cloudy
16.00 – Wind NE, Force 1, 1015 mbar, 10°C, overcast
20.00 – Wind NE, Force 2, 1014 mbar, 16°C, overcast
23.59 – Wind E, Force 4, 1014 mbar, 13°C, overcast



26th March 2017 – Porcupine Bank Canyon
04.00 – Wind NW, Force 5, 1012 mbar, 14ºC, overcast
08.00 – Wind light, Airs, 1014 mbar, 14ºC, cloudy
12.00 – Wind N, Force 2, 1015 mbar, 15ºC, partly cloudy
16.00 – Wind NE, Force 1, 1015 mbar, 16ºC, overcast
20.00 – Wind NE, Force 2, 1014 mbar, 16ºC, overcast
23.59 – Wind NE, Force 4, 1014 mbar, 13ºC, overcast

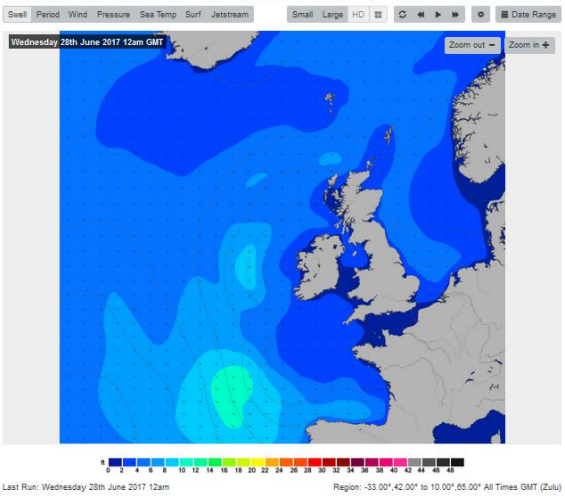


27th March 2017 – Porcupine Bank Canyon
04.00 – Wind NW, 1005 mbar, 13ºC, mist
08.00 – Wind NE, Force 3, 1004 mbar, 13ºC, cloudy
12.00 – Wind NE, Force 4, 1004 mbar, 15ºC, partly cloudy
16.00 – Wind NE, Force 2, 1003 mbar, 15ºC, partly cloudy
20.00 – Wind NE, Force 5, 1003 mbar, 13ºC, cloudy
23.59 – Wind NW, Force 7, 1003 mbar, 12ºC, overcast



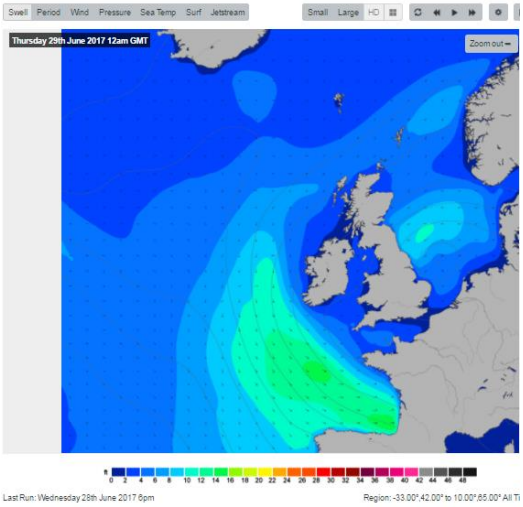
28th March 2017 – Porcupine Bank Canyon

04.00 – Wind NNW, Force 9, 1002 mbar, 12°C, Rain
08.00 – Wind NW, Force 9, 1004 mbar, 13°C, Gale
12.00 – Wind NW, Force 7, 1004 mbar, 12°C, overcast and rainy
16.00 – Wind xx, Force x, xxx mbar, xx°C, x
20.00 – Wind xx, Force x, xxx mbar, xx°C, x
23.59 – Wind xx, Force x, xxx mbar, xx°C



29th March 2017 – Porcupine Bank Canyon

04.00 – Wind xx, Force x, xxx mbar, xx°C
08.00 – Wind xx, Force x, xx mbar, xx°C
12.00 – Wind xx, Force x, xxx mbar, xx°C, x
16.00 – Wind xx, Force x, xxx mbar, xx°C, x
20.00 – Wind xx, Force x, xxx mbar, xx°C, x
23.59 – Wind xx, Force x, xxx mbar, xx°C



Appendices

Appendix I

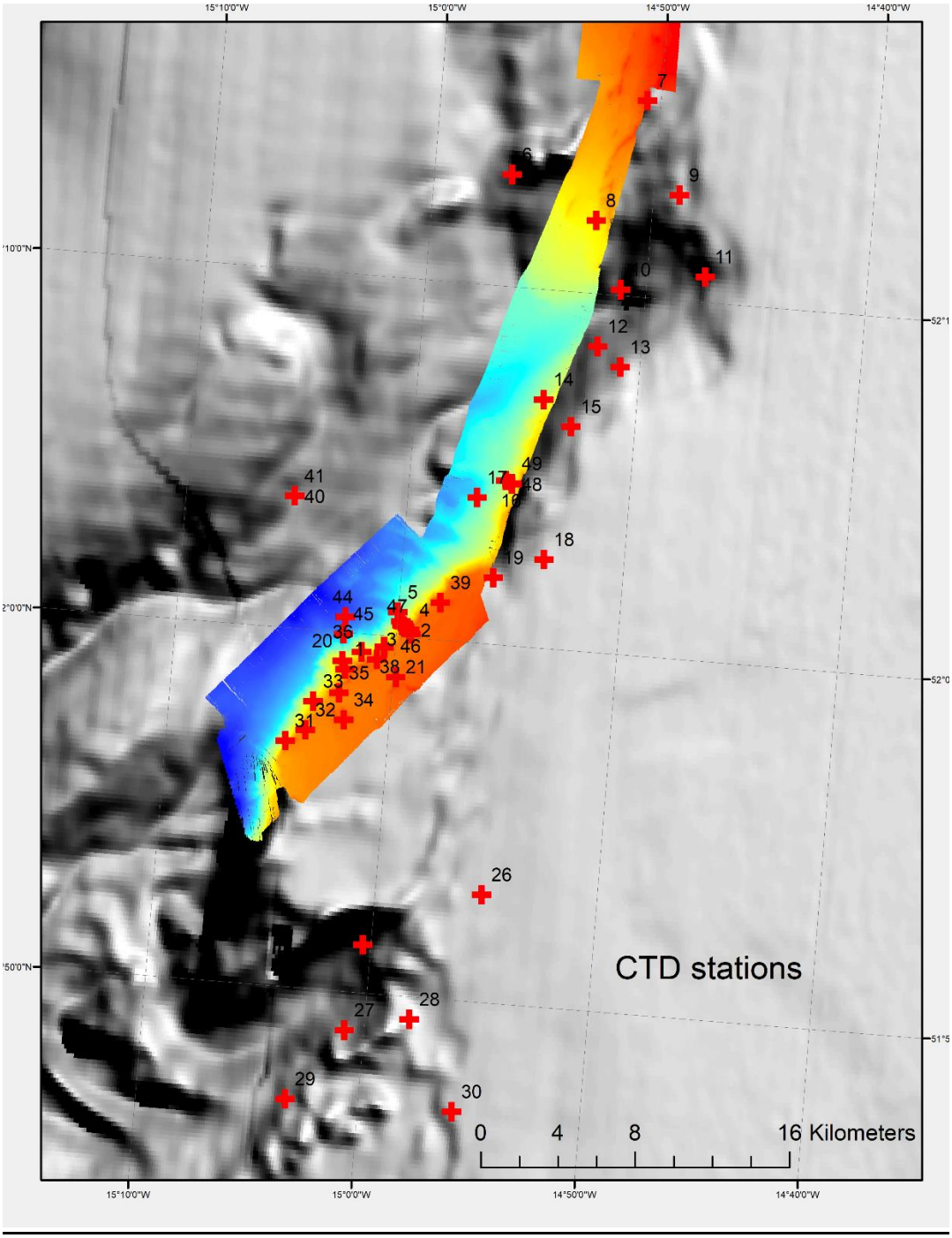
Personnel

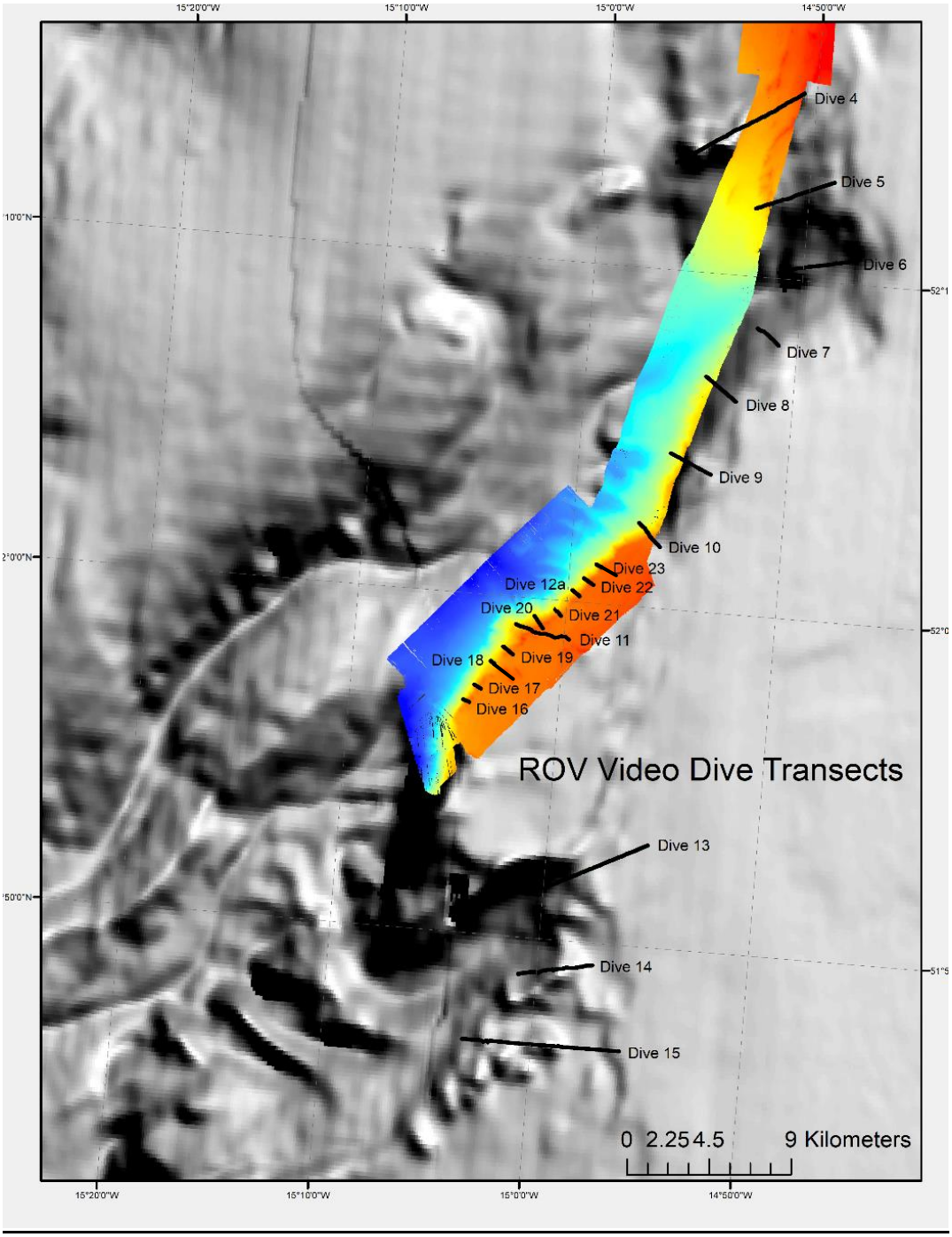
Ship's Officers & Crew	**Scientific Party**
Harry McClenahan *Captain*	Prof. Andy Wheeler *Chief Scientist – Geologist (UCC)*
Michael O Regan *Chief Officer*	Dr. Aaron Lim (UCC) *Geologist/Multibeam (Galway Bay only)*
Pat Connelly *2nd Officer*	Siobhan Burke (UCC) *Geologist/Multibeam operator*
Sarah Ledwith *2nd Officer*	Bogna Griffin (GMIT) *Biologist*
Rory O Rourke *Chief Engineer*	Findabhair Ní Fhoalain *Biologist*
Ray Hewitt *2nd Engineer*	Luke O'Reilly (UCC) *Geologist*
Julian O'Sullivan *Electrical Engineer*	Gerard Summers (UCC) *Geologist/Geoinformatics*
Noel Wheeler *Assistant Engineer*	
Kieran Lambie *Boson*	**Holland I ROV Team**
Glen Murray *Assistant Boson*	Paddy O'Driscoll *ROV technician/pilot (team lead)*
Jonathon O'Mahony Able Seaman	Karl Bredendick ROV technician/pilot
Gavin Walsh Able Seaman	Rob Carpenter *ROV technician/pilot*
Fergus Cunningham Able Seaman	Colin Ferguson *ROV technician/pilot*
Steven O'Reilly Able Seaman	Liam Murphy *ROV technician/pilot*
Declan Maguire *Cook*	Martin Rouse ROV technician/pilot
Bill Adams *Cook's Assistant*	Ian Florence *Kongsberg technician (Galway Bay only)*

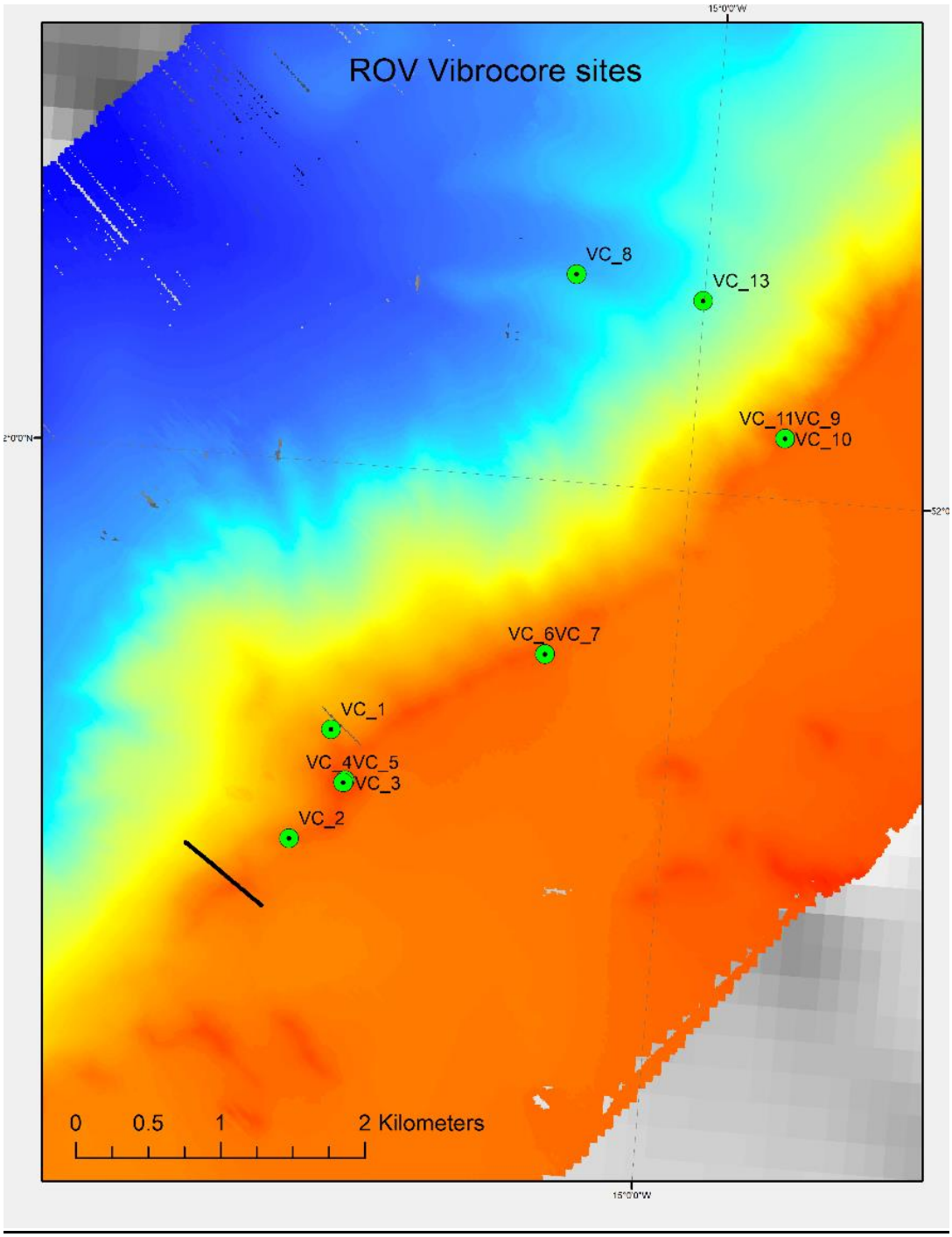
Appendix II

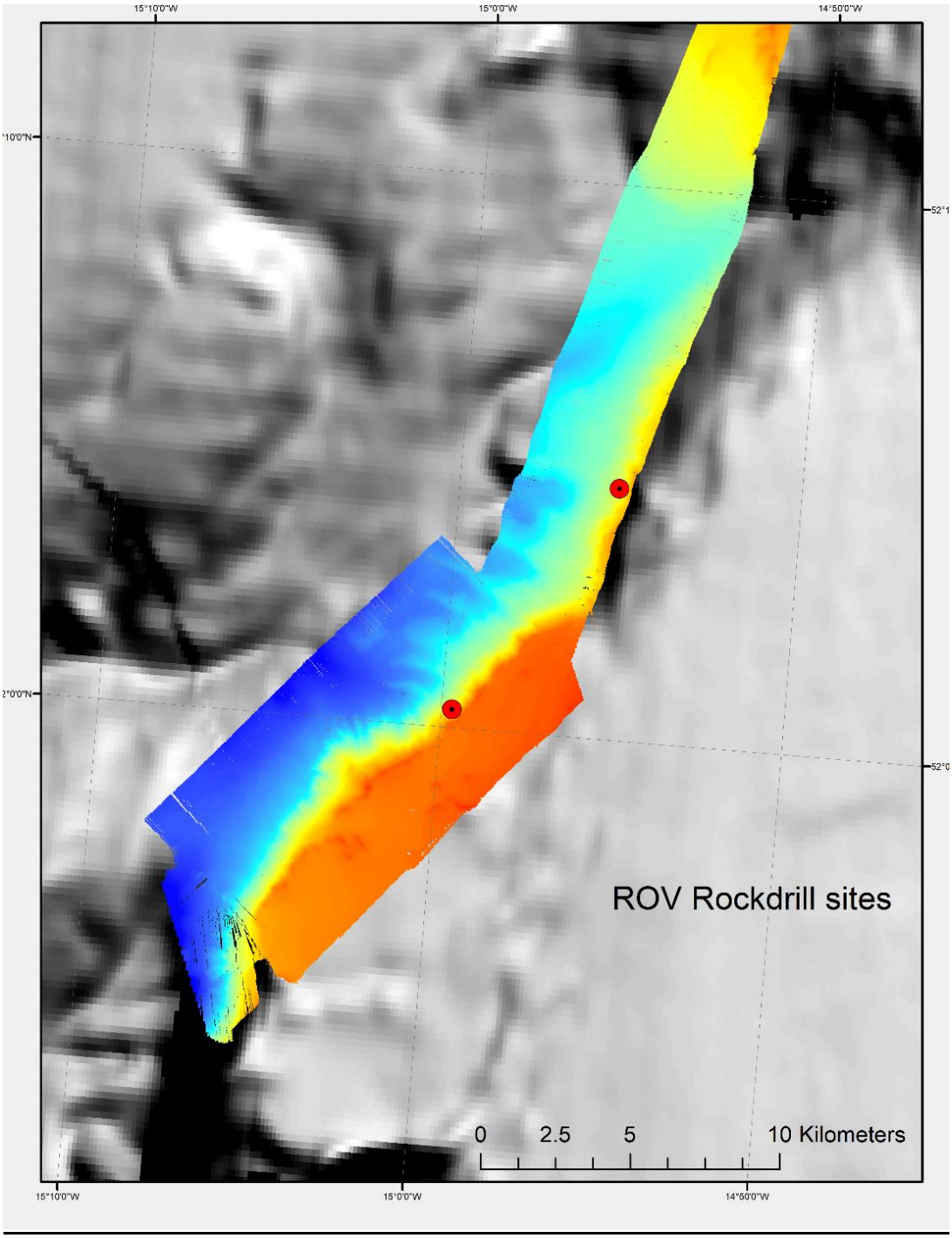
Area maps

Porcupine Bank Canyon




15°20'0"W
15°10'0"W
15°0'0"W
14°50'0"W
Dive 4
Dive 5
Dive 6
Dive 7
Dive 8
Dive 9
Dive 10
Dive 23
Dive 12a
Dive 22
Dive 20
Dive 21
Dive 11
Dive 18
Dive 19
Dive 17
Dive 16
ROV Video Dive Transects
Dive 13
Dive 14
Dive 15
0 2.254.5 9 Kilometers


ROV Vibrocore sites
VC_8
VC_13
VC_11VC_9
VC_10
VC_6VC_7
VC_1
VC_4VC_5
VC_3
VC_2
0
0.5
1
2 Kilometers


15°10'0"W
15°0'0"W
14°50'0"W
ROV Rockdrill sites
0
2.5
5
10 Kilometers

Appendix III
Station Lists

Vibrocore Stations *All times are recorded as UTC (GMT-1hr)*

Core	St	Date	Time	Lat	Long Min	Water Depth	Penetration (m)	Retrieved core (m)	Comment
RH17002_VC1	1	20/06/17	22.29	51° 59.008	-15° 02.022	840m	0.49	0.39	Open coral area in canyon – vented sediment from top of barrel
~~RH17002_VC2~~	1	20/06/17	22.50	51° 58.974	-15° 02.209	840m	0.46	0.10	Open coral area in canyon – **CORE DISCARDED**
~~RH17002_VC3~~	2	20/06/17	23.59	51° 58.823	-15° 01.913	624m	0.50	0.26	Ziggy Md upper flank canyon – **CORE DISCARDED**
RH17002_VC4	2	21/06/17	00.25	51° 58.814	-15° 01.923	612m	1.23	1.04	Ziggy Md Summit
RH17002_VC5	2	21/06/17	00.43	51° 58.814	-15° 01.923	612m	1.26	0.71	Ziggy Md Summit
RH17002_VC6	3	21/06/17	18.30	51° 59.354	-15° 00.773	651m	1.23	0.66	Coral md summit, outside of core muddy to 0.75m
RH17002_VC7	3	21/06/17	18.55	51° 59.353	-15° 00.773	651m	1.26	0.98	Coral md summit, outside of core muddy to 1.05m
RH17002_VC8	3	21/06/17	19.11	51° 59.353	-15° 00.773	650m	1.21	1.00	Coral md summit, outside of core muddy to 1.00m
RH17002_VC9	4	21/06/17	21.44	52° 00.227	-14° 59.437	656m	1.26	1.06	Querci Md summit, outside of core muddy to 1.20m
RH17002_VC10	4	21/06/17	22.03	52° 00.227	-14° 59.435	657m	1.26	0.73	Querci Md summit, outside of core muddy to 1.10m
RH17002_VC11	4	21/06/17	22.15	52° 00.227	-14° 59.437	657m	1.25	1.02	Querci Md summit, outside of core muddy to 1.10m
RH17002_VC12	5	22/06/17	00.16	52° 00.740	-15° 00.067	1469m	1.04	0.42	Muddy area in upper canyon
~~RH17002_VC13~~	5	22/06/17	00.48	52° 00.713	-14° 59.997	1426m	0.20cm	0.10	Muddy area in upper canyon– **CORE DISCARDED**

CTD Stations *All times are recorded as UTC (GMT-1hr)*

CTD	St	Front winch or ROV	Date	Time	Lat	Long Min	Water Depth	Comment
RH17002_CTD1	1	ROV D1	20/06/17	21.47	51° 59.005	-15° 02.175	840m	Downcast
RH17002_CTD2	2	Winch	21/06/17	09.33	52° 00.135	-14° 59.323	633m	Did not reach the seabed as CTD failed
RH17002_CTD3	3	ROV D2	21/06/17	19.23	51° 59.353	-15° 00.773	648m	Upcast
RH17002_CTD4	4	ROV D3	21/06/17	21.08	52° 00.252	-14° 59.394	690m	Downcast
RH17002_CTD5	5	ROV D3	22/06/17	00.53	52° 00.713	-14° 59.997	1426m	Upcast
RH17002_CTD6	6	ROV D4	22/06/17	08.40	52° 13.162	-14° 56.467	1047	Downcast
RH17002_CTD7	6	ROV D4	22/06/17	16.06	52° 15.522	-14° 50.605	580mm	Upcast
RH17002_CTD8	7	ROV D5	23/06/17	04.34	52° 12.074	-14° 52.494	1013m	Downcast
RH17002_CTD9	7	ROV D5	23/06/17	09.21	52° 12.963	-14° 48.815	568m	Upcast
RH17002_CTD10	8	ROV D6	23/06/17	12.04	52° 10.200	-14° 51.136	1254m	Downcast
RH17002_CTD11	8	ROV D6	23/06/17	17.01	52° 10.744	-14° 47.361	639m	Upcast
RH17002_CTD12	9	ROV D7	23/06/17	18.54	52° 08.565	-14° 51.970	1031m	Downcast
RH17002_CTD13	9	ROV D7	23/06/17	21.03	52° 08.044	-14° 50.871	701m	Upcast
RH17002_CTD14	10	ROV D8	23/06/17	22.50	52° 06.965	-14° 54.212	1233m	Downcast
RH17002_CTD15	10	ROV D8	23-24/06/17	01.44	52° 06.279	-14° 52.881	644m	Upcast
RH17002_CTD16	11	ROV D9	24/06/17	04.12	52° 04.627	-14° 55.619	1250m	Downcast
RH17002_CTD17	11	ROV D9	24/06/17	08.13	52° 04.091	-14° 56.850	574m	Upcast
RH17002_CTD18	12	ROV D10	24/06/17	10.30	52° 02.511	-14° 53.612	1237m	Downcast
RH17002_CTD19	12	ROV D10	24/06/17	13.39	52° 01.894	-14° 55.830	685m	Upcast
RH17002_CTD20	13	ROV D11	24/06/17	16.35	51° 59.231	-15° 02.321	1017m	Downcast
RH17002_CTD21	13	ROV D11	24/06/17	19.46	51° 58.898	-14° 59.854	698m	Upcast
RH17002_CTD22	13a	Aborted ROV dive	24/06/17	23.33	52° 00.355	-14° 59.740	1053m	Downcast at site of aborted dive which was in the wrong position
RH17002_CTD23	14	ROV D12a	25/06/17	00.16	52° 00.365	-14° 59.767	1053m	Downcast
RH17002_CTD24	14	ROV D12a	25/06/17	01.32	52° 00.203	-14° 59.411	675m	Upcast
RH17002_CTD25	15	ROV D13	25/06/17	04.33	51° 51.373	-15° 00.345	1045m	Downcast
RH17002_CTD26	15	ROV D13	25/06/17	11.13	51° 53.038	-14° 55.184	589m	Upcast

RH17002: CoCoHaCa

CTD	St	Front winch or ROV	Date	Time	Lat	Long Min	Water Depth	Comment
RH17002_CTD27	16	ROV D14	25/06/17	13.09	51° 48.957	-15° 00.851	1030m	Downcast
RH17002_CTD28	16	ROV D14	25/06/17	18.25	51° 49.406	-14° 57.972	723m	Upcast
RH17002_CTD29	17	ROV D15	25/06/17	20.03	51x° 46.909	-15° 03.256	1075m	Downcast
RH17002_CTD30	17	ROV D15	26/06/17	04.22	51° 46.929	-14° 55.744	591m	Upcast
RH17002_CTD31	18	ROV D16	26/06/17	07.15	51° 56.876	-15° 04.581	966m	Downcast (missing top 100m). No upcast at end
RH17002_CTD32	19	ROV D17	26/06/17	11.01	51° 57.231	-15° 03.720	766m	Upcast (no downcast)
RH17002_CTD33	20	ROV D18	26/06/17	12.11	51° 58.039	-15° 03.480	763m	Downcast
RH17002_CTD34	20	ROV D18	26/06/17	14.16	51° 57.598	-15° 02.030	717m	Upcast
RH17002_CTD35	21	ROV D19	26/06/17	16.59	51° 58.334	-15° 02.350	749m	Upcast (no downcast)
RH17002_CTD36	22	ROV D20	26/06/17	18.49	51° 59.528	-15° 01.480	992m	Downcast (no upcast)
RH17002_CTD37	23	ROV D21	26/06/17	22.39	51° 59.700	-15° 00.485	873m	Upcast (no downcast)
RH17002_CTD38	23	ROV D21a	27/06/17	01.28	51° 59.726	-15° 00.487	869m	Downcast (no upcast)
RH17002_CTD39	25	ROV D23	27/06/17	08.17	52° 01.079	-14° 58.118	600m	Upcast (no downcast)
RH17002_CTD40	26	Winch	27/06/17	10.13	52° 03.717	-15° 05.085	1794m	Downcast
RH17002_CTD41	26	Winch	27/06/17	11.00	52° 03.717	-15° 05.085	1794m	Upcast
RH17002_CTD42	27	Winch	27/06/17	13.02	52° 00.467	-14° 59.833	1180m	Downcast
RH17002_CTD43	27	Winch	27/06/17	13.23	52° 00.467	-14° 59.833	1180m	Upcast
RH17002_CTD44	28	ROV D24	27/06/17	14.39	52° 00.467	-15° 02.346	904m	Downcast
RH17002_CTD45	28	ROV D24	27/06/17	17.18	51° 59.985	-15° 02.371	877m	Upcast
RH17002_CTD46	29	ROV D25	27/06/17	19.04	52° 00.343	-14° 59.678	970m	Downcast
RH17002_CTD47	29	ROV D25	27/06/17	20.37	52° 00.345	-14° 59.679	970m	Upcast
RH17002_CTD48	30	ROV D26	27/06/17	23.54	52° 04.538	-14° 55.336	1136m	Downcast
RH17002_CTD49	30	ROV D26	28/06/17	02.23	52° 04.554	-14° 55.334	1130m	Upcast

Rockdrill Stations *All times are recorded as UTC (GMT-1hr)*

Rockdrill	St	Date	Time	Lat	Long Min	Water Depth	Comment
RH17002_R1	29	27/06/17	20.07	52° 00.345	-14° 59.679	970m	Exposed ?gabbro on step wall of canyon. 85mm plug retrieved
RH17002_R2	30	28/06/17	01.18	52° 04.553	-14° 55.331	1132m	Exposed sandstone on step wall of canyon. 116mm plug retrieved

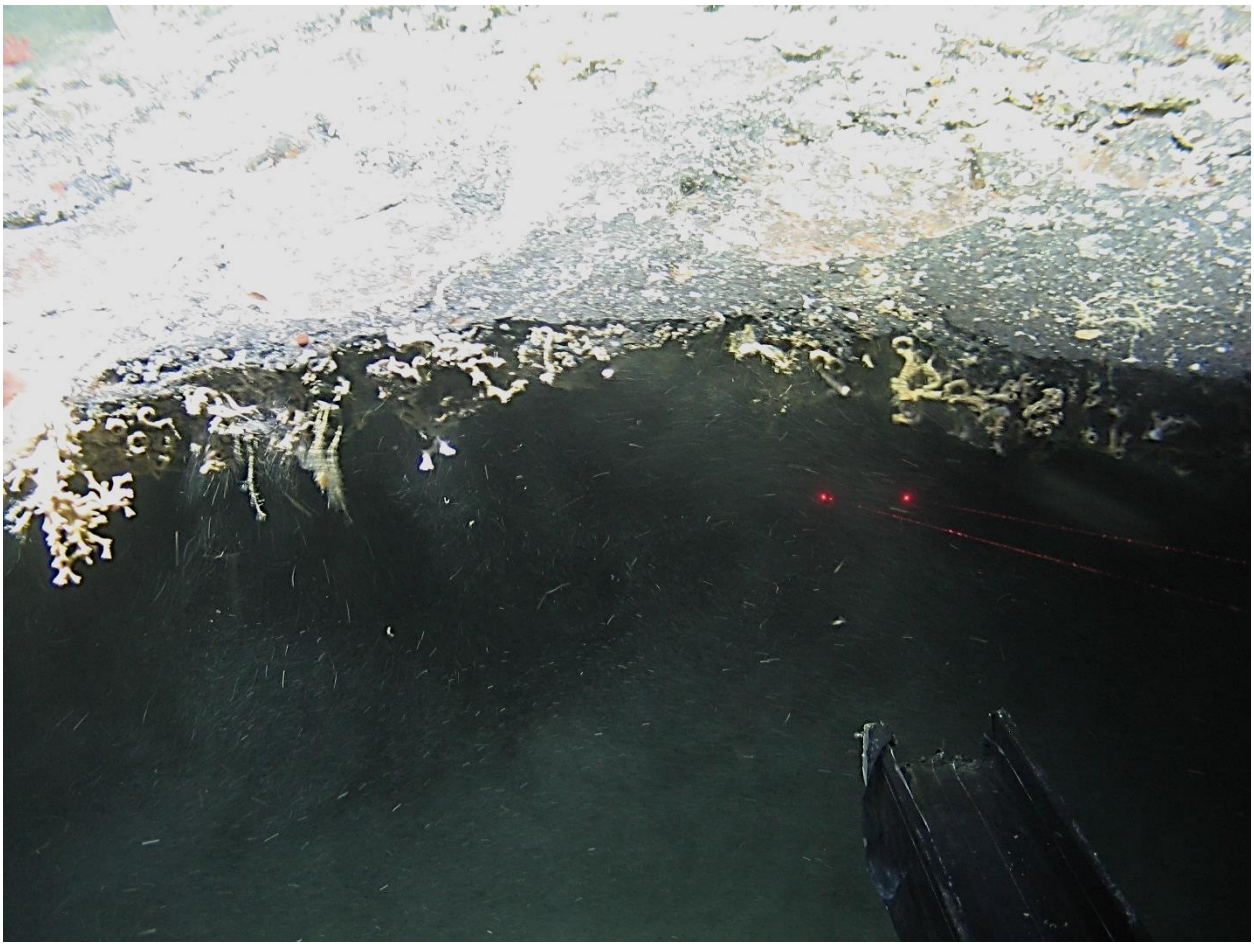
ROV Dive Stations *All times are recorded as UTC (GMT-1hr)*

Dive	St	Date	Time off deck	Time on bottom	Lat SOL	Long SOL	Water Depth	Lat EOL	Long EOL	Time off bottom	Time on deck	Comments
RH17002_D1	1	20/06/17 – 21/06/17	21.29	22.24	51° 59.005	-15° 02.175	840-612m	51° 58.814	-15° 01.923	00.50	01.21	Vibrocores VC1-5 taken. RH17002_CTD1
RH17002_D2	3	21/06/17	17.28	18.12	51° 59.338	-15° 00.747	651-650m	51° 59.353	-15° 00.773	19.22	19.58	Vibrocores VC6-8 taken. RH17002_CTD3
RH17002_D3	4 & 5	21-22/06/17	21.00	21.22	52° 00.252	-14° 59.397	702-1426m	52° 00.713	-14° 59.997	00.52	01.49	Vibrocores VC9-13 taken. RH17002_CTD4 & 5
RH17002_D4	6	22/06/17	08.40	09.25	52° 13.162	-14° 56.466	1047-580m	52° 15.522	-14° 50.605	16.04	17.45	RH17002_CTD6 & 7
RH17002_D5	7	23/06/17	04.20	05.05	52° 12.074	-14° 52.494	1013-568m	52° 12.963	-14° 48.815	09.21	09.42	RH17002_CTD8 & 9
RH17002_D6		23/06/17	11.49	12.57	52° 10.200	-14° 51.136	1251-639m	52° 10.749	-14° 47.316	17.00	17.38	GoPro camera deployment failed. RH17002_CTD10 & 11
RH17002_D7	9	23/06/17	18.52	19.42	52°. 08.519	-14° 51.911	1031-702m	52° 08.044	-14° 50.871	21.03	21.39	Survey line cut short. RH17002_CTD12 & 13
RH17002_D8	10	23-24/06/17	22.46	00.24	52°. 06.965	-14° 54.212	1233-644m	52° 06.300	-14° 52.688	01.41	02.17	RH17002_CTD14 & 15
RH17002_D9	11	24/06/17	04.12	04.55	52°. 04.643	-14° 55.619	1250-574m	52°. 04.091	-14° 53.599	08.09	08.37	GoPro deployed at start of dive. RH17002_CTD16 & 17
RH17002_D10	12	24/06/17	10.30	11.20	52°. 02.506	-14° 56.845	1237-685m	52°. 01.894	-14° 55.830	13.39	14.12	RH17002_CTD18 & 19

Dive	St	Date	Time off deck	Time on bottom	Lat SOL	Long SOL	Water Depth	Lat EOL	Long EOL	Time off bottom	Time on deck	Comments
RH17002_D11	13	24/06/17	15.48	16.35	51º. 59.231	-15º 02.321	1017-698m	51º. 58.898	-14º 59.815	19.48	20.26	Survey line cut short. RH17002_CTD20 & 21
RH17002_D12a	14	24-25/06/17	23.27	00.16	52º. 00.365	-14º 59.767	1053-674m	52º. 00.203	-14º 59.411	01.32	02.03	Initial attempt at dive aborted due to wrong ship's position. RH17002_CTD23 & 24
RH17002_D13	15	25/06/16	04.20	05.18	51º. 51.426	-15º 00.302	1045-589m	51º. 53.040	-14º 55.182	10.41	11.20	Poor ROV nav at start of dive. RH17002_CTD25 & 26
RH17002_D14	16	25/06/17	12.58	13.49	51º. 48.957	-15º 00.851	1036-723m	51º. 49.369	-14º 57.402	18.25	19.00	GoPro deployed at start of dive. RH17002_CTD27 & 28
RH17002_D15	17	25-26/06/17	20.00	20.46	51º. 46.709	-15º 03.274	1075-591m	51º. 46.920	-14º 55.728	04.19	04.53	RH17002_CTD29 & 30
RH17002_D16	18	26/06/17	07.01	07.46	51º. 56.569	-15º 04.581	966-754m	51º 56.824	-15º 04.220	08.48	n/a	Blue water hop to next station. RH17002_CTD31
RH17002_D17	19	26/06/17	n/a	09.53	51º. 57.358	-15º 04.066	c.950-766m	51º. 57.240	-15º 03.720	11.01	n/a	Blue water hop to next station. No HD video. RH17002_CTD32
RH17002_D18	20	26/06/17	n/a	12.11	51º. 58.040	-15º 03.408	952-717m	51º. 57.598	-15º 02.030	14.16	n/a	Blue water hop to next station. RH17002_CTD33 & 34
RH17002_D19	21	26/06/17	n/a	15.48.	51º. 58.547	-15º 02.841	987-749m	51º. 58.334	-15º 02.353	16.53	17.44	RH17002_CTD35
RH17002_D20	22	26/06/17	18.45	19.28	51º. 59.521	-15º 01.478	992-716m	51º. 59.163	-15º 01.042	20.29	n/a	Blue water hop to next station. RH17002_CTD36
RH17002_D21	23	26/06/17	n/a	21.53	51º. 59.787	-15º 00.552	985-873m	51º. 59.699	-15º 00.485	22.39	23.41	Dive aborted due to problems with the umbilical. RH17002_CTD37
RH17002_D21a	23	27/06/17	01.18	01.57	51º. 59.705	-15º 00.399	869-625m	51º. 59.578	-15º 00.177	02.58	n/a	Dive resuming line of D21. Blue water hop to next station. RH17002_CTD38

RH17002: CoCoHaCa

Dive	St	Date	Time off deck	Time on bottom	Lat SOL	Long SOL	Water Depth	Lat EOL	Long EOL	Time off bottom	Time on deck	Comments
RH17002_D22	24	27/06/17	n/a	04.45	52°. 00.753	-14° 59.292	1000-698m	52°. 00.575	-14° 58.793	05.55	n/a	Blue water hop to next station.
RH17002_D23	25	27/06/17	n/a	07.22	52°. 01.181	-14° 58.718	1000-719m	52°. 01.164	-14° 58.720	08.10	08.55	Last ROV video dive ☹. RH17002_CTD39
RH17002_D24	28	27/06/17	14.32	15.18	51°. 59.041	-15° 02.316	904-877m	51°. 59.985	-15° 02.371	17.17	17.59	Rockdrill attempt but not possible. RH17002_CTD44 & 45
RH17002_D25	29	27/06/17	19.00	19.47	52° 00.343	-14° 59.678	970m	52° 00.345	-14° 59.679	20.37	21.11	Rockdrill RH17002_R1 collected. RH17002_CTD46 & 47
RH17002_D26	30	27-28/06/17	23.43	00.33	52° 04.538	-14° 55.366	1132m	52° 04.554	-14° 55.334	01.28	02.29	Rockdrill RH17002_R2 collected. RH17002_CTD48 & 49



Here be monsters