National Oceanography Centre, Southampton

Cruise Report No. 41

RRS *James Cook* Cruise 36
19 JUN-28 JUL 2009

The Geobiology of Whittard Submarine Canyon

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2009

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DOCUMENT DATA SHEET

AUTHOR	*PUBLICATION DATE*
MASSON, D G et al	2009

TITLE

RRS *James Cook* Cruise 36, 19 Jul-28 Jul 2009. The Geobiology of Whittard Submarine Canyon.

REFERENCE

Southampton, UK: National Oceanography Centre, Southampton, 53pp.
(National Oceanography Centre Southampton Cruise Report, No. 41)

ABSTRACT

The biological and geological research programme for *James Cook* cruise 36 was built around a series of ROV video transects to determine variations in species and community structure and composition in different geological and topographic settings down the canyon. ROV transects were planned to undertake detailed studies of recognised biological hotspots on both hard and soft substrates, to collect specimens for taxonomic studies, including molecular genetics, and to carry out biological experiments, including the use of in situ incubation chambers and tracer feeding experiments to study the physiology of deep-water fauna. Additional coring, CTD and water column particulate sampling programmes were planned to investigate the recent geological history of the canyon, and, in particular, to investigate whether significant sediment is currently accumulating in any part of the canyon, to sample macro- and meiofauna in areas of soft substrate, and to investigate the fate of organic carbon in the canyon.

JC36 was highly successful. The cruise built on the successful mapping of the canyon, using swath bathymetry and 30 kHz sidescan sonar, undertaken during JC35. The main achievements of JC36 included the completion of 26 ROV dives, totalling 340 hr. Seafloor video and photographs along 12 transects from the eastern and western canyon branches between 500 and 3600 m waterdepth were collected. A collection of over 240 biological specimens was collected to verify species identification from the video transects. Pushcores for sedimentology, organic geochemistry, biology and microbiology were also collected. Ultra high-resolution swath bathymetry of the canyon floor using the multibeam system mounted on the ROV was collected on 8 dives. A total of 10 dives were dedicated to placing, initiating and recovering a variety of biological experiments on the seafloor, mainly to examine respiration rates of individual animals or animal communities.

The coring programme completed 19 successful piston core stations and 29 successful megacore stations. Most of the latter were processed for macrofauna and meiofauna but some were subsampled for sedimentology and geochemistry. A preliminary assessment suggests that most of the sediment recovered is late glacial in age, and that little Holocene sediment has been deposited in the canyon.

6 CTD profiles and 5 SAPS (stand-alone pump) stations were completed to characterise the suspended particulate matter above the canyon floor. A total of 30 pushcores and megacores also sampled for organic geochemistry.

KEYWORDS

biology, cruise 36 2009, CTD, geology, Isis, *James Cook,* megacores, organic geochemistry, piston cores, ROV, SAPS, sedimentology, Whittard Canyon

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ITINERARY

Departed	Brest, France	19th June, 2009
Arrived	Southampton, UK	28th July, 2009

CRUISE OBJECTIVES

Background

Submarine canyons provide one of the main conduits through which sediment passes from the continental shelf, across the continental margin, and into the deep ocean. They redistribute pollutants from the land and shelf seas to the deep ocean, may play an important role in carbon storage, and have a powerful influence on the structure and biodiversity of benthic ecosystems and the biogeography of species.

When sealevel rose at the end of the last glaciation, many canyons lost their connection to sediment sources that were active at low sealevel. As a consequence, some canyons on the European margin, such as Setubal Canyon on the Portuguese margin, became largely inactive; others, such as Nazare Canyon, have been transformed into sediment traps that are presently accumulating large volumes of sediment, whilst a third group, such as Whittard Canyon in the Bay of Biscay, are thought to remain active as sediment transport conduits. The variable nature of present day canyons is only just becoming apparent and remains little understood. What processes bring sediment into the canyon? What drives episodic sediment transport processes (e.g. turbidity currents) and how often do they occur? How do canyons interact with ocean currents? What influences, beneficial or otherwise, do sediment transport processes exert on canyon benthic ecosystems?

The EU HERMES and HERMIONE Projects, led from NOC, have developed a comprehensive strategy for the study of Europe's continental margin. Particular attention is being given to canyons as important 'hotspots' of biodiversity and biomass. Canyons are complex systems, highly variable in terms of their hydrography, sedimentology, biogeochemistry and biology, and each with its own characteristics. To create useful policies for whole ecosystem management there is a clear need not only for a concerted effort to compare canyons from different biogeochemical provinces and different topographic settings, but also for co-coordinated, multidisciplinary projects relating the fauna to the environmental variables that regulate their distributions. These objectives are shared by the NERC funded OCEANS 2025 programme.

To address these objectives cruise JC36 will undertake sediment coring, current measurements, water column measurements, video observations, biological sampling and in situ biological experiments in canyons on the northern Bay of Biscay margin. Recent and long-term (glacial-interglacial) sedimentation rates and processes will be determined, as will the driving mechanisms of present-day processes. The proposed programme will build on work completed on several previous cruises, including CD157, CD179, D297 and JC10 to the Portuguese margins. The JC10 ROV cruise demonstrated the extreme heterogeneity of the canyon environments (on metre to tens of metres scales) and provided a compelling justification for the use of the ISIS ROV in canyon investigations.

JC36 programme

The seagoing programme on JC36 was planned to focus on the Whittard Canyon on the northern slope of the Bay of Biscay. The Whittard Canyon region is much less well studied than the canyons on the Portuguese margin on which we have previously focussed, although regional swath bathymetry data are available and three reconnaissance ROV dives were undertaken during JC10 in 2007. These dives provided evidence for high-energy sediment transport processes in the canyon axis and for the occurrence of rich and diverse biological communities, including cold-water corals, on the canyon walls. Because of the lack of pre-existing data, particularly high-resolution survey data and sediment cores, from Whittard Canyon, cruise JC35 was designed to collect high-resolution survey data for the entire canyon system, principally using the TOBI 30 kHz sidescan sonar system.

On cruise JC36, the planned programme of biological and geological research was built around a series of ROV video transects to determine variations in species and community structure and composition in different geological and topographic settings down the canyon.

At suitable sites located on the ROV transects, it was planned, in particular, to:

(i) undertake detailed studies of recognised biological hotspots on both hard and soft substrates
(ii) collect specimens for taxonomic studies, including molecular genetics
(iii) carry out biological experiments including the use of in situ incubation chambers and tracer feeding experiments to study the physiology of deep-water fauna
(iv) install a lander with an upward-looking ADCP to measure currents within the canyon axis. A small unit, deployed by ROV, but heavily-weighted to ensure survival if turbidity currents occur during the deployment, will be used.
(v) collect a suite of piston cores to examine the recent sedimentation history of the canyon and, in particular, to investigate whether sediment is currently accumulating in any part of the canyon

NARRATIVE (times in GMT except where otherwise noted)

19th June 2009 (JD170).
1300 (1500 local time). Ship departed from Brest.
1300-2400. On passage to working area.

20th June 2009 (JD171).
0000-1329. On passage to working area.
1329-1940. Isis dive 098 (station JC36-001). Deployed ADCP using the ROV in the axial channel of the western Whittard Canyon at 1649. Dive aborted at 1819 due to jammed tool-sled on ROV. ROV on surface at 1927.
1940-2010. Reposition to megacore site,
2010-2357. Megacore (station JC36-002). Good samples (29-42 cm) in all 8 core tubes. All cores sieved for biology.

21st June 2009 (JD172).
0043-0418. Megacore (station JC36-003). Good samples (33-47 cm) in 7 out of 8 tubes. All cores sieved for biology.
0420-0500. Reposition to next ROV dive site.
0520-1927. Isis dive 099 (station JC36-004). Video transect of western slope of western branch of Whittard canyon and adjacent canyon floor (3700-3560 m waterdepth). Variable, often poor, visibility throughout dive due to suspended particles in water. Abundant holothurians seen; two species sampled. On the basis of this dive it was decided to use a species of the holothurian *Peniagone* for the in situ experiments.
1930-2010. Reposition to deployment site for Amphipod trap, JC36-005.

2050. Amphipod trap deployed, JC36-005.
2050-2115. Reposition to piston core deployment site.
2154-2400. Piston core station JC36-006. 9 m barrel.

22nd June 2009 (JD173).

0010. Piston core station JC36-006 completed. Core and bottom 3 m of core barrel lost because of a failed weld on one core barrel.
0015-0100. Reposition to deploy ROV.
0105-1310. Isis dive 100 (station JC36-007). Video transect of eastern slope of western branch of Whittard canyon and adjacent canyon floor (3100-3600 m waterdepth). Collected 6 push cores and a single specimen of a large holothurian species.
1310-1410. Reposition to deploy CTD.
1420-1700. Completed CTD station (JC36-008).
1725-2330. Completed SAPS station (JC36-009). Sampled near bottom particle rich layer (10 m off bottom).
2335-0000. Piston core station (JC36-010).

23rd June 2009 (JD174).

0000-0206. Completed piston core station (JC36-010). 1.36 m recovered from a 6 m barrel.
0250-0701. Megacore station (JC36-011). Acceptable samples (13-23 cm) in 6 out of 8 cores. All cores sieved for biology.
0710-0916. Repositioned to site of Amphipod trap deployment (JC36-005) and activated release. Trap surfaced at 0841 and was recovered on board at 0916.
0942. Deployed Bathysnack time lapse camera system (baited Bathysnap). Station JC36-012.
0950-1030. Reposition to site of first elevator deployment.
1043. Deployed Elevator 107 with University of Aberdeen experiments (JC36-013). Elevator reached seabed at 1225.
1327. Deployed Elevator 105 with NOCS experiments (JC36-014). Elevator on seabed at 1522.
1600-2400. Isis dive 101 (JC36-015). Reach Elevator 107 at 1805. Experiments from Elevator 107 were placed on the seabed and activated between 1810 and 2045. Six push cores were also taken at this site between 2107 and 2119. The ROV then transited to Elevator 105.

24th June 2009 (JD175)

0000-0528. Completion of Isis dive 101 (JC36-015). The second set of experiments from Elevator 105 were placed on the seafloor and activated between 0050 and 0315. At this point, a small oil leak on one manipulator arm resulted in the termination of the dive. Isis was recovered on board at 0528.
0530-0730. Reposition to site at 3500 m waterdepth west of Whittard canyon, to collect a set of megacore samples to give a comparison with the equivalent 3500 m site in the canyon.
0802-1133. Megacore station (JC36-16). Acceptable samples (11-13 cm) recovered from 7 out of 8 cores. All cores processed for biology.
1211-1545. Megacore station (JC36-17). Acceptable samples (7-14 cm) recovered from 7 out of 8 megacore tubes and a single multicore tube. All cores processed for biology.
1609-1933. Megacore station (JC36-18). Acceptable samples (7-12 cm) recovered from 6 out of 8 cores. All cores processed for biology.
1955-2331. Megacore station (JC36-19). Acceptable samples (9-15 cm) recovered from 7 out of 8 cores. All cores processed for biology.
2353. Start Megacore station (JC36-20).

25th June 2009 (JD176)

0342. Completed megacore station (JC36-20). Acceptable samples (10-14 cm) recovered from 7 out of 8 megacore tubes and a single multicore tube. All cores processed for biology.

0345-0630. Reposition to next ROV dive site.

0654-1831. Isis dive 102 (JC36-021). Video transect of the western slope of the western branch of Whittard canyon (3300-2859 m). 9 biological samples and 4 push cores were collected.

1913-2350. Piston core station (JC36-022), located on a terrace some 200 m above the canyon axis. 8.45 m recovered using a 12 m corer.

26th June 2009 (JD177).

0205-0605. Piston core station (JC36-023), located on a terrace a few tens of metres above the channel axis. 7.28 m recovered using a 12 m corer.

0808-1033. Recovered bathysnap (station JC36-12).

1128-1943. Isis dive 103 (station JC36-024). Finished experiment on elevator 105. Collected 12 push cores. Released elevator 105 at 1714 using the ROV to free feet stuck in the sediment.

2057. Elevator 105 recovered onboard.

2155-2400. Start Isis dive 104 (station JC36-25). Put the experiments back on elevator 107. Collected 8 push cores.

27th June 2009 (JD178)

0000-0510. Completed Isis dive 104.

0518-0801. Recovered elevator 107. Elevator collided with the ship on recovery and one of the experiments was dislodged and lost.

0854-1319. Completed megacore station (JC36-026). Good cores (35-42) recovered in 5 out of 8 megacore tubes and a single multicore tube. However, problems with the winch control system had become apparent during this deployment and it was decided that no further winch operations were possible until a solution could be agreed with engineers ashore.

1436-1815. Repositioned to site of Bathysnap deployment.

1815-1930. Deployed bathysnap (JC36-027).

1930-2400. Scientific operations suspended due to winch failure (weather too bad for ROV deployment).

28th June 2009 (JD179).

0000-0800. Scientific operations suspended due to winch failure (weather too bad for ROV deployment)..

0800-1846. Isis dive 105 (JC36-028). Video transect from 2950 to 2420 m on slope of western branch of Whittard canyon. 3 pushcores, 2 boxcores and 8 biological samples collected.

1912-2030. Attempted to recover Bathysnap (JC36-027). Reliable contact with Bathysnap was eventually established after over a hour of trying. However, it was now too late to recover it in daylight so recovery was postponed until the following day.

2158-2400. Isis dive 106 (station JC36-029). Video transect of slope of western branch of Whittard canyon between 2310 and 1640 m. 2 pushcores and 5 biological samples collected.

29th June 2009 (JD180).

0000-0918. Complete Isis dive 106 (station JC36-029).

0720. Deployed a T5 XBT to a depth of 1658 m (JC36-030).

1150-1311. Recovered bathysnap (JC36-027).

1548-1554. Deployed amphipod trap (JC36-031).

1600-2400. Scientific operations suspended due to bad weather.

30th June 2009 (JD181)

0000-0540. Scientific operations suspended due to bad weather.

0540-1948. Isis dive 107 (station JC36-032). Video survey of slope of western canyon from 1000-550 m waterdepth. Collected 5 pushcores and 9 biological samples. Commenced swath survey at 1646, but this was terminated prematurely due to low hydraulic oil levels.

1703. Deployed T7 XBT (station JC36-033).

1948-2400. Downtime while repairs to Isis were completed.

1st July 2009 (JD182)

0000-0243. Downtime while repairs to Isis were completed.

0243-1746. Isis dive 108 (station JC36-034). ROV swath bathymetry survey of gullied canyon wall in 500-1000 m waterdepth.

1845-1955. Recovered amphipod trap deployed two days earlier (station JC36-031).

2040-0000. Isis dive 109 (Station JC36-035). Video transect of slope of western branch of Whittard canyon between 1700 and 920 m. Collected 4 pushcores, 2 boxcores and 7 biological samples.

2nd July, 2009 (JD183).

0000-1450. Completed Isis dive 109 (Station JC36-035). Latter part of dive (0624-1336) collected 3 lines of swath bathymetry across steep eastern slope of canyon between 923 and 1700 m.

1037-1042. Deployed T5 XBT probe.

1500-2400. Passage to Cork to collect Odim winch engineers for attempt to repair winches.

3rd July, 2009 (JD184).

0000-2400. Complete passage to Cork and embarked three Odim winch engineers. Passage back to deep water to complete winch tests and repairs, and stream wires.

4th July, 2009 (JD185).

0000-2400. Winch trials.

5th July, 2009 (JD186).

0000-2400. Completed winch trials. Passage back to Cork to disembark winch engineers and one scientist.

6th July, 2009 (JD187).

0000-0700. Completed passage to Cork and disembarked engineers.

0730-2400. Passage back to work area.

7th July, 2009 (JD188).

0000-0320. Completed passage back to work area.

0320-0515. Deployed elevator 105 with NOCS experimental equipment (JC36-037).

0610-0750. Deployed elevator 107 with Aberdeen experimental equipment (JC36-038).

0824-1754. Isis dive 110 (JC36-039). Placed 'Peniagone' holothurians in various experimental chambers and started both NOCS experiments. Began collecting holothurians at 1515, but this had to be abandoned when it was noticed that one of the ROV manipulator arms had developed an oil leak. Recovery of the ROV began immediately.

1832-2127. Piston core station JC36-040. 7.58 m core recovered in a 12 m barrel.

2327. Began piston core station JC36-041.

8th July, 2009 (JD189).

0000-0143. Completed piston core station JC36-041. 8.02 m core recovered in a 12 m barrel.

0333-1224. Isis dive 111 (JC36-042). Completed sampling of '*Peniagone*' holothurians. Intended to prepare elevator 107 for recovery, but this was abandoned due to impending bad weather that left insufficient time to redeploy elevator and run a new experiment. Instead, the TOCS experiment on the elevator was initiated, as it is not time limited, and the AROBICS experiment was abandoned.

1252-1636. Megacore station JC36-043. Recovered 6 out of 8 megacores and 1 multicore. Core lengths not recorded.

1715. Deployed bathysnap (station JC36-044) for the remainder of the cruise.

2009-2222. Piston core station JC36-045. 9 m barrel, 5.52 m core recovered.

9th July, 2009 (JD190).

0001-0159. Piston core station JC36-046. 9 m barrel, 5.47 m core recovered.

0354-0547. Piston core station JC36-047. 9 m barrel 6.61 m core recovered.

0700-1000. Downtime for winch repairs.

1018-1152. Piston core station JC36-048. 9 m barrel, 4.7 m core recovered.

1318-1435. Piston core station JC36-049. 9 m barrel. Core catcher sheared off, about 15 cm of indurated sediment recovered from barrel.

1610-1922. Megacore station JC36-050. Recovered 6 out of 6 cores, up to 29 cm long.

1854-2042. CTD station JC36-051. SVP mounted on CTD frame.

2110. Started SAPS station JC36-052.

10th July, 2009 (JD191).

0000-0115. Completed SAPS station JC36-052.

0246-0514. Megacore station JC36-053. Recovered 6 out of 6 cores, up to 45 cm long.

0745-1843. Downtime for winch repairs. Weather deemed too marginal for ROV launch.

1844-2233. Megacore station JC36-54. Recovered 3 good megacores out of 6 (41-42 cm) and one multicore (43 cm).

2318. Started CTD station JC36-55.

11th July, 2009 (JD192).

0137. Completed CTD station JC36-55.

0213-0750. SAPS station JC36-056.

0800-1000. Downtime for winch repairs.

1000-2030. Downtime due to bad weather.

2039. Restart operations. Megacore station JC36-57.

12th July, 2009 (JD193).

0005. Complete megacore station JC36-57. Recovered 3 out of 6 cores (40-41 cm) and one multicore (36 cm).

0049-0321. CTD station JC36-58.

0418-1009. SAPS station JC36-59.

1210-1405. Piston core station JC36-60. 9.65 m recovered in a 12 m barrel.

1534-1741. Piston core station JC36-61. 8.48 m recovered in a 12 m barrel.

1843-2201. Megacore station JC36-62. Recovered 2 out of 8 cores (41-44 cm) and one multicore (18 cm).

2218. Started megacore station JC36-63.

13th July, 2009 (JD194).

0143. Completed megacore station JC36-63. Recovered 6 out of 8 cores (22-44 cm) and one multicore (35 cm).

0421-0743. Megacore station JC36-64. Recovered 8 out of 8 cores (27-47 cm); multicore empty.

0811-1131. Megacore station JC36-65. Recovered 7 out of 8 cores (37-44 cm) and one multicore (38 cm).

1149-1502. Megacore station JC36-66. Recovered 3 out of 8 cores (38-42 cm) and one multicore (29 cm).

1526-1839. Megacore station JC36-67. Recovered 7 out of 8 cores (37-44 cm).

1913-2236. Megacore station JC36-68. Recovered 5 out of 8 cores (36-42 cm).

2236-2400. Downtime due to bad weather.

14th July, 2009 (JD195).

0000-2230. Downtime due to bad weather.

2237. Start megacore station JC36-069.

15th July, 2009 (JD196).

0210. Complete megacore station JC36-069. Core failed, recovering only one short core (18 cm) from 8 core tubes.

0449-2100. Isis dive 112 (station JC36-070). Completed a short test of the MS2000 swath system at 2 m above bottom to see whether useful information could be collected. Collected 9 push cores from the experiments on elevator 107 and prepared both elevators for recovery. Collected 25 specimens of 'Peniagone' holothurians and 3 other biological specimens.

2236. Started piston core station JC36-071.

16th July, 2009 (JD197).

0058. Completed piston core station JC36-071. 6.14 m core recovered from a 12 m barrel.

0316-0531. Released and recovered elevator 107 (Station JC36-038).

0613-0828. Released and recovered elevator 105 (Station JC36-037).

1124. Started Isis dive 113 (station JC36-072). Video transect of eastern canyon from 3200 to 2600 m. Collected 12 pushcores in and around a scarp/scour on the canyon floor. Collected biological samples at nine sites and three rock samples using the manipulators and/or suction sampler.

17th July, 2009 (JD198).

0046. Completed Isis dive 113 (station JC36-072).

0140-0407. Piston core station JC36-073. Recovered only 0.3 m core from a 12 m piston core that, on recovery, was found to be bent.

0628-0807. Piston core station JC36-074. Recovered 5.37 m core from a 9 m barrel.

1024-1143. Piston core station JC36-075. Recovered 5.51 m core from a 9 m barrel.

1247-1509. Megacore station JC36-076. Recovered two cores only (28 and 40 cm) from 6.

1630-1802. Megacore station JC36-077. No useful cores recovered.

1920-2305. Megacore station JC36-078. Recovered 6 short cores (9-14 cm) from 8 tubes.

2030. T5 XBT probe deployed (station JC360-079). Good profile recorded.

2132-2318. Megacore station JC36-080. 8 short cores (11-17 cm) recovered from 8 tubes.

2341. Start megacore station JC36-081.

18th July, 2009 (199).

0124. Completed megacore station JC36-081. 5 short cores (10-14 cm) recovered from 8 tubes.

0222-0319. Piston core station JC36-082. 1.28 m core recovered from a 9 m barrel.

0450. Deployed amphipod trap (station JC36-083).
0544-0717. CTD station JC36-084.
0800-1220. SAPS station JC36-085.
1252-2400. Isis dive 114 (station JC36-086). Video transect of eastern canyon wall from 1675-1200 m water depth. Spectacular dive with abundant fauna on steep cliffs. Collected 18 biological samples and 3 pushcores.

19th July, 2009 (JD200).
0250. Completed Isis dive 114 (station JC36-086).
0454-1333. Isis dive 115 (station JC36-087). Video transect of eastern canyon wall from 1675-1389 m waterdepth. Collected 9 biological samples and 3 pushcores.
1416-1550. Megacore station JC36-088. Recovered 5 good cores (31-43 cm) from 6 tubes.
1641. Started Isis dive 116 (station JC36-089).

20th July, 2009 (JD201).
0337. Completed Isis dive 116 (station JC36-089). Video transect on eastern canyon wall from 1370-899 m waterdepth. Collected 5 biological samples and 1 rock.
0430-0600. Recovered amphipod trap (station JC36-083) after 48 hour deployment.
0841-2329. Started Isis dive 117 (station JC36-090). Video transect of eastern canyon wall from 2450-1683 m. Collected 8 biological samples and 6 pushcores.

21st July, 2009 (JD202).
0058-0218. Piston core station JC36-091. Core failed; bottom 3 m core section sheared off at weld.
0710-0916. Piston core station JC36-092. Recovered am 8.61 m core from a 12 m barrel.
1100-1413. Megacore station JC36-093. Recovered 7 cores (29-44 cm) from 8 tubes, plus one multicore (38 cm).
1447-1759. Megacore station JC36-094. Recovered 7 cores (33-42 cm) from 8 tubes, plus one multicore (38 cm).
1824-2145. Megacore station JC36-095. Recovered 4 cores (41-54 cm) from 8 tubes, plus one multicore (43 cm).
2223. Started megacore station JC36-096. Recovered 4 cores (33-42 cm) from 8 tubes.

22nd July, 2009 (JD203).
0138. Completed megacore station JC36-096. Recovered 4 cores (33-42 cm) from 8 tubes.
0201-0516. Megacore station JC36-097. Recovered 5 cores (29-45 cm) from 8 tubes.
0556-0912. Megacore station JC36-098. Recovered 4 cores (39-44 cm) from 8 tubes.
0939-1136. Deployed elevator with biological experiments (station JC36-099).
1213. Started Isis dive 118 (station JC36-100). Started BICS experiments, placed Aberdeen spreader experiments on the seafloor and collected 15 pushcores.

23rd July, 2009 (JD204).
0004. Completed Isis dive 118 (station JC36-100).
0131. Deployed amphipod trap (station JC36-101).
0529-1138. Isis dive 119 (station JC36-102). ROV swath survey of gullied canyon at 300-800 m waterdepth. Only 1.5 lines of survey completed. Dive abandoned due to technical problems.
1450. Started Isis dive 120 (station JC36-103).

24th July, 2009 (JD205).

1256. Completed Isis dive 120 (station JC36-103). ROV swath bathymetry survey of the eastern canyon wall between 1600 and 2400 m in area of extreme gullied topography.

1645-1845. Recovered bathysnap (station JC36-44).

1903. Started Isis dive 121 (station JC36-104).

25th July, 2009 (JD206).

0250. Completed Isis dive 121 (station JC36-104). Completed short ROV swath bathymetry survey around the ADCP deployed early in the cruise (station JC36-001). Recovered ADCP.

0514-1257. Isis dive 122 (station JC0-36-105). Completed 'spreader' experiment by taking 12 pushcores. Also collected 3 suction samples and two pushcores for biology.

1521. Recovered elevator with biological experiments (station JC36-099).

1808. Recovered amphipod trap (station JC36-101).

1984-2032. Piston core station JC36-106. Recovered 8.43 m from a 12 m barrel.

2324. Started piston core station JC36-107.

26th July, 2009 (JD207).

0022. Completed piston core JC36-107. Recovered 8.17 m from a 12 m barrel.

0357-0517. CTD station JC36-108.

0722-1406. Isis dive 123 (station JC36-109). Swath mapping of coral cliff with MS2000 mounted vertically.

1555. Begin passage to Southampton.

27th July, 2009 (JD208).

0000-2400. Passage to Southampton.

28th July, 2009 (JD209).

0730. Docked in Southampton

SCIENTIFIC REPORTS

ROV swath bathymetry

Detailed bathymetry surveys were carried out with the Kongsberg SM2000 system mounted on the ISIS ROV. This high-resolution multibeam system runs at a frequency of 200 kHz and has 128 beams, spaced with equal angles over a total of 120°. Surveys were generally carried out at 40 to 60 m above the seabed, at a speed of 0.3 to 0.4 kn. Swath widths at those depths are theoretically 140 to 210 m, but line spacing was kept to a conservative 80 to 120 m, in order to obtain sufficient overlap (especially in very heterogeneous terrain) and data quality.

The swath system was used during 8 dives, for a variety of purposes (Table 2). Three major areas were mapped, one in the shallow part of the western branch of the Whittard Canyon (550-1200 m, spread over two dives, Figure 1), one in the medium depth areas of the western branch (900-1650 m) and one in the medium to deeper regions of the eastern branch (1600-2400 m). A fourth survey was planned in shallow waters in the second eastern branch (250-800 m), but was given up after one line because of technical problems.

A very short survey was carried out around the deployment site of the ADCP (~3600 m). Two further deployments of the SM2000 were of rather experimental nature. One consisted of a series of short datasets, recorded at different heights above the bottom along a transit between two elevator sites. The aim of the exercise was to test the system performance very close to the seabed, and to evaluate its usefulness during video and photo surveys. The vehicle was kept at heights of 2, 4, 6 and 8 m above the bed, and short stretches of data were recorded. The data were processed at 5, 10, 15 cm grid spacing respectively (the last file could not yet be processed due to a fault in recording). The results of the first line were rather noisy, but from heights of 4 m upwards, the vehicle and recordings were stable and a very detailed map of the seafloor was created.

The last survey consisted of a test to map a vertical/overhanging wall on the western flank of the eastern Whittard Canyon branch, at 1350 m depth. For this work, the SM2000 was mounted vertically on the front basket of ISIS, and the ROV was moved sideways at a fixed depth and distance from the wall. Distances of 65, 30, 15 and 7 m were tried, and the resulting data were gridded at 1.5, 0.75, 0.25 and 0.1 m pixel sizes. The tests gave very good results, and give an overview of both the geological structure of the wall (at 30 to 65 m distance) and of the spatial distribution of the coral colonies (especially at 7 m distance).

The general operational procedure during the swath surveys was to keep the SM2000 recording all the time (raw files), but to export the data in different files for each line (and each turn - .mab format). At the start of each line, the Doppler navigation was reset to the USBL location, the TECHSAS file number was changed and the export was started. Towards the end the Doppler and TECHSAS were reset again.

Processing was carried out within the IFREMER software suite 'Caraibes', which has been adapted to handle the ISIS SM2000 data. The on-board processing steps were limited to the essential routines in order to create working maps for further dive planning and initial interpretation of the area. Detailed processing will be carried out at base.

The processing steps included importation of navigation, immersion and bathymetry data, basic filtering, basic manual cleaning using the module 'Odicce', DTM creation and export to ArcGIS. Depending on the depth, either the USBL navigation was used (for very shallow dives), a smoothed version of the USBL data was used, or the Doppler navigation was imported (for the deeper dives or short lines). The latter needed to be rectified for drift, using the smoothed USBL and features in the data

During the surveys, the incoming data was broadcast in real-time to the tracking system 'Sumatra' to be displayed (in uncorrected form) on the interactive map. The performance of the system was intermittent, although in general an indication of the swath width was obtained.

Veerle Huvenne

Dive transects and megafauna of Whittard Canyon

The observations from 13 dives in both the eastern and western Whittard Canyon, supplemented by three dives from JC10 leg 3, provide a comprehensive assessment of the megafauna of this region.

In excess of 120 putative species have been recognised of which a high proportion have provided voucher specimens and molecular samples (see report below). In the deeper parts of the canyon at depth >3000 m the megafauna is dominated by holothurians and occasional seastars. The most common holothurian is *Peniagone* sp., although *Benthothuria* and *Benthodytes* were regularly seen when diving at these depths. Although awaiting detailed analysis, there appears to be a superficial difference between the megafauna of the western and eastern canyon. The western canyon is almost entirely sedimentary and the step slopes and cliffs in this part of the system appear to be of soft rock. The middle part of the western canyon is dominated by the soft coral *Anthomastus* sp. especially on harder surfaces, whilst the gorgonian *Chrysogorgia* and an unidentified irregular echinoid that formed very distinct tracks as it moved dominate sedimentary surfaces. Further up the western canyon, on its eastern side, there was a steep rocky area dominated by the pink gorgonian *Paragorgia* interspersed with small clumps of the coral *Lophelia pertusa*. At the northern extremity of the canyon the seabed was mainly sedimentary although the semi-consolidated rock forming a cliff face was dominated by two colour morphs of *Cerianthus* sp.

In the eastern canyon there appeared to be more vertical rock faces and the dominating species in these habitats were cold water corals, especially *Lophelia pertusa*, *Dendrophyllia* sp. and an unidentified coral. Associated with the corals was a rich and diverse megafauna dominated by *Aceste*, *Echinus*, *Gorgonocephalus* and a variety of unidentified anemones. In addition to a major distribution of *Lophelia*, small patches of coral were found at a number of locations during Dive 117. Sedimentary areas in the shallower parts of the eastern canyon were dominated by the bush gorgonian *Acanella*, an unidentified whip gorgonian and the comatulid crinoid *Pentametrocrinus*.

Paul Tyler and Chris Hauton

Megafauna sampling in JC36

One of the aims of the RRS *James Cook* cruise JC36 was to characterize and compare the megafaunal communities in the western and eastern branches of the Whittard Canyon (Figure 2). This comparison would make use of data available from the NERC *Isis* ROV video transects of the eastern branch of the canyon carried out during JC10 and from transects of the eastern and western branches carried out during JC36 (see above). A reference collection of voucher specimens was also collected to support species identification from the video transects. Species identification was based on morphological characteristics and will be supported by molecular phylogenetic comparison using both mitochondrial and nuclear DNA markers (DNA barcoding) where possible. A total of 242 specimens were collected during JC36 as summarised in Table 3.

In addition to comparing the overall community structure at different depths and within different branches of the canyon, additional specimens were collected to investigate the degree to which canyon populations are reproductively isolated within a single branch and from populations occurring across the wider bathyal and abyssal North Atlantic. Two collections (n = 20 in each) of the putative alcyonarian octocoral *Anthomastu*s spp. were made from the eastern and western branches of the Whittard Canyon. The genetic diversity of these samples will be compared using an analysis of Amplified Fragment Length Polymorphisms (AFLPs). Collections were also made of three putative species of the holothurian *Peniagone* spp.; *viz*. a numerically dominant pink colour morph, a transparent colour morph and a 'horned' morph. The genetic identity of these three putative species will be analysed using DNA barcoding and their genetic diversity will also be compared, using AFLP analysis, with samples of *Peniagone* spp. that have been collected from across North Atlantic (specimens available from the Discovery Collections and from the forthcoming JC37 ECOMAR cruise).

The majority of specimens were collected using the ROV *Isis*, using either the 'slurp sampler', push cores, box cores or the ROV manipulators. The use of the 'slurp sampler' allowed multiple samples to be collected during one dive although in some instances the specimens were damaged during collection. Push cores and box cores allowed the recovery of a small number of intact delicate specimens.

Additional ophiuroid brittlestars were serendipitously collected from surface sediments as sampled by either megacore or piston core.

Chris Hauton

In situ stable isotope pulse-chase experiments in the Whittard Canyon: Investigating the benthic community response to organic matter deposition.

Submarine canyons are major pathways, through which organic matter and sediment is moved from the continental shelf into the deep sea. Canyons experience high sedimentation rates and temporarily accumulate high levels of allochthonous sediment and organic matter. These eutrophic conditions allow the soft sediments within canyons to support higher levels of biomass, relative to the surrounding continental margin. This results in relatively high biological oxygen demand in canyon sediments. Episodic flushing events drive high levels of sediment through canyons to the abyssal plains. As such, canyons ecosystems receive organic matter from a variety of sources, including material from terrestrial and freshwater environments. However, the relative importance of this material in driving benthic ecosystem processes is unexplored. A suite of in situ and in vitro experiments were designed to test the feeding and respiratory responses of the benthic community to the deposition of different forms of organic matter.

The AROBIC (Aberdeen ROV deployable Benthic Incubation Chamber) system was used to conduct pulse-chase experiments with isotopically labelled ($^{13}C/^{15}N$) phytodetritus. This autonomous system consists of an acetal plastic chamber that is motor driven into the seabed to enclose an area of 0.0441 m^2. One hour after insertion, isotopically labelled algae is injected into the chamber by a motor-driven injector, allowing the uptake and assimilation or respiration of fresh organic matter by the benthic community and its subduction into the sediment to be quantified. The chambers are completely sealed, and at pre-programmed intervals 8 water samples are withdrawn from the chamber by a motor-driven syringe sample, allowing quantification of oxygen consumption and production of dissolved inorganic carbon ($DI^{13}C$) by the sediment community to be quantified. At the end of the incubation a motor driven shutter encloses the sediment within the chamber, and the chamber is withdrawn from the sediment. Following recovery at the surface the sediment within the chamber is sub-sampled with 8.2 cm push cores for analysis of the label uptake by the microbial, foraminiferal, meio- and macro-faunal assemblages, and the water samples are processed for analysis of oxygen and $DI^{13}C$ concentrations.

The AROBIC system was deployed once during JC36-015, at 3595m in the western branch of the Whittard Canyon (Table 4). A 72 hour incubation experiment was carried out at the site using 2 replicate AROBIC chambers to deposit diatomaceous algae onto the sea floor. Unfortunately during recovery at the surface one of the chambers was lost and so the results could only be obtained from one of the two replicates.

In order to measure the change in benthic respiration in response to food pulse, a control experiment was designed using 2 TOCS (Total Oxygen Consumption System) chambers. This is a system for enclosing a $0.049m^2$ area of seabed, and monitoring its oxygen consumption over time. The system comprises 2-4 Perspex chambers (height: 30 cm, diameter: 25 cm) with water tight acetal lids, all connected to a central CPU. The lids are fitted with optodes (Aanderra, Norway), for measuring oxygen concentrations, and stirrer motors to keep the enclosed water mixed. Unfortunately, a recurrent software error within this system resulted in no data being obtained.

As a result of the loss of one of the AROBIC chambers, subsequent experimental work was carried out using a much simpler ROV deployable benthic incubation chamber, the spreader. The spreader consists of a polycarbonate tube (height: 30 cm diameter: 25 cm) and an acetal plastic lid. Isotopically labelled phytodetritus is released from a cartridge in the lid, by activating an elastically tensioned spiked plunger. This punctures the membranes on a cartridge containing the algal slurry, which then settles on the seabed enclosed by the tube. The enclosed plot is then subsampled by the ROV using push-cores. The lid is removed and three push cores inserted into the enclosed sediment. After the cores have been taken, the tube is recovered from the sediment.

Spreader experiments were carried out at two stations within Whittard Canyon (Table 4). A pulse-chase experiment was carried out with three replicate spreaders in the western branch of the Whittard canyon at 3595 m. These spreaders delivered a dose of 1 g C cm^{-2} of diatomaceous phytodetritus (lyophilised *Thalassiosira weissflogii*) onto the sea floor. They were sampled, after 7 days, using 6 cm ROV push cores, to quantify the uptake of ^{13}C and ^{15}N labels by the microbial, foraminiferal, meio- and macrofaunal assemblages. A second pulse-chase experiment was carried out using the spreaders, in the Eastern branch of the Whittard canyon at 3412 m. Five spreaders were successfully deployed, three containing 1 g C m^{-2} of diatomaceous phytodetritus and two containing 1 g C m^{-2} of terrestrial phytodetritus (lyophilised wheat leaves). These spreaders were sampled after a three day incubation, as described above.

In addition to the experimental samples, background samples were taken to quantify the natural stable-isotope signatures of the microbial, foraminiferal, meio- and macrofaunal assemblages. The sediment community oxygen consumption from the one AROBIC chamber was determined aboard the ship, by Winkler titration. Analysis of the uptake of the isotopic label will be carried out ashore. Uptake of the label by the foraminifera, meiofaunal and macrofauna will be carried out by isotope-ratio mass spectroscopy of individual organisms, and compared with background stable-isotope data. Assimilation of the isotope label by the microbial community will be carried out using bacterial phospholipid fatty acids (PLFAs) as bio-marker for carbon and the ratio of $_{D}$- and $_{L}$- alanine amino acids as a biomarker for nitrogen (GC-c-IRMS).

Owing to the difficulty deploying experimental equipment in the upper reaches of the canyon, where the walls form steep slopes, a shipboard experiment was designed to compare the feeding and respiratory responses of the benthic community in this region to deposition of different organic matter substrates. Twelve cores where obtained from 1635 m in the eastern branch of the Whittard canyon, and used to carry out a stable-isotope pulse chase experiment, of 36 hours incubation time. The cores were divided into four groups of three replicates, with three cores receiving a 1 g C m^{-2} dose of diatomaceous organic matter (lyophilised *T. Weissflogii*), three cores receiving a 1 g C m^{-2} dose of terrestrial organic matter (lyophilised wheat) and three cores receiving a 1 g C m^{-2} dose of fresh water organic matter (lyophilised *Chlorella pyrenoidosa*). The cores where sealed with purpose built, air-tight, core lids and incubated in a chest freezer at a constant temperature of 4^o C, approximating the ambient water temperature at 1635 m. Water samples were taken after 3, 6, 12, 24 and 36 hours and where processed for analysis of $DI^{13}C$ production and oxygen concentration. Thus allowing respiration to be estimated. After the 36 hours the incubation was terminated, the cores-lids removed. Overlying water was siphoned off and any surficial macrofauna present picked off and preserved for analysis. The cores were sectioned and processed for analysis of the bulk movement of the ^{13}C label through the sediment, and assimilation by the microbial assemblage, as previously described. This allowed the benthic communities response to different organic matter sources to be compared directly.

Will Hunter

Peniagone **sp. study**

During the video transect in dive 99, high densities of the deep-sea holothurian *Peniagone* sp. were seen in the Whittard Canyon. In order to understand the reason for such high abundances two main hypotheses were investigated: a) the bioavailability of potential food sources and b) the existence of trophic interactions with prokaryotes to enhance the ability of the holothurian to digest sediment. To address these questions, sediment samples, holothurian gut contents and faecal material were collected.

1. Experiment
An experiment was performed using ISIS to look at the bacterial community and OM composition present in the faecal material from these specimens. Two dives were undertaken at ca. 3500 m in Whittard Canyon (Table 5).

During each dive, the ISIS ROV used the suction sampler to catch 4 *Peniagone* sp. and put one specimen into each compartment. One of the compartments was left free as a control (Figure 1). When the experiment was finished, the vials with the faecal material were closed and the device was retrieved. When on board, each vial with faecal material was frozen at -80 °C.

2. Collection of specimens and sediment
Immediately adjacent to the experiment, 25 *Peniagone* were caught with the ROV suction sampler. In the temperature controlled laboratory, each specimen was dissected and each gut taken out. A small sample of sediment was also taken in each compartment of the gut and stored in the -80 °C freezer. Moreover, three push cores were taken from the surrounding sediment. These cores were immediately processed in the temperature-controlled laboratory. The sediment in the cores was extruded and sliced in layers to investigate the bacteria community and bioavailability of potential food sources in each sediment depth: 0-1, 1-3, 3-5, 5-10, 10-15 cm. Slices were immediately frozen at - 80 °C.

For all samples collected, organic matter degradation rates (measured as aminopeptidase, β-glucosidase and alkaline phosphatase enzymatic activities) were also measured in the sediment. To obtain these parameters, onboard incubations were carried out by means of enzymatic cleavage of fluorogenic substrates and subsequent fluorometric determinations. All incubations were carried out at *in situ* temperature and in the dark.

From all the Peniagone sp. collected, gonadal tissue was also taken for reproduction studies.

Teresa Amaro and Michael Tangherlini

Fatty Acids in holothurians

Objectives: Fatty acids are particularly useful biomarkers for identification of macro- and microplankton species and their contribution to animal diets. The examination of the differences in composition of these markers in holothurians found in the canyons plus sediment and water should demonstrate whether or not these animals have a species-specific biochemistry.

Collection of specimens: Deep-sea holothurians were collected using ISIS ROV from various places and depths in the Whittard Canyon (Table 6). After dissecting each specimen a small part of the muscle and gonadal tissue was taken out and put it in the - 80 °C freezer. On return to the laboratory the samples will be analysed for fatty acid composition.

Teresa Amaro and Michael Tangherlini

Metabolic rates in crustacean species inhabiting the Whittard Canyon

Rationale: Crustacea are key faunistic elements of deep-water ecosystems, globally. They are important contributors to the food chain, as major seafloor predators (Decapoda) or scavengers (Peracarida), which use food falls as their main source of energy. As such, they often act as ecosystem engineers and contribute to different trophic levels of benthic food webs. The metabolic activity of ectotherms can be used as an indirect measure in assessing their energetic requirements. Experimental comparative physiology enables us to understand better how these organisms have adapted to the biotic and abiotic conditions prevailing in their habitat.

Aims and Objectives: The aim of this study is to elucidate the physiological tolerance window (= scope) in key canyon invertebrates by assessing their metabolic activity in response to temperature. This is done by:
• sampling crustacean species for studies under controlled laboratory conditions at sea
• conducting experimental work under temperature controlled laboratory conditions
• manipulating experiments with respect to temperature and pressure tolerance
• sampling and freezing tissues for later molecular (Hsp70) heat shock response analysis at NOCS

Materials and methods
During JC36, decapod species were obtained by opportunistic ROV sampling during various dives, using either the robot arms or suction sampler. Furthermore, amphipod scavengers were obtained on three occasions using a baited amphipod trap. Based on availability, high-pressure IPOCAMP (Ravaux et al. 2003) experiments focused on the study of the brachyuran crab *Chaceon* sp. In each treatment lasting 6 days, a single specimen was exposed to a pressure routine, incrementing hyperbaric pressure stepwise by 50 atm per day to a maximum of 200 atm. Over this period heartbeat rates were measured using the system described by Robinson et al. (2009) and respiratory response using oxygen micro-optodes (Presens, Germany). An endoscope was used for video recording.

Specimens of a yet to be identified scavenging amphipod species were exposed to pressure routines (1, 50, 100, 150, 200, 250, 300 atm, and controls) using small pressure vessels (after Mestre et al. 2009) at 3 and 5.5 ºC, representing habitat temperatures at sampling. The acute respiratory response was assessed following an acclimation period to experimental temperatures. At the end of each treatment, specimens were frozen at -80 ºC for further heat-shock response analysis (Hsp70) at NOCS.

Outlook: The IPOCAMP high-pressure system was used for the first time at sea during JC36. Technical experience during the cruise will be valuable in further improving the system for future research cruises. Experimental data obtained will be analysed at NOCS and in comparison with physiological data available, mostly from shallow water species. Molecular analysis (Hsp70) will underpin the physiological capability of the studied amphipod species to acutely respond to both changes in temperature and pressure. A stock of live amphipods was transferred to the aquarium at NOCS for complementary experiments on site.

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Sven Thatje and Nathan Robinson

Benthic Incubation Chamber System (BICS) Deployments

During JC036 five respiration measurements were made of a sea cumber in the genus *Peniagone* and two in the genus *Benthodytes* (Figure 4). The *Peniagone* are among the most abundant animals observed in the many photos in the western branch of Whittard Canyon, while *Benthodytes* was among the more abundant mobile megafauna in the eastern branch.

Respiration measurements were made using two Benthic Incubation Chamber Systems (BICS) principally developed by B. Boorman and H. A. Ruhl using a design adapted from A. Jamieson and B. Wigham. Each BICS consists of two 14 l chambers with oxygen optode and pH sensors and a small motor-driven stirrer to avoid stratification in the chamber during incubations. During deployment the chamber lids are secured open and the system is logging so that data is collected during descent and when the system is on the seafloor with the lids open. Then the animals were collected using ISIS and a suction sampler nozzle also developed by Boorman and Ruhl. The nozzle allowed animals to be vacuumed off the seafloor with any entrained sediment suctioned off while the animal remained in the front end of the nozzle so that it will fall into the chamber when suction was stopped. Once the animals were placed in the chamber the lid was shut and remained shut until recovery several days later.

For the 1st deployment one *Peniagone* sp. was placed in chamber 17049 and one in 17089. 17053 and 17088 were used as controls (Table 7). The pH sensor on 17049 was damaged by the manipulator arm while closing the lid. Initial review of the data from the deployment showed that the chambers with animals had more than double the oxygen drawdown of the controls. Measurements of pH had more noise and differences between sensors while the lids were open than the O_2 measurements.

A 2nd deployment was carried out in the vicinity of the first. During the second deployment 17049, 17053, 17088, had one *Peniagone* sp. each with 17089 used as control. Control vs. animal results again indicated greater O_2 drawdown in chambers with animals. Comparatively variable pH results were again seen.

With the aim of improving pH accuracy the calibrations were reset to default (0, 14) before pre-deployment calibration so that the next calibration offset was not based on the previous dive's calibration. For the post 2nd deployment and pre 3rd calibrations the sensors were calibrated synchronously in the same standard volume instead of sequentially to ensure that the sensors were indeed measuring the same conditions. The sealant which is used to ensure no through 'hull' oxygen exchange was also placed on the outside of the main seal where it had been inside on the optodes previously.

Also during the 2nd deployment the optode male connector on the housing of 17088 became sufficiently corroded to break one of the pins. The 'best practice' of unplugging these rather small connectors may need careful consideration so that they are unplugged as little as possible. Dummy plugs and spare connector parts are also clearly needed. The vendor will be contacted regarding any potential manufacturing flaws, as the rubber of the connector also appeared to have minor delamination.

The 3rd deployment was conducted in the eastern branch of the canyon. For the 3rd deployment the pH sensor on 17088 was moved to 17049 and the 17088 logger and chamber were taken out of service. A specimen of *Benthodytes* sp. was place in each of 17053 and 17089 with 17049 used as a control. The preliminary results indicate that *Benthodytes sp*., which is substantially larger than the *Peniagone sp*., indeed had greater net respiration rates. Also the new approach to the pH calibration and sealant application seemed to have resulted in more accurate readings.

A preliminary review of the overall results shows that the size of the animal was an important factor in respiration rate. Generally warm water and smaller body sizes are associated with increased respiration. Once size and temperature have been taken into account, the data collected here can be compared with respiration data collected elsewhere.

Henry Ruhl

Sampling for macrofauna and meiofauna

Three stations in the Whittard Canyon, and one station on the slope to the west of the canyon, were sampled for macrofauna and meiofauna using the megacorer (Table 8). All were located at ~3,500 m water depth. In most cases, the corer was fitted with eight large (100 mm diameter megacore) and 1 small (59 mm diameter multicore) tubes for macro- and meio-fauna respectively (Mega 8+1 configuration). Five replicate deployments were made at each station.

For each deployment, the megacores were sliced into five sediment layers (0-1, 1-3, 3-5, 5-10, 10-15 cm) and all corresponding layers (i.e. all 0-1 cm, 1-3 cm etc layers) placed in the same 20 litre bucket and homogenised to produce one combined sample for each layer (five in total). The overlying water was added to the 0-1 cm sample. 10% buffered formalin was added to the 0-1 and 1-3 cm buckets in order to ensure immediate fixation. The combined sediment layers were carefully washed with seawater on 300 and 500 um sieves. The sieved material (i.e. 300-500 and >500 µm residues) from each layer was placed in 5 litre tubs and 10% buffered formalin added. One multicore from each of three deployments was sliced into 12 layers (0.5 cm layers to 2 cm depth and 1 cm layers between 2 and 10 cm). The layers were placed, unsieved, in 500 ml bottles and fixed in 10% buffered formalin.

Teresa Amaro and Andrew Gooday

Small-scale heterogeneity in meiofauna distribution

Small-scale features on the seabed create heterogeneity that potentially influences faunal assemblage characteristics. Samples were obtained for meiofauna (metazoans and foraminifera) during Dive 113 (Station 072; 3211-3212 m depth) in order to address this question. Six push cores were collected within 10 cm of a small cliff-like feature and further 6 cores were taken at a control site some distance away. In each case, five cores were sliced into layers (0-0.5, 0.5-1.0, 1.0-1.5, 1.5-2.0, 2-3, 3-4, 4-5 cm) that were fixed in buffered formalin. The sixth core was frozen (-80 ºC) for environmental analyses.

Andrew Gooday

Foraminifera, xenophyophores and gromiids

Representative foraminifera were picked from >150 µm fractions of unfixed push core and multicore samples (Table 9). In general, they comprised a mixture of calcareous and agglutinated species that are typical of bathyal continental margins. Notable were the large agglutinated species (*Astrorhiza arenaria, Cyclammina cancellata, Pelosina* spp., *Rhabdammina inaequalis*) abundant in upper bathyal biobox samples (895-1449 m depth). These samples also yielded large specimens of *Lenticulina* and nodosariids. Otherwise, the most visually conspicuous calcareous species were *Hoeglundina elegans* (2477-3648 m) and a large *Cornuspira* species that occurred on core surfaces (3395 m) and was visible in video transects (Station JC36-007). Occasional specimens of *Capsammina miceacea*, a new genus and species recently described from the Nazare Canyon where it is very abundant at 3,500 m, was notable at stations JC36-087 (1389 m) and 053 (2436 m).

Gromiids occurred sporadically in biobox and core residues between 895 and 3372 m, although only a few specimens were present in each sample. However, they were quite diverse; in total, at least 12 species were recognised with some samples yielding several species. The most interesting of these was the large and spectacularly elongate gromiid found in the biobox sample from station JC36-035 (1250 m) and a box core from station 086 (1449 m).

Large xenophyophores were observed at two sites. *Syringammina fragilissima* was very abundant in video transects from Dive 114 (1300-1450 m) in the eastern branch of the canyon. Three specimens were recovered in box cores. This well-known species is common at upper bathyal depths around the NW European margin. Another species was common at the second experimental site (3403 m depth) in the lower part of the eastern branch. Two specimens were collected. Rather surprisingly, they appear to be different from the xenophyophore species obtained at ~4000 m in the lower part of the Whittard canyon during JC10 (Dive 063). Instead, they most closely resemble the species (*Reticulammina* sp. nov.) from the 4300 m site in the Nazare canyon. Push core residues from stations JC36-007, 024, 028 (2477-3645 m) yielded small, isolated specimens of *Aschemonella ramuliformis,* a species that formed extensive patches on the seafloor in the Nazare Canyon.

Most of the material was preserved in formalin (Table 9). Selected foraminifera, gromiids, and fragments of the xenophyophores *S. fragilissima* and ?*Reticulammina* sp., were also frozen in liquid nitrogen or in the -80 ºC freezer. In addition, small volumes of surface and subsurface sediment (0-1, 2-3, 5-6 cm) were frozen at -80 ºC for molecular analyses.

Andrew Gooday

Piston coring

During JC36 19 piston cores were recovered from the Whittard canyon region (Table 10.). The coring encompassed both the eastern and western branches of the canyon, wherein comparable sites (depth and position with regard to the canyon axis) were chosen to provide meaningful comparisons between the branches. The cores were stratigraphically logged on board to provide a preliminary interpretation of the flow regime down the canyon.

The piston cores recovered from the Whittard Canyon preserve a sedimentary record that extends beyond the Holocene to the period of deglaciation following the Last Glacial Maximum. ^{14}C dating of the cores will be undertaken as follow up work to date the sequences. The upper sections of most of the recovered cores preserve a Holocene record of few, yet thick, sandy turbidite deposits. These overlie abundant (up to 200 individual flows in some cores), thin, stacked, silt and sand turbidite deposits that represent turbulent flows sourced from outwash from the retreating European glaciers. Localised debris flows were also sampled.

Piston Core Station List Summary:

JC36-006: 48° 9.17’N, 10° 33.7’W, 3629 m depth. Core failed. The welded join between the 6 m ad 3 m barrels sheared off and all sediment was lost.

JC36-010: 48° 9.17’N, 10° 32.35’W, 3556 m depth. One section, 1.36 m long, recovered. Some evidence of core compression. Contains sand turbidites intercalated with bioturbated mud, likely from the Holocene.

JC36-022: 48° 21.39’N, 10° 52.26’W, 3144 m depth. Seven sections, totalling 8.45 m, recovered. Contains Holocene record of ~2 sandy turbidites overlying a stacked series of thinly bedded turbidites, likely deposited during pre-Holocene deglaciation.

JC36-023: 48° 18.24’N, 10° 49.62’W, 3359 m depth. Six sections, totalling 7.28 m, recovered. Some core compression evident. Contains Holocene record of sandy turbidites overlying a stacked series of thinly bedded turbidites, likely deposited during pre-Holocene deglaciation.

JC36-040: 48° 10.99’N, 10° 31.43’W, 3561 m depth. Six sections, totalling 7.58 m, recovered. Bioturbated mud with 2 sandy turbidites overlying a chaotic debris flow comprised of contorted turbidite mud, hemipelagic and stiff white clay clasts. Organic matter-rich silty and sandy turbidites dominate the base of the core.

JC36-041: 48° 06.15’N, 10° 24.11’W, 3720 m depth. Six sections, totalling 8.02 m, recovered. Holocene sandy turbidites and a debris flow overlying thinly bedding silt and sandy turbidites, two more debris flows.

JC36-045: 48° 26.86’N, 11° 01.48.44’W, 3002 m depth. Four sections, totalling 5.52m, recovered. Dominantly bioturbated mud with sandy turbidites and a 36 cm thick debris flow. Possibly some foraminifera for ^{14}C dating.

JC36-046: 48° 34.08’N, 11° 10.08’W, 2773 m depth. Four sections, totalling 5.47 m, recovered. The units in this core have been heavily bioturbated, destroying much original structure. Stacked series of sandy turbidites intercalated with bioturbated turbidite mud and hemipelagic sediment.

JC36-047: 48° 41.08’N, 11° 12.09’W, 2437 m depth. Five sections, totalling 6.61 m, recovered. Stacked series of thinly bedded silty and sandy turbidites. Little to no hemipelagic sediment.

JC36-048: 48° 48.79’N, 11° 09.16’W, 1915 m depth. Four sections, totalling 4.70 m, recovered. Top of core lost during coring. Stacked organic-rich turbidites. Abundant bioturbation. Core ends in a stiff mud debris flow deposit (from core catcher sample).

JC36-049: 48° 55.41’N, 11° 09.32’W, 1416 m depth. Core failed. Core catcher sheared off and piston core probably fell on its side on the sea floor. Have a 20 cm uncut piston core.

JC36-060: 48° 15.87'N, 10° 09.78'W, 3425 m depth. Eight sections, totalling 9.65 m, recovered. From the eastern branch of the canyon. Contains abundant organic matter and a strong sulphur smell. Evidence of gas dissolution in core from depressurizing during core recovery (vesicular mud and fractures where the as has escaped). Holocene mud and sandy turbidites overlying a stacked series of black, organic rich silt and fine sand turbidites and a muddy debris flow.

JC36-061: 48° 17.02'N, 10° 18.84'W, 3338 m depth. Seven sections, totalling 8.48 m, recovered. The core dominantly comprises heavily bioturbated mud with sandy turbidites overlying a thick muddy debris flow deposit. The core ends in the stiff debris flow deposit.

JC36-071: 48° 10.41'N, 10° 15.29'W, 3629 m depth. Five sections, totalling 6.14 m, recovered. Heavily bioturbated turbidite mud with 2 sandy turbidites overlying abundant (>100) thinly bedded organic rich silt and sandy turbidites, likely from a glacial outwash source.

JC36-073: 48° 23.81'N, 10° 00.36'W, 3045 m depth. One section, totalling 30 cm, recovered. The core fell over on the sea floor and lost the core catcher. Recovered a thin sequence of bioturbated mud and a clean turbidite mud overlying extremely stiff light grey clay (similar to what was observed with the ROV as comprising the rocky ledges on the sides of the canyons).

JC36-074: 48° 23.82'N, 09° 59.56'W, 2963 m depth. Five sections, totalling 5.37 m, recovered. Top of the core was lost during core recovery. Core comprises a stacked sequence of thinly bedded silty and sandy turbidites with a high organic content.

JC36-075: 48° 27.20'N, 09° 56.99'W, 2450 m depth. Five sections, totalling 5.51 m, recovered. Top of the core disturbed by coring process. Stacked series of silt and sandy turbidites. Between 100 to 136 cm depth the core has penetrated a stiff white clay "rock" similar to those observed with the ROV lying as isolated boulders on the seafloor (see geology grab sample).

JC36-082: 48° 36.20'N, 09° 57.67'W, 1636 m depth. Two sections, totalling 1.28 m, recovered. Top of the core has been disturbed during core recovery. Coarse shell and coral fragment boundary at 38 cm depth. Core dominantly comprises a coarse coral, shell and mud clast debris flow.

JC36-091: 48° 30.68'N, 09° 56.19'W, 2124 m depth. Core failed, core barrel sheared of at join between the 6m and 3 m barrels. No sediment recovered.

JC36-092: 48° 19.12'N, 10° 23.75'W, 3257 m depth. Seven sections, totalling 8.61 m, recovered. Holocene record of sandy turbidites intercalated with bioturbated mud overlies a stacked series of thinly bedded, organic-rich silt and sandy turbidites that represent frequent pulses of outwash from retreating continental glaciers.

JC36-106: 48° 23.81'N, 10° 18.98'W, 8.43 m depth. Seven sections, totalling 8.43 m, recovered. This core contains only homogenous mud.

JC36-107: 48° 25.61'N, 10° 18.52'W, 8.17 m depth. Seven sections, totalling 8.17 m, recovered. Upper sections of the core contain homogenous mud. The lowermost sections contain a stacked series of silty, organic-rich turbidites.

Jess Trofimovs

Megacoring for geology

Seven megacores were sub-sampled for geology on board during the JC36 cruise (Table 11.). These sub-sampled cores were capped and put into cold storage to be split on land under controlled conditions.

Jess Trofimovs

CTD and SAPS surveys

The SAPS (stand-alone pump system) filters large amounts of sea-water *in situ*, thus delivering a concentrate of sinking particles collected from a certain water mass. The CTD (conductivity, temperature, depth) allows the identification of water masses according to their temperature, salinity and particle load. During JC36 the CTD was therefore always deployed prior to the SAPS to determine the structure of the water body and to assess the particle load of the bottom waters. Station numbers and coordinates are given in Table 12.

The basic target of the SAPS survey in the Whittard Canyon was the organic matter that reaches the canyon floor and represents the ultimate food source for all benthic organisms living there. The SAPS were therefore deployed as close to the seafloor as possible even though CTD data occasionally revealed a higher particle load in overlying water strata compared to near bottom. Since a SAPS deployment represents a snapshot of a specific flux event it is unsuitable to calculate total (annual, monthly, etc.) fluxes of organic matter. However, the quality of the organic matter during a certain season can be determined and compared to organic matter buried in the sediment and taken up by benthic organisms. The amounts of essential compounds such as poly-unsaturated fatty acids are particularly interesting since benthic animals cannot synthesize some of these, which have to be taken up with the food.

Apart from indicating the particle load, CTD data allowed the Mediterranean outflow water, characterised by minimum oxygen contents and enhanced salinity, to be identified. An example showing high densities of particles in westernmost canyon branch (station 084, JD 199) is shown in Figure 5.

SAPS deployments

The SAPS was deployed 10 to 30 meters above the seafloor (masf) and programmed to pump for 1.5 or 2 hours (see Table 12). The filtering unit was fitted with two glass fibre filters (Whatman GF/F, diameter: 29.3 cm) that previously had been muffled at 450°C for 12 hours.

The first SAPS deployment (station 009, JD 173) was carried out under calm weather conditions and the pump could be lowered safely down to 10 m above the sea floor. All following deployments were conducted during heavy weather and the pump could not therefore be lowered as close to the seafloor as during the first deployment. In all cases, however, the SAPS was placed within the bottom water mass usually characterised by an enhanced particle load according to CTD data.

The filters recovered from the first deployment in the lower main branch of the Whittard Canyon (station JC36-009) were completely covered by greenish material suggesting high amounts of chlorophyll-containing organic matter. The following three deployments (stations JC36-052, 056, 059) recovered significantly smaller amounts of material. This material appeared rather yellowish and, especially in case of station 052, contained a recognisable amount of mineral matter (silt and fine sand). It appeared an obvious initial assumption that the peak flux of organic-rich material following the summer algal bloom had tailed off, especially with regard to the time that had passed since the first deployment. However, the last deployment in the easternmost branch of the Whittard Canyon (station 085, JD 199) delivered a filter coated with greenish material, again, comparable to the one from the first deployment. Considering the short time span between the fourth and the fifth deployment this suggests that type and amount of material exported from the shelf through the various canyon branches might actually differ from each other.

Sediment sampling
A number of sediment cores (push cores taken by ROV and megacores) from 15 stations representing different canyon areas were sampled for analysis of sedimentary organic matter to enable a comparison with sinking/suspended organic matter sampled by the SAPS. Samples were taken at 0.5 cm intervals from the top 2 cm of each sediment core and at 1 cm intervals down to 10 cm depth. The organic matter at the sediment surface and near-surface is relatively little degraded and might reveal general differences of organic matter composition in certain areas of the canyon in contrast to the snapshot sampling by the SAPS.

Outlook
The organic fraction of the filtered material from the SAPS survey and sediment samples will be characterised by extracting the lipid fraction and analysing its composition in detail. This work will be carried out using the GC-MS facility at Liverpool University. It will be interesting to see if the organic matter composition is different in the central canyon branches (stations JC36-052, 056, 059) that have been sampled within a very short time period. Similarly, the comparison of organic matter from the high-flux events in the southernmost and easternmost canyon sections might reveal compositional differences (station JC36-009 *vs*. 085). The prime objective, however, will be to detect and identify mono- and poly-unsaturated fatty acids, substances that are essential food compounds for benthic organisms such as holothurians. Comparison with the lipid composition of sedimentary organic matter and of gut contents and body tissue samples of holothurians is anticipated to reveal evidence for the turnover of these compounds within the deep-sea food web.

Jens Holtvoeth

SUMMARY OF RESULTS

James Cook 36 completed an integrated geological and biological study of Whittard Canyon, building on the successful mapping of the canyon, using swath bathymetry and 30 kHz sidescan sonar, undertaken during JC35 (Figure 6). The main achievements of JC36 included:

(i) a total of 26 ROV dives, totalling 340 hr. These dives collected seafloor video and photographs along 12 transects from the eastern and western canyon branches between 500 and 3600 m waterdepth. A reference collection of over 240 biological voucher specimens was collected to support species identification from the video transects. Pushcores for sedimentology, organic geochemistry, biology and microbiology were also collected. Ultra high-resolution swath bathymetry of the canyon floor using the multibeam system mounted on the ROV was collected on 8 dives. A total of 10 dives were dedicated to placing, initiating and recovering a variety of biological experiments on the seafloor, mainly to examine respiration rates of individual animals or animal communities.

(ii) 19 successful piston core stations, with core lengths ranging from 0.3 to 9.65 m. In addition, 7 megacores were also collected and subsampled for sedimentology and geochemistry. A preliminary assessment suggests that most of the sediment recovered is late glacial in age, and that little Holocene sediment has been deposited in the canyon.

(iii) 22 megacores were collected and processed for macrofauna and meiofauna. At least 5 replicate cores were collected at 4 stations, 3 located in different branches of the canyon at waterdepths between 3380 and 3670 m, the fourth outside the canyon on the open slope at a depth of 3500 m.

(iv) 6 CTD profiles and 5 SAPS (stand alone pump) stations were completed to characterise the suspended particulate matter above the canyon floor. A total of 30 pushcores and megacores also sampled for organic geochemistry.

FIGURES

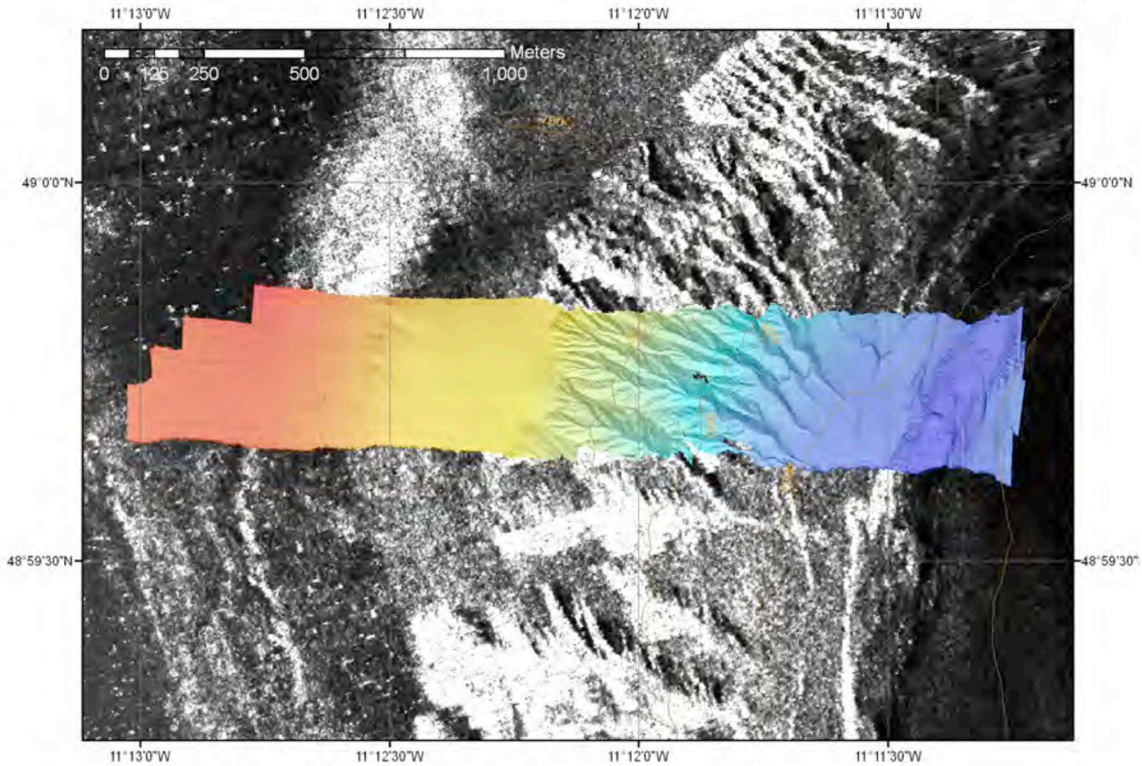

Figure 1. ROV swath bathymetry over the shallow western Whittard Canyon branch draped over TOBI sidescan sonar data collected during JC35.

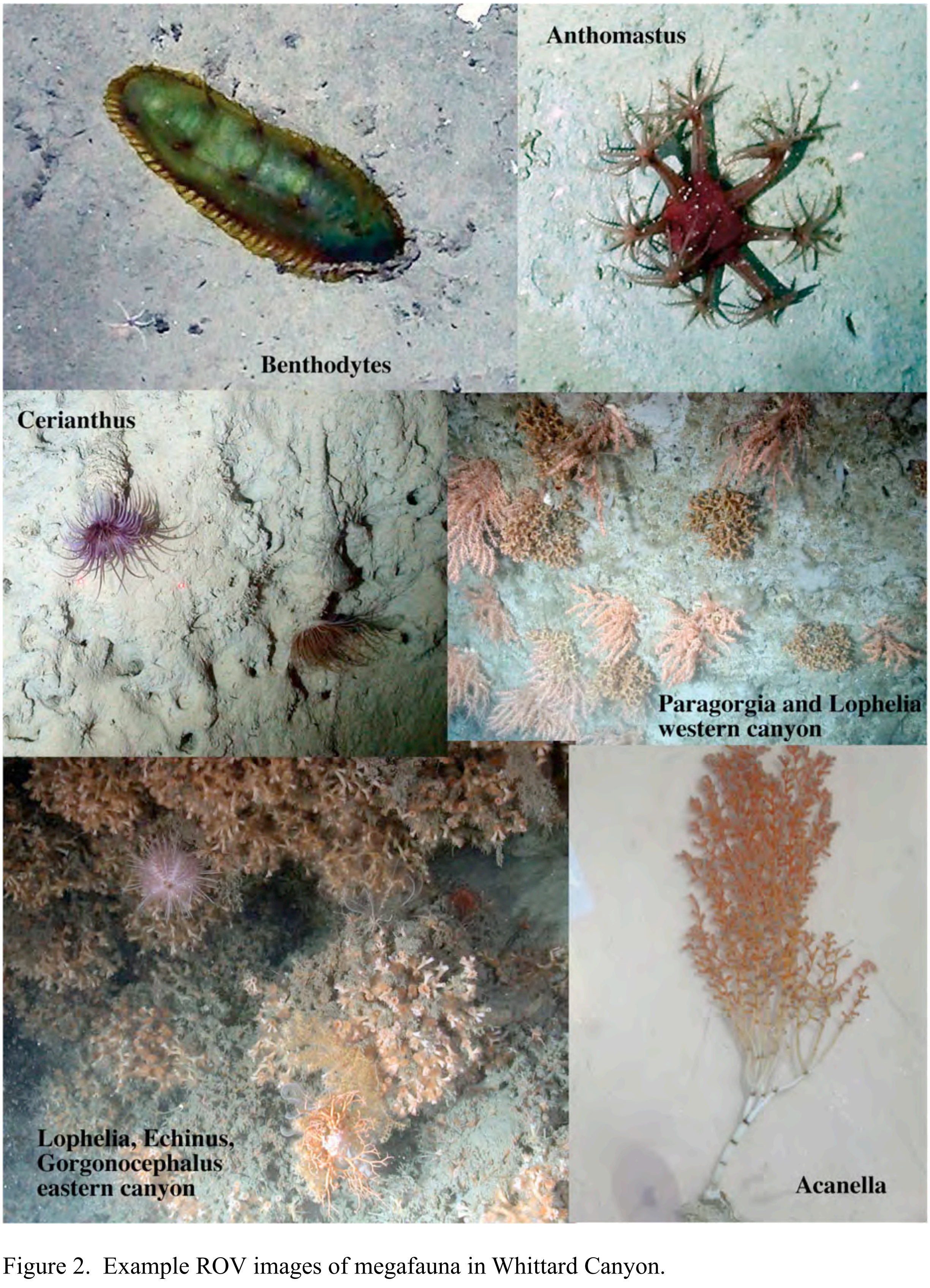

Figure 2. Example ROV images of megafauna in Whittard Canyon.

Figure 3. ISIS suction sampler putting a specimen of *Peniagone* sp. in the experimental apparatus.

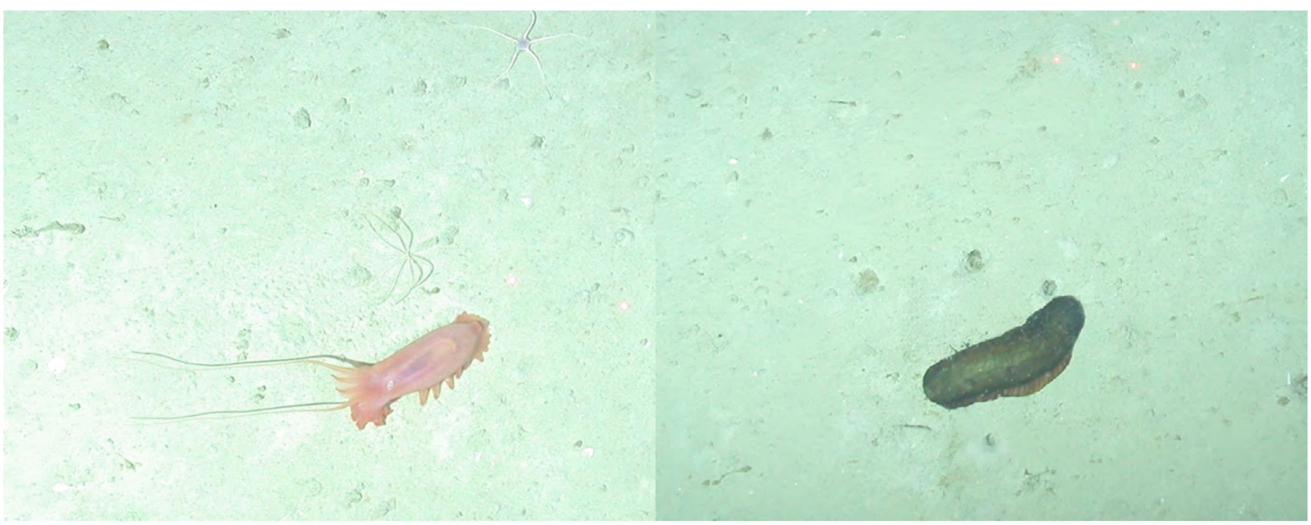

Figure 4. Left: A *Peniagone* sea cucumber, about 10 cm in length, on the seafloor at ~3,700 m depth. This one is moving from right to left feeding on marine snow on the sediment. Right: A *Benthodytes sp.*, approximately 20 cm in length.

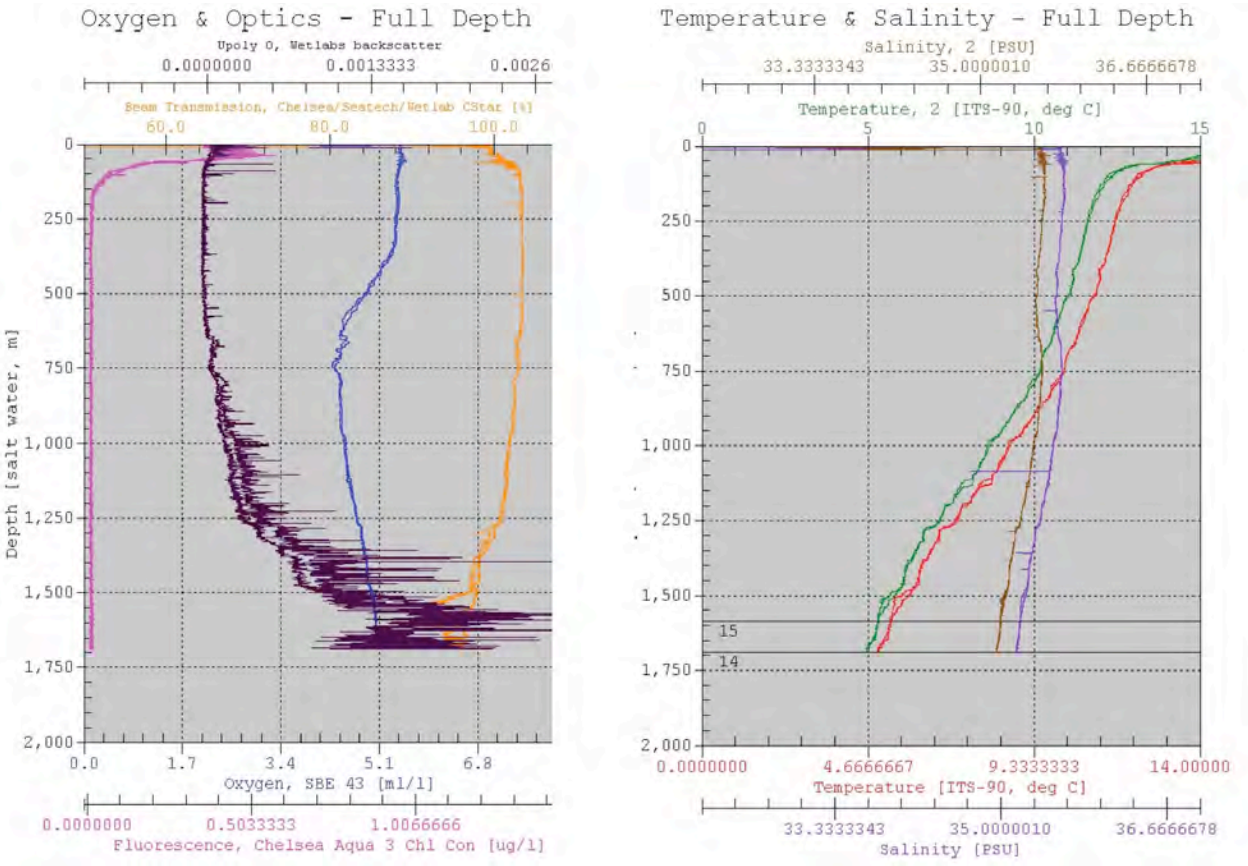

Figure 5. Example of CTD data plots from station JC33-084 revealing high particle load below ~1300 m and suggesting the presence of Mediterranean outflow water between 550 and 1250 m water depth.

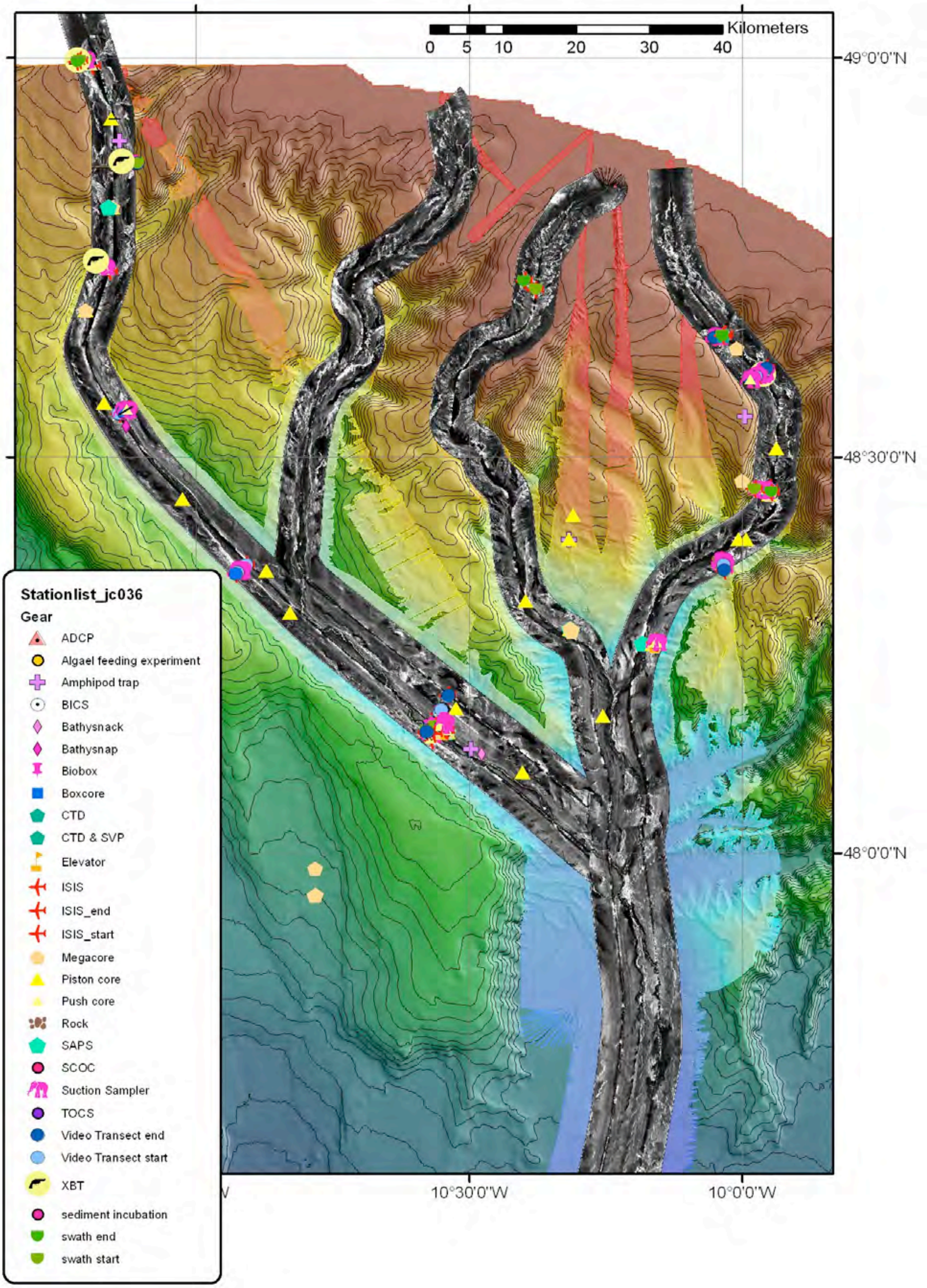

Figure 6. Station map for JC36 plotted on a map showing location of TOBI sidescan sonar data (grey scale) and swath bathymetry data (coulours). Full details of station positions are given in Table 14.

TABLES

Table 1. Summary of cruise activities

Date	ISIS ROV (hr)	Megacoring (hr)	Piston coring (hr)	Amphipod trap (hr)	CTD (hr)	SAPS (hr)	Bathysnap (hr)	Elevator (hr)	Equipment downtime	Weather downtime	Passage (hr)
19/6/09											11
20/6/09	6.2	4.3									13.5
21/6/09	14.5	5	3.2	1.3							
22/6/09	13.2		1.5		2.8	6.5					
23/6/09	8	4.9	2.1	2.3			0.4	6.3			
24/6/09	5.5	18.5									
25/6/09	14.8	3.7	5.5								
26/6/09	12.1		6.1				4.5	1.3			
27/6/09	5.2	5.3					6.2	2.8	4.5		
28/6/09	14.3						1.7		8		
29/6/09	9.3			2.7			3.9		8.1		
30/6/09	14.2								4.4	5.4	
1/7/09	18.4			2.9					2.7		
2/7/09	15								9		
3/7/09									24		
4/7/09									24		
5/7/09									24		
6/7/09									24		
7/7/09	10		6.1					4.6	3.3		
8/7/09	11.7	4.2	6.7				1.4				
9/7/09		4.8	11.6		1.3	3.3			3		
10/7/09		7.8			1.5	1.3			13.4		
11/7/09		3.4			1.6	6.2			2	10.8	
12/7/09		6.4	6.7		3.3	7.6					
13/7/09		22.6								1.4	
14/7/09		1.5								22.5	
15/7/09	18.8	2.2	3								
16/7/09	15.5		1					7.5			
17/7/09	0.8	12.3	10.9								
18/7/09	11.7	1.4	1.9	1.5	2.4	5.1					
19/7/09	21.6	2.4									
20/7/09	21.8			2.2							
21/7/09	0.5	14.7	8.8								
22/7/09	12.4	9.2						2.4			
23/7/09	22.5			1.5							

24/7/09	21.7						2.3				
25/7/09	13		5.9	2.7				2.4			
26/7/09	10.6		0.4		4.9						8.1
27/7/09											24
28/7/09											9
	ISIS ROV (hr)	**Megacoring (hr)**	**Piston coring (hr)**	**Amphipod trap (hr)**	**CTD (hr)**	**SAPS (hr)**	**Bathysnap (hr)**	**Elevator (hr)**	**Equipment downtime**	**Weather downtime**	**Passage (hr)**
Total (hr)	343.3	134.6	81.4	17.1	17.8	30	20.4	27.3	154.4	40.1	65.6

Table 1 (contd). Summary of cruise activities.

Station JC36-	**Dive**	**Start date (2009)**	**Start time**	**End date (2009)**	**End time**	**Start lat**	**Start long**	**Start depth (m)**	**No. lines**	**Line space (m)**	**Line length (m)**	**Height (m)**	**Grid size (m)**	**Sound velocity**	**Navig-ation**	**Comments**
032-SW01	107	30.06	16:46	30.06	18:57	48°59.82	11°12.94	517	1		2100	40	1	1503	USBL	survey ended: ROV oil leak; data problem: time-jump in SM2000 records
034-SW01	108	01.07	03:51	01.07	16:56	48°59.83	11°12.77	507	4	80	2100	40	1	1503	USBL	
035-SW01	109	02.07	06:24	02.07	13:36	48°52.12	11°06.41	923	3	80	1000-2500	40	1	1503	Doppler	
070-SW01	112	15.07	07:37	15.07	08:44	48°09.69	10°33.73	3640	4			2-8	0.05-0.2	1503	Doppler	test survey close to seabed at different heights above bottom
102-SW01	119	23.07	06:29	23.07	10:06	48°42.65	10°22.69	790	1		2300	40	1	1499	USBL	survey stopped due to technical problem
103-SW01	120	23.07	16:17	24.07	10:59	48°27.62	09°58.65	1521	5	120	2300	60	1.5	1507	Smooth USBL	
104-SW01	121	24.07	01:12	24.07	23:20	48°09.30	10°34.67	3665	2	100	300	40	1	1507	Doppler	survey around ADCP site
109-SW01	123	26.07	09:32	26.07	13:01	48°39.18	10°02.12	1348	9	variable	50-300	7-65	0.1-1	1497	Doppler	Sideways swath of coral wall

Table 2. Summary of ROV swath bathymetry surveys

JC36 station	Julian day	MC	PC	AT	*Isis* dive number	Depth range (m)	Start position	End position	Phyla							
									Porifera	**Cnidaria**	**Arthropoda**	**Annelida**	**Mollusca**	**Brachiopoda**	**Echinodermata**	**Chordata**
	172				99	3683-3562	48° 09.078 10° 34.607	48° 08.590 10° 34.119				1			3	
006	173				100	3595-3083	48° 11.974 10° 32.275	48° 10.579 10° 33.272				1			1	
021	176				102	3295-2859	48° 21.869 10° 54.480	48° 21.179 10° 55.638		1					6	
024	177				103	3648-3048	48° 09.572 10° 33.872	48° 09.592 10° 33.848							1	
028	179				105	2942-2424	48° 33.257 11° 08.441	48° 33.670 11° 07.395		4		1			8	1
029	180				106	2271-1644	48° 44.008 11° 09.480	48° 44.771 11° 11.042	1	5	1				10	
032	181				107	1021-1857	48° 59.378 11° 11.360	48° 59.802 11° 12.140		1	1				5	
031	182			X			48° 53.835 11° 08.356				1					
035	182				109	1721-1655	48° 52.216 11° 08.102	48° 52.305 11° 08.218		25		1			12	
039	188				110	3635-3640	48° 09.733 10° 33.68	48° 09.715 10° 33.68							2	
042	189				111	3624-3626	48° 09.683 10° 33.173	48° 09.671 10° 33.143							17	
043	189	X				3662	48° 09.156 10° 33.762								1	
045	190		X			3002	48° 26.866 11° 01.463								1	
050	190	X				1922	48° 48.81 11° 09.19								1	
062	193	X				3372	48° 17.033 10° 18.839								1	
070	196				112	3640-3615	48° 09.713 10° 33.693	48° 09.207 10° 32.698		1	1				19	
072	197				113	3202-2596	48° 22.292 10° 02.369	48° 21.468 10° 01.352		27		2			12	
086	199				114	1640-1215	48° 36.192 09° 58.004	48° 36.746 09° 57.280		7	2	1		2	15	
087	200				115	1677-1389	48° 36.278 09° 58.065	48° 35.849 09° 59.084		2	3				8	
089	200				116	1370-899	48° 39.286 10° 01.854	48° 39.042 10° 03.047							4	
090	201				117	2448-1683	48°27.606 09° 56.929	48° 27.60 09 58.20		6	1	1			5	
100	203				118	3399-3411	48° 16.060 10° 09.580	48° 15.995 10° 09.464							1	
115	206				122	3414-2290	48° 15.995 10° 09.468	48° 15.944 10° 09.437			2	3			3	
TOTAL									**1**	**79**	**12**	**11**	**0**	**2**	**136**	**1**

Table 3: Overview of samples collected for molecular phylogeography analyses using barcoding and AFLP techniques. Positions given in degrees and decimal minutes and based on *Isis* or core USBL fixes (WGS84). MC = megacore, PC = piston core, AT = amphipod trap.

Station JC36	Canyon location	Equipment Deployed	Date	Latitude	Longitude	Depth (m)	Sample description
015	Western Branch	AROBIC chamber A (Lost)	23.06.09	48° 09.343	10° 32.457	3593	Sediment and water samples were obtained from one AROBIC chamber. 4 push cores processed for analysis of microbial, meiofaunal, macrofaunal and foraminiferal assemblages; 8x 5ml water samples for analysis of DIC production. 6 background cores were taken.
	Western Branch	AROBIC chamber B	23.06.09	48° 09.337	10° 32.473	3594	
	Western Branch	TOCS A (software failure)	23.06.09	48° 09.338	10° 32.448	3594	
	Western Branch	TOCS B (software failure)	23.06.09	48° 09.352	10° 32.463	3594	
	Western Branch	6 push cores (background)	23.06.09	48° 09.340	10° 32.452	3595	
025	Western Branch	6 push cores (background)	27.06.09	48° 09.342	10° 32.436	3583	6 push cores taken for analysis of background stable isotope signatures of the microbial and faunal assemblages.
042	Western Branch	3 Spreaders	08.07.09	48° 09.685	10° 33.169	3626	Each spreader sampled using three 6cm push cores, for analysis OM uptake by the benthic microbes and fauna
	Western Branch	TOCS A	08.07.09	48° 09.338	10° 32.448	3594	
	Western Branch	TOCS B	08.07.09	48° 09.352	10° 32.463	3594	
080	Eastern Branch	Megacore: 6 cores for shipboard experiment	17.07.09	48° 36.189	9° 57.699	1638	12 cores for shipboard feeding experiment, sectioned for analysis of microbial uptake at the end of a 36 hour incubation period.
081	Eastern Branch	Megacore: 6 cores for shipboard experiment	18.07.09	48° 36.188	9° 57.698	1640	
099	Eastern Branch	6 push cores (background)	22.07.08	48° 15.997	10° 09.465	3414	6 push cores taken for analysis of background stable isotope signatures of the microbial and faunal assemblages.
100	Eastern Branch	6 Spreaders (2 failed)	22.07.09	48° 15.998	10° 09.466	3415	4 spreaders sampled. Each using three 6cm push cores, for analysis of stable-isotope label uptake by the benthic microbes and fauna

Table 4. Summary of stable isotope pulse-chase experiments: equipment deployed and samples obtained.

Station JC36-	Dive	Gear	Start date	End date	Latitude	Longitude	Depth (m)
024	103	ISIS - Holothurian chambers	23.06.09	26.06.09	48^o 09.604	10^o 33.813	3500
039	110	ISIS - Holothurian chambers	07.07.09	15.07.09	48^o 09.735	10^o 22.684	3500

Table 5. Locations of the *Peniagone sp* experiments were performed in Whittard Canyon

Station JC36-	Dive	Gear	Date	Latitude	Longitude	Depth (m)	Species
JC36-021	102	ISIS	25.06.09	48^o 21.869	10^o 54.480	3300	? and Deima sp.
JC36-027	105	ISIS	28.06.09	48^o 33.296	11^o 08.346	2950	Psychropotes sp.
JC36-032	107	ISIS	30.06.09	48^o 59.874	11^o 12.249	687	Benthogone rosea
JC36-042	111	ISIS	08.07.09	48^o 09.604	10^o 33.813	3500	Peniagone sp.
JC36-070	112	ISIS	15.07.09	48^o 09.604	10^o 33.813	3500	Psychropotes sp.
JC36-100	118	ISIS	22.07.09	48^o 15.999	10^o 09.495	3592	Benthothuria sp.

Table 6 - List of the stations in Whittard Canyon from where holothurians were collected.

Station JC36-	Experiment ID	Start JD	End JD	latitude	longitude	Depth (m)	Treatment
015-BICS	17049-1	174	177	48° 09.61	10° 33.82	3645	*Peniagone sp.*
015-BICS	17053-1	174	177	48° 09.61	10° 33.82	3645	Control
015-BICS	17088-1	174	177	48° 09.61	10° 33.82	3645	Control
015-BICS	17089-1	174	177	48° 09.61	10° 33.82	3645	*Peniagone sp.*
039-BICS	17049-2	188	196	48° 09.72	10° 33.68	3636	*Peniagone sp.*
039-BICS	17053-2	188	196	48° 09.72	10° 33.68	3636	*Peniagone sp.*
039-BICS	17088-2	188	196	48° 09.72	10° 33.68	3636	*Peniagone sp.*
039-BICS	17089-2	188	196	48° 09.72	10° 33.68	3636	*Control*
100-BICS	17049-3	203	206	48° 15.99	10° 09.47	3406	*Control*
100-BICS	17053-3	203	206	48° 15.99	10° 09.47	3406	*Benthodytes sp.*
100-BICS	17089-3	203	206	48° 15.99	10° 09.47	3406	*Benthodytes sp.*

Table 7. Summary of BICS deployments.

Station JC36-	Date	Depth (m)	Rig	Megacores collected	Multicores	Position
002	20.06.09	3670	Mega 8	8	-	Western branch
003	21.06.09	3661	Mega 8	7	-	Western branch
011	23.06.09	3582	Mega 8+1	6	0	Western branch
016	24.06.08	3511	Mega 8+1	8	0	Slope
017	24.06.08	3512	Mega 8+1	7	1	Slope
018	24.06.08	3512	Mega 8+1	6	0	Slope
019	24.06.08	3505	Mega 8+1	8	1	Slope
020	25.06.08	3514	Mega 8+1	7	1	Slope
026	27.06.09	3670	Mega 8+1	5	1	Western branch
043	08.07.09	3657	Mega 8+1	6	1	Western branch
063	13.07.09	3375	Mega 8+1	6	1	Central branch
064	13.07.09	3382	Mega 8+1	8	0	Central branch
065	13.07.09	3373	Mega 8+1	7	1	Central branch
066	13.07.09	3381	Mega 8+1	3, combined with 068	1	Central branch
067	13.07.09	3376	Mega 8	7	-	Central branch
068	13.07.09	3375	Mega 8	5, combined with 066	-	Central branch
093	21.07.09	3424	Mega 8+1	8	1	Eastern branch
094	21.07.09	3429	Mega 8+1	7	1	Eastern branch
095	21.07.09	3429	Mega 8+1	4 combined with 094	1	Eastern branch
096	22.07.09	3424	Mega 8	4 combined with 095	-	Eastern branch
097	22.07.09.	3425	Mega 8	5	-	Eastern branch
098	22.07.09	3432	Mega 8	4	-	Eastern branch

Table 8. Core samples used for macrofauna and meiofauna.

Station JC36-	Dive	Sample type	Depth (m)	Large xenos	Foraminifera preserved in Formalin	Foraminifera preserved in Liquid N	Sediment frozen at (-80ºC)	Common/notable foraminifera, xenophyophores and gromiids
004	99	push core	3648		X			*Hoeglundina elegans, Reophax* spp., elongate gromiid
007	100	push core	3395				X	*Cornuspira* and stalked miliolid on surface
007	100	push core	3395		X		X	*Reophax* spp., *Aschemonella ramuliformis, Hoeglundina elegans*
024	103	push core	3645		X	X	X	*Rhizammina* common, *A. ramuliformis*, *H. elegans*
028	105	push core	2477		X		X	Several gromiids; *Nodellum; Reophax* spp, *H. elegans*
029	106	biobox	1857		x			*Hyperammina friabilis, Pelosina sp.*
032	107,	biobox	895		X	X		*Cyclammina cancellata, Rh inaequalis, Pelosina*
032	107	push core	971		X			Diverse rotaliids, *Fissurina, Hyp. laevigata*; several gromiids
035	109	biobox	1250		X	X		*Pelosina, Storthosphaera alba, Bathysiphon rufum*, very elongate gromiids
035	109	push core	1385		X			*Globobulimina, Sigmoilopsis schlumbergeri*
050		megacore	1922		X		X	Mainly dead calcareous (*Brizalina, Cassidulina, Uvigerina*)
053		megacore	2436		X	X		Mainly calcareous; also *Capsammina*, saccamminid, gromiid
054		megacore	3372		X		X	*Hormosina* sp., *Ammobaculites, Bathysiphon* spp., gromiid
057		megacore	3423		X			*H. elegans, Hyperammina* spp., *Bathysiphon* spp
086	114	ROV boxcore	1449	X	X	X		*Syringammina, Astrorhiza arenaria, Pelosina*, gromiids (including long species)
086	114	ROV boxcore	1305	X	X			2 *Syringammina* frozen (-80ºC); 4 gromiid species, including very elongate species seen at Station 035
	115	push core	1389		X			*Capsammina, Rhizammina*, Komoki-like, *Vanhoeffenella* (1), saccamminids
105	122	push core	3403	X				2 xenophyophores (?*Reticulammina*)

Table 9. Samples used for survey of foraminifera, xenophyophores and gromiids.

Station JC36-	Julian day	Latitude	Longitude	Depth (m)	Length (m)
006	172	48° 09.17' N	10° 33.70' W	3629	-
010	174	48° 09.17' N	10° 32.35' W	3556	1.36
022	176	48° 21.39' N	10° 52.26' W	3144	8.45
023	177	48° 18.24' N	10° 49.62' W	3359	7.28
040	188	48° 10.99' N	10° 31.43' W	3561	7.58
041	189	48° 06.14' N	10° 24.11' W	3720	8.02
045	189	48° 26.86' N	11° 01.48' W	3002	5.52
046	190	48° 34.08' N	11° 10.08' W	2773	5.47
047	190	48° 41.08' N	11° 12.09' W	2437	6.61
048	190	48° 48.79' N	11° 09.16' W	1915	4.70
049	190	48° 55.42' N	11° 09.31' W	1416	0.2
060	193	48° 15.87' N	10° 09.78' W	3425	9.65
061	193	48° 17.02' N	10° 18.84' W	3338	8.48
071	196	48° 10.41' N	10° 15.29' W	3629	6.14
073	198	48° 23.81' N	10° 00.36' W	3045	0.3
074	198	48° 23.82' N	9° 59.56' W	2963	5.37
075	198	48° 27.21' N	9° 56.99' W	2450	5.51
082	199	48° 36.21' N	9° 57.67' W	1636	1.28
091	202	48° 30.68' N	9° 56.19' W	2124	-
092	202	48° 19.12' N	10° 23.75' W	3257	8.61
106	206	48° 23.81' N	10° 18.99' W	1769	8.43
107	206	48° 25.63 'N	10° 18.52' W	1281	8.17

Table 10. Piston cores stations occupied during JC36.

Station JC36-	Julian day	Latitude	Longitude	Depth (m)
050	190	48°48.81' N	11° 09.19' W	1922
053	191	48°41.08' N	11° 12.09' W	2433
054	191	48°17.01' N	10° 18.84' W	3372
062	193	48°17.01' N	10° 18.84' W	3371
076	198	48°27.18' N	9° 57.00' W	2452
080	198	48°36.19' N	9° 57.70' W	1638
088	200	48°38.22' N	10° 00.58' W	1437

Table 11. Megacores subsampled for geology.

Station JC36-	Gear	JD	Date	Start time	Latitude	Longitude	Depth (m)	SAPS pump time (h)	Height above seafloor (m)
008	CTD	173	22.06.09	14:21	48° 09.181	10° 32.353			
009	SAPS	173	22.06.09	19:27	48° 09.180	10° 32.350	3595	2.0	10
051	CTD	190	09.07.09	18:54	48° 48.770	10° 09.550	1975		
052	SAPS	190	09.07.09	23:39	48° 48.780	10° 09.549	1973	1.5	20
055	CTD	191	10.07.09	23:18	48° 17.010	10° 18.837	3369		
056	SAPS	192	11.07.09	04:02	48° 17.010	10° 18.840	3367	2.0	20
058	CTD	193	12.07.09	00:49	48° 15.925	10° 10.920	3531		
059	SAPS	193	12.07.09	06:05	48° 15.930	10° 10.923	3536	2.0	30
084	CTD	199	18.07.09	05:44	48° 36.196	9° 57.999	1699		
085	SAPS	199	18.07.09	09:23	48° 36.170	9° 57.920	1701	2.0	18

Table 12: Coordinates and times of CTD and SAPS deployments.

Station JC36-	core	ISIS dive	Julian Day	Latitude	Longitude	Depth (m)	Length (cm)	sampling intervals (cm)
004	PUC 2	99	172	48°08.71'	10°34.13'	3646	27.0	0-2 (0.5 cm), 2-10 (1cm), 14-15, 19-20
004	PUC 3	99	172	48°08.69'	10°34.13'	3646	27.0	0-2 (0.5 cm), 2-10 (1cm), 14-15, 19-20
004	PUC 4	99	172	48°08.69'	10°34.14'	3646	22.5	0-2 (0.5 cm), 2-10 (1cm), 14-15, 19-20
021	PUC 1	102	176	48°21.87'	10°54.50'	3296	19.0	0-2 (0.5 cm), 2-10 (1cm), 14-15
024	PUC 4	103	177	48°09.61'	10°33.82'	3646	17.0	0-2 (0.5 cm), 2-10 (1cm), 14-15
024	PUC 5	103	177	48°09.61'	10°33.82'	3646	15.0	0-2 (0.5 cm), 2-10 (1cm), 14-15
024	PUC 6	103	177	48°09.61'	10°33.82'	3646	17.0	0-2 (0.5 cm), 2-10 (1cm), 14-15
032	PUC 3	107	181	48°59.42'	11°11.44'	1065	9.5	0-2 (0.5 cm), 2-9 (1cm)
035	PUC 1	109	183	48°52.18'	11°07.54'	1385	21.0	0-2 (0.5 cm), rest kept frozen
035	PUC 2	109	183	48°52.18'	11°07.54'	1385	18.5	0-2 (0.5 cm), rest kept frozen
086	PUC 1	114	200	48°36.50'	09°57.56'	1299	22.5	0-2 (0.5 cm), rest kept frozen
086	PUC 2	114	200	48°36.50'	09°57.56'	1299	25.0	0-2 (0.5 cm), rest kept frozen
086	PUC 3	114	200	48°36.50'	09°57.56'	1299	27.0	0-2 (0.5 cm), rest kept frozen
090	PUC 3	117	201	48°27.57'	09°57.13'	2483	22.0	0-2 (0.5 cm), rest kept frozen
090	PUC 4	117	201	48°27.57'	09°57.13'	2483	24.0	0-2 (0.5 cm), rest kept frozen
100	PUC 13	118	203	48°16.00'	10°09.46'	3411	21.0	0-2 (0.5 cm), rest kept frozen
100	PUC 14	118	203	48°16.00'	10°09.46'	3411	23.5	0-2 (0.5 cm), rest kept frozen
100	PUC 15	118	203	48°16.00'	10°09.46'	3411	20.0	0-2 (0.5 cm), rest kept frozen
050	MC 1	-	190	48°48.81'	11°09.19'	1922		sub-sampled, kept frozen
050	MC 8	-	190	48°48.81'	11°09.19'	1922		" "
053	MC 2	-	191	41°08.35'	12°09.15'	2436	45	" "
053	MC 3	-	191	41°08.35'	12°09.15'	2436	43	" "
054	MC 2	-	191	48°17.01'	10°18.83'	3372	42	" "
054	MC 6	-	191	48°17.01'	10°18.83'	3372	43	" "
057	MC ?	-	192	48°89.39'	10°81.46'	3421		" "
057	MC ?	-	192	48°89.39'	10°81.46'	3421		" "
076	MC 1	-	198	48°27.18'	09°57.00'	2452	28	" "
081	MC ?	-	199	48°36.19'	09°57.68'	1640	13	0-2 cm (0.5cm)
088	MC 3	-	200	48°38.22'	10°00.58'	1437	33	sub-sampled, kept frozen
088	MC 5	-	200	48°38.22'	10°00.58'	1437	31	" "

Table 13: Samples taken from push cores (PUC) and megacores (MC) for organic-geochemical analyses

Table 14. Station list

Station Number JC36-	ISIS Dive No.	Equipment and operation	Start JD	Start date 2009	Start time GMT	End date 2009	End time GMT	start latitude	start longitude	end latitude	end longitude	Depth (m)	Comments
001	98	ISIS	171	20.06	13:05	20.06	19.27	48° 09.058	10° 34.589	48° 09.236	10° 34.647	3735	
001-VT01	98	Video transect	171	20.06	15:29	20.06	18:36	48° 09.07	10° 34.58	48° 09.236	10° 34.646	3705	
001-ADCP	98	ADCP	171	20.06	16:49	24.07	2351	48° 09.239	10° 34.65	48° 09.246	10° 34.652	3706	
002		Megacore	171	20.06	22:09			48° 09.18	10° 33.7			3670	8 cores. 0.29-0.41 m. Macrofauna
003		Megacore	172	21.06	02:29			48° 09.174	10° 33.7			3661	7 cores, 0.33-0.47 m. Macrofauna
004	99	ISIS	172	21.06	05:20	21.06	17:12	48° 09.17	10° 33.696	48° 08.59	10° 34.119	3647	
004-VT01	99	Video transect	172	21.06	07:14	21.06	09:30	48° 09.078	10° 34.607	48° 09.491	10° 34.411	3658	
004-Bibo01	99	Biobox	172	21.06	09:37			48° 09.531	10° 34.42			3660	holothurian
004-Bibo02	99	Biobox	172	21.06	11:14			48° 09.529	10° 34.407			3661	holothurian
004-VT02	99	Video transect	172	21.06	11:50	21.06	14:13	48° 09.51	10° 34.34	48° 09.103	10° 34.102	3661	
004-SUS01	99	Suction sampler	172	21.06	14:21			48°9.1	10° 34.101			3673	holothurian
004-SUS02	99	Suction sampler	172	21.06	14:27			48° 09.082	10° 34.11			3680	holothurian
004-SUS03	99	Suction sampler	172	21.06	14:30			48° 09.074	10° 34.112			3679	holothurian
004-PUC01	99	Push core	172	21.06	16:17			48° 08.708	10° 34.135			3648	sampled for foraminifera
004-PUC02	99	Push core	172	21.06	16:30			48° 08.713	10° 34.103			3646	0.27 m. Sampled for organic geochem
004-PUC03	99	Push core	172	21.06	16:35			48° 08.694	10° 34.132			3646	0.27 m. Sampled for organic geochem
004-PUC04	99	Push core	172	21.06	16:39			48° 08.69	10° 34.137			3646	0.22 m. Sampled for organic geochem
005		Amphipod trap	172	21.06	20:49	23.06	09:16	48° 07.92	10° 29.76	48° 07.87	10° 29.74	3651	start time in water, end time on deck
006		Piston core	172	21.06	22:50			48° 09.17	10° 33.7			3629	no recovery
007	100	ISIS	173	22.06	01:00	22.06	13:26	48° 10.58	10° 33.273	48° 11.974	10° 32.321	3593	
007-VT01	100	Video transect	173	22.06	04:04	22.06	04:19	48° 10.596	10° 33.269	48° 10.648	10° 33.245	3593	
007-Bibo01	100	Biobox	173	22.06	04:44			48° 10.649	10° 33.258			3592	holothurian and polycheates
007-VT02	100	Video transect	173	22.06	04:56	22.06	05:42	48° 10.651	10° 33.269	48° 10.855	10° 33.068	3595	
007-PUC01	100	Push core	173	22.06	05:49			48° 10.86	10° 33.096			3595	0.15 m. sampled for foraminifera
007-PUC02	100	Push core	173	22.06	05:52			48° 10.858	10° 33.072			3595	sampled for foraminifera
007-PUC03	100	Push core	173	22.06	05:57			48° 10.858	10° 33.072			3595	sampled for biology
007-PUC04	100	Push core	173	22.06	05:59			48° 10.857	10° 33.07			3595	archived for sedimentology
007-VT03	100	Video transect	173	22.06	06:31	22.06	10:30	48° 10.881	10° 33.053	48° 11.907	10° 32.349	3592	
007-PUC05	100	Push core	173	22.06	10:41			48° 11.918	10° 32.342			3144	sampled for biology
007-PUC06	100	Push core	173	22.06	10:46			48° 11.916	10° 32.343			3144	sampled for biology
007-VT04	100	Video transect	173	22.06	11:15	22.06	11:24	48° 11.915	10° 32.344	48° 11.974	10° 32.275	3137	
008		CTD	173	22.06	14:21	22.06	17:00	48° 09.181	10° 32.353	48° 09.172	10° 32.35	3589	start time in water end time on deck
009		SAPS	173	22.06	19:27	22.06	2120	48° 09.18	10° 32.35	48° 09.18	10° 32.35	3595	start time pump on, end time pump off
010		Piston core	174	23.06	00:52			48° 09.17	10° 32.35			3556	1.36 m core
011		Megacore	174	23.06	04:35			48° 09.22	10° 32.355			3595	6 cores, 0.13-0.23 m, Macrofauna
012		Bathysnack	174	23.06	09:42	26.06	10:30	48° 07.532	10° 28.63	48° 07.58	10° 28.84	3640	start time deployed, end time on deck
013		Elevator	174	23.06	12:25	27.06	08:01	48° 09.35	10° 32.645	48° 09.893	10°32.753	3583	
014		Elevator	174	23.06	15:22	26.06	20:57	48° 09.504	10° 33.897	48° 09.6	10° 33.4	3667	

015	101	ISIS	174	23.06	16:01	24.06	05:31	48° 09.351	10° 32.516	48° 09.345	10° 32.516	3586	
015-ARB01	101	AROBICS A	174	23.06	18:06	27.06	00:15	48° 09.343	10° 32.457	48° 09.343	10° 32.457	3593	sediment incubation, experiment lost
015-ARB02	101	AROBICS B	174	23.06	19:33	27.06	01:30	48° 09.337	10° 32.473	48° 09.337	10° 32.473	3594	sediment incubation
015-TOC01	101	TOCS chambers	174	23.06	20:17	27.06	00:55	48° 09.338	10° 32.448	48° 09.338	10° 32.448	3594	no data, software failure
015-TOC02	101	TOCS chambers	174	23.06	20:45	27.06	01:18	48° 09.352	10° 32.463	48° 09.352	10° 32.463	3594	no data, software failure
015-PUC01	101	Push core	174	23.06	21:07			48° 09.34	10° 32.452			3595	sediment/OM/Fauna/Microbes
015-PUC02	101	Push core	174	23.06	21:10			48° 09.34	10° 32.452			3595	sediment/OM/Fauna/Microbes
015-PUC03	101	Push core	174	23.06	21:12			48° 09.34	10° 32.452			3595	sediment/OM/Fauna/Microbes
015-PUC04	101	Push core	174	23.06	21:15			48° 09.34	10° 32.452			3595	sediment/OM/Fauna/Microbes
015-PUC05	101	Push core	174	23.06	21:18			48° 09.34	10° 32.452			3595	sediment/OM/Fauna/Microbes
015-PUC06	101	Push core	174	23.06	21:19			48° 09.34	10° 32.452			3595	sediment/OM/Fauna/Microbes
015-Bics01	101	BICS	174	24.06	00:50	26.06	17:00	48° 09.612	10° 33.816	48° 09.612	10° 33.816	3645	respiration experiment
015-Holo01	101	Holothurian exp.	174	24:06	02:15	26.06	17:00	48° 09.614	10° 33.810	48° 09.614	10° 33.810	3647	holothurian poo catcher
015-Bibo01	101	Biobox	174	24.06	02:23			48° 09.604	10° 33.813			3649	holothurian
015-Bibo02	101	Biobox	174	24.06	03:00			48° 09.608	10° 33.814			3648	holothurian
015-Bibo03	101	Biobox	174	24.06	03:15			48° 09.614	10° 33.81			3647	holothurian
016		Megacore	175	24.06	09:52			47° 56.787	10° 46.853			3513	7 cores, 0.11-0.13 m. Macrofauna.
017		Megacore	175	24.06	13:47			47° 56.778	10° 46.846			3505	8 cores, 0.07-0.14 m. Macrofauna.
018		Megacore	175	24.06	17:06			47° 56.807	10° 46.908			3506	7 cores, 0.08-0.12 m. Macrofauna.
019		Megacore	175	24.06	21:38			47° 56.742	10° 46.935			3505	9 cores. 0.09-0.15 m. Macrofauna.
020		Megacore	176	25.06	01:32			47° 56.780	10° 46.852			3507	8 cores, 0.10-0.14 m. Macrofauna.
021	102	ISIS	176	25.06	06:54	25.06	18:37	48° 21.869	10° 54.48	48° 21.179	10° 55.638	3163	
021-PUC01	102	Push core	176	25.06	09:11			48° 21.871	10° 54.505			3296	sedimentology
021-PUC02	102	Push core	176	25.06	09:22			48° 21.868	10° 54.505			3296	organic geochemistry
021-VT01	102	Video transect	176	25.06	09:31	25.06	11:20	48° 21.864	10° 54.495	48° 21.555	10° 55.044	3295	
021-sus01	102	Suction Sampler	176	25.06	11:38			48° 21.539	10° 55.043			3131	Anenome x2
021-rock01	102	Rock	176	25.06	11:38			48° 21.539	10° 55.043			3131	rock sample from cliff
021-PUC03	102	Push core	176	25.06	11:51			48° 21.539	10° 55.043			3131	pushcore from rock face
021-VT02	102	Video transect	176	25.06	11:57	25.06	12:32	48° 21.539	10° 55.043	48° 21.47	10° 55.295	3131	
021-sus02	102	Suction sampler	176	25.06	12:53			48° 21.472	10° 55.295			3062	holothurian
021-bibo01	102	Biobox	176	25.06	14:02			48° 21.397	10° 55.339			2988	echinothirid
021-sus03	102	Suction sampler	176	25.06	14:02			48° 21.397	10° 55.341			2988	holothurian Peniagone
021-sus04	102	Suction sampler	176	25.06	14:09			48° 21.411	10° 55.341			2988	suction sampling of burrows
021-sus05	102	Suction sampler	176	25.06	14:20			48° 21.411	10° 55.341			2988	sea-star
021-PUC04	102	Push core	176	25.06	14:23			48° 21.396	10° 55.336			2988	sedimentology
021-VT03	102	Video transect	176	25.06	14:27	25.06	14:47	48° 21.411	10° 55.342	48° 21.369	10° 55.418	2986	
021-sus06	102	Suction sampler	176	25.06	15:01			48° 21.344	10° 55.466			2942	holothurian
021-VT04	102	Video transect	176	25.06	15:04	25.06	16:37	48° 21.329	10° 55.428	48° 21.179	10° 55.638	2942	
021-BX01	102	ROV Boxcore	176	25.06	16:09			48° 21.222	10° 55.655			2859	cushion star
022		Piston core	176	25.06	22:12			48° 21.39	10° 52.26			3144	8.45 m core
023		Piston core	177	26.06	04:14			48° 18.236	10° 49.622	48° 18.329	10° 49.643	3359	7.28 m core
024	103	ISIS	177	26.06	11:28	26.06	19:43	48° 09.482	10° 33.893	48° 09.592	10° 33.848	3650	
024-VT01	103	Video transect	177	26.06	13:30	26.06	13:46	48° 09.572	10° 33.872			3646	
024-PUC01	103	Push core	177	26.06	13:52			48° 09.609	10° 33.826			3646	organic geochemistry

024-PUC02	103	Push core	177	26.06	14:01			48° 09.609	10° 33.826			3646	organic geochemistry
024-PUC03	103	Push core	177	26.06	14:13			48° 09.611	10° 33.823			3646	organic geochemistry
024-PUC04	103	Push core	177	26.06	14:22			48° 09.609	10° 33.82			3646	foraminifera
024-PUC05	103	Push core	177	26.06	14:26			48° 09.609	10° 33.82			3646	organic geochemistry
024-PUC06	103	Push core	177	26.06	14:31			48° 09.611	10° 33.82			3646	organic geochemistry
024-PUC07	103	Push core	177	26.06	14:34			48° 09.611	10° 33.822			3646	organic geochemistry
024-PUC08	103	Push core	177	26.06	14:40			48° 09.612	10° 33.822			3646	microbiology
024-PUC09	103	Push core	177	26.06	15:13			48° 09.612	10° 33.818			3646	failed
024-PUC10	103	Push core	177	26.06	15:19			48° 09.612	10° 33.818			3646	microbiology
024-PUC11	103	Push core	177	26.06	15:21			48° 09.612	10° 33.818			3646	microbiology
024-PUC12	103	Push core	177	26.06	15:26			48° 09.612	10° 33.818			3646	microbiology
024-Bibo01	103	Biobox	177	26.06	16:34			48° 09.15	10° 33.813			3648	SNAPS sampler
025	104	ISIS	178	26.06	22:04	27.06	04:59	48° 09.351	10° 32.659	48° 09.339	10° 32.469	3583	sediment/OM/Fauna/Microbes
025-PUC01	104	Push core	178	27.06	02:38			48° 09.342	10° 32.436			3583	sediment/OM/Fauna/Microbes
025-PUC02	104	Push core	178	27.06	02:40			48° 09.342	10° 32.436			3583	sediment/OM/Fauna/Microbes
025-PUC03	104	Push core	178	27.06	02:43			48° 09.342	10° 32.436			3583	sediment/OM/Fauna/Microbes
025-PUC04	104	Push core	178	27.06	02:46			48° 09.342	10° 32.436			3583	sediment/OM/Fauna/Microbes
025-PUC05	104	Push core	178	27.06	02:48			48° 09.342	10° 32.436			3583	sediment/OM/Fauna/Microbes
025-PUC06	104	Push core	178	27.06	02:51			48° 09.342	10° 32.436			3583	sediment/OM/Fauna/Microbes
025-PUC07	104	Push core	178	27.06	02:53			48° 09.342	10° 32.436			3583	sediment/OM/Fauna/Microbes
025-PUC08	104	Push core	178	27.06	02:55			48° 09.342	10° 32.436			3583	sediment/OM/Fauna/Microbes
026		Megacore	178	27.06	10:59			48° 09.183	10° 33.731	48° 09.179	10° 33.711	3756	7 cores, 0.35-0.42 m. Macrofauna
027		Bathysnap	178	27.06	18:21	29.06	13:11	48° 32.355	11° 07.645	48° 32.581	11° 07.723	2978	
028	105	ISIS	179	28.06	08:04	28.06	18:38	48° 33.257	11° 08.441	48° 33.67	11° 07.395	3085	
028-VT01	105	Video transect	179	28.06	09:57	28.06	10:14	48° 33.257	11° 08.431	48° 33.296	11° 08.431	2941	
028-Bibo01	105	Biobox	179	28.06	10:19			48° 33.296	11° 08.346			2949	holothurian; psychropotes
028-PUC01	105	Push core	179	28.06	10:24			48° 33.296	11° 08.346			2948	failed
028-PUC02	105	Push core	179	28.06	10:27			48° 33.296	11° 08.346			2949	organic geochemistry
028-VT02	105	Video transect	179	28.06	10:35	28.06	11:59	48° 33.296	11° 08.545	48° 33.455	11° 07.993	1949	
028-SUS01	105	Suction sampler	179	28.06	11:59			48° 33.463	11° 07.993			2762	ophuroid
028-SUS02	105	Suction sampler	179	28.06	12:00			48° 33.463	11° 07.993			2762	stalked crinoid
028-SUS03	105	Suction sampler	179	28.06	12:01			48° 33.463	11° 07.993			2762	whip gorgonian
028-Bibo02	105	Biobox	179	28.06	12:28			48° 33.474	11° 07.941			2720	bivalve
028-VT03	105	Video transect	179	28.06	13:08	28.06	12:16	48° 33.474	11° 07.941	48° 33.451	11° 07.961	2687	
028-Bibo03	105	Biobox	179	28.06	13:16			48° 33.471	11° 07.935			2687	seastars
028-VT04	105	Video transect	179	28.06	14:06	28.06	14:06	48° 33.471	11° 07.904	48° 33.471	11° 07.909	2669	
028-Bx01	105	Boxcore	179	28.06	14:31			48° 33.497	11° 07.812			2624	failed
028-Bx02	105	Boxcore	179	28.06	14:44			48° 33.5	11° 07.812			2624	
028-SUS04	105	Suction sampler	179	28.06	15:46			48° 33.6	11° 07.603			2489	gorgonian
028-PUC03	105	Push core	179	28.06	16:02			48° 33.612	11° 07.58			2477	xenophyophore
029	106	ISIS	180	29.06	23:17	29.06	09:18	48° 44.008	11° 09.48	48° 44.771	11° 11.042	2300	
029-PUC01	106	Push core	180	29.06	01:26			48° 44.105	11° 09.652			2310	organic geochemistry
029-PUC02	106	Push core	180	29.06	01:30			48° 44.105	11° 09.652			2310	failed
029-PUC03	106	Push core	180	29.06	01:36			48° 44.108	11° 09.658			2310	organic geochemistry

029-SUS01	106	Suction sampler	180	29.06	03:15			48° 44.297	11° 9.992			2112	sea whip
029-SUS02	106	Suction sampler	180	29.06	04:33			48° 44.4	11° 10.26			1998	cerianthid anemone
029-Bibo01	106	Biobox	180	29.06	05:52			48° 44.567	11° 10.575			1857	stalked sponge
029-Bibo02	106	Biobox	180	29.06	07:44			48° 44.765	11° 11.002			1655	crab
029-Bibo03	106	Biobox	180	29.06	07:56			48° 44.765	11° 11.019			1651	crab
029-Bibo04	106	Biobox	180	29.06	08:01			48° 44.766	11° 11.032			1649	crab
030		XBT	180	29.06	07:20			48° 44.773	11° 11.027			1658	
031		Amphipod trap	180	29.06	15:54	01.07	19:55	48° 53.835	11° 08.356	48° 53.66	11° 08.80	1528	
032	107	ISIS	181	30.06	05:43	30.06	18:57	48° 59.38	11° 11.36	48° 59.802	11° 12.14		
032-PUC01	107	Push core	181	30.06	07:04			48° 59.424	11° 11.435			1065	sedimentology
032-PUC02	107	Push core	181	30.06	07:04			48° 59.424	11° 11.435			1065	sedimentology
032-PUC03	107	Push core	181	30.06	07:04			48° 59.424	11° 11.435			1065	organic geochemistry
032-PUC04	107	Push core	181	30.06	08:42			48° 59.59	11° 11.738			971	foraminifera
032-PUC05	107	Push core	181	30.06	08:49			48° 59.59	11° 11.735			971	sedimentology
032-Bibo01	107	Biobox	181	30.06	09:17			48° 59.629	11° 11.851			895	Urchin
032-Bibo02	107	Biobox	181	30.06	09:43			48° 59.63	11° 11.857			895	Urchin
032-Bibo03	107	Biobox	181	30.06	09:52			48° 59.632	11° 11.861			892	Starfish
032-SUS01	107	Suction sampler	181	30.06	12:27			48° 59.822	11° 12.199			687	Holothurian
032-Bibo04	107	Biobox	181	30.06	12:58			48° 59.827	11° 12.208			686	crab
032-SUS02	107	Suction sampler	181	30.06	13:04			48° 59.828	11° 12.209			689	anemone
032-VT01	107	Video transect	181	30.06	13:08	30.06	09:17	48° 59.828	11° 12.209	48° 59.629	11° 11.851	689	
032-SUS03	107	Suction sampler	181	30.06	13:24			48° 59.841	11° 12.209			686	holothurian
032-VT02	107	Video transect	181	30.06	13:25	30.06	12:27	48° 59.841	11° 12.249	48° 59.822	11° 12.199	686	
032-SUS04	107	Suction sampler	181	30.06	13:35			48° 59.844	11° 12.249			686	anemone on hermit crab
032-Bibo05	107	Biobox	181	30.06	13:57			48° 59.886	11° 12.32			671	crab
032-VT03	107	Video transect	181	30.06	14:07	30.06	15:40	48° 59.886	11° 12.32	49° 00.014	11° 12.649	669	
032-SW01	107	ROV swath	181	30.06	16:46	30.06	18:57	48° 59.825	11° 12.937	48° 59.802	11° 12.14	517	
033		XBT	181	30.06	17:03			48° 59.829	11° 13.039			520	
034	108	ISIS	182	01.07	02:43	01.07	18:46	48° 59.83	11° 12.764	48° 59.7	11°13.07	547	
034-SW01	108	ROV swath	182	01.07	03:51	01.07	16:56	48° 59.826	11° 12.765	48°59.7	11° 13.034	507	swath survey 40 m off seabed
035	109	ISIS	182	01.07	20:47	02.07	13:36	48° 52.216	11° 08.16	48° 52.305	11° 08.218	1727	
035-VT01	109	Video transect	182	01.07	22:04	01.07	22:54	48° 52.222	11° 08.207	48° 52.196	11° 07.889	1723	
035-SUS01	109	Suction sampler	182	01.07	23:00			48° 52.195	11° 07.889			1695	anthomastus
035-Bibo01	109	Biobox	182	01.07	23:51			48° 52.199	11° 07.828			1629	gorgonian
035-VT02	109	Video transect	182	01.07	23:52	02.07	01:14	48° 52.199	11° 07.828	48° 52.181	11° 07.541	1629	
035-PUC01	109	Push core	183	02.07	01:15			48° 52.181	11° 07.541			1385	organic geochemistry
035-PUC02	109	Push core	183	02.07	01:15			48° 52.181	11° 07.541			1385	organic geochemistry
035-PUC02	109	Push core	183	02.07	01:15			48° 52.181	11° 07.541			1385	sedimentology
035-PUC02	109	Push core	183	02.07	01:15			48° 52.181	11° 07.541			1385	foraminifera
035-Bibo02	109	Biobox	183	02.07	02:04			48° 52.158	11° 07.321			1265	crinoid + seastar
035-Bibo03	109	Biobox	183	02.07	02:25			48° 52.149	11° 07.257			1232	crinoid + sea urchin
035-VT03	109	Video transect	183	02.07	02:37	02.07	03:50	48° 52.149	11° 07.257	48° 52.149	11° 07.257	1232	
035-Bx01	109	Boxcore	183	02.07	03:57			48° 52.141	11° 06.957			1119	anemone
035-Bibo04	109	Biobox	183	02.07	04:13			48° 52.137	11° 06.893			1098	anemone

035-Bibo05	109	Biobox	183	02.07	04:23			48° 52.137	11° 06.893			1098	holothurian
035-VT04	109	Video transect	183	02.07	04:27	02.07	05:09	48° 52.137	11° 06.893	48° 52.126	11° 06.621	1098	
035-Bx02	109	Boxcore	183	02.07	05:19			48° 52.126	11° 06.621			1018	anemone
035-VT05	109	Video transect	183	02.07	05:25	02.07	06:10	48° 52.126	11° 06.621	48° 52.106	11° 06.412	1018	
035-SW01	109	ROV swath	183	02.07	06:24	02.07	13:36	48° 52.116	11° 06.414	48° 52.31	11° 08.22	923	
036		XBT	183	02.07	10:37			48° 52.25	11° 08.2			1712	
JC37-037		Elevator	188	07.07	08:28	16.07	08:28	48° 09.722	10° 33.693	48° 09.795	10° 33.798	3628	
038		Elevator	188	07.07	07:50	16.07	05:31	48° 09.685	10° 33.176	48° 09.618	10° 33.021	3612	
039	110	ISIS	188	07.07	08:24	07.07	17:54	48° 09.731	10° 33.676	48° 09.574	11° 33.12	3638	
039-Bics01	110	BICS	188	07.07	12:55	15.07	07:12	48° 09.724	10° 33.681	48° 09.724	10° 33.681	3636	respiration experiment
039-Holo01	110	Holothurian exp	188	07.07	15:05	15.07	07:12	48° 09.735	10° 33.684	48° 09.735	10° 33.684	3639	holothurian poo catcher
040		Piston core	188	07.07	20:08			48° 10.99	10° 31.43			3561	7.58 m core
041		Piston core	189	08.07	00:34			48° 06.149	10° 31.43			3720	8.02 m core
042	111	ISIS	189	08.07	03:33	08.07	12:24	48° 09.683	10° 33.173	48° 09.671	10° 33.143	3624	
042-SUS01	111	Suction sampler	189	08.07	05:48			48° 09.662	10° 33.19			3627	total of 25 *peniagone* holothurians
042-TOCS1	111	TOCS chambers	189	08.07	09:53	15.07	09:04	48° 09.662	10° 33.254	48° 09.685	10° 33.172	3626	no data, software failure
042-Spre01	111	Spreaders	189	08.07	09:53	15.07	10:39	48° 09.662	10° 33.254	48° 09.685	10° 33.170	3626	pulse-chase experiment, 3 spreaders
043		Megacore	189	08.07	14:36			48° 09.153	10° 33.762			3662	macrofauna
044		Bathysnap	189	08.07	17:15	24.07	18:45	48° 09.094	10° 34.076			3662	
045		Piston core	189	08.07	21:22			48° 26.863	11° 01.482			3002	5.52 m core
046		Piston core	190	09.07	01:05			48° 34.083	11° 10.082			2773	5.47 m core
047		Piston core	190	09.07	04:34			48° 41.081	11° 12.090			2437	6.61 m core
048		Piston core	190	09.07	10:53			48° 48.791	11° 09.164			1915	4.7 m core
049		Piston core	190	09.07	13:42			48° 55.417	11° 09.316			1416	no recovery
050		Megacore	190	09.07	17:12			46° 48.81	11° 09.19			1922	6 cores, 0.17-0.29 m, geology, geochem
051		CTD & SVP	190	09.07	18:54	09.07	20:42	48° 48.77	11° 09.55	48° 48.77	11° 09.55	1975	start time in water end time on deck
052		SAPS	190	09.07	23:39	10.07	01:01	48° 48.78	11° 09.549	48° 48.78	11° 09.549	1973	start time pump on, end time pump off
053		Megacore	191	10.07	04:00			48° 41.08	11° 12.09			2433	7 cores, 0.24-0.45 m, geology, geochem
054		Megacore	191	10.07	20:30			48° 17.009	10° 18.842			3372	4 cores. 0.42-0.43, geology, geochem
055		CTD	191	10.07	23:18	11.07	01:37	48° 17.010	10° 18.837	48° 17.004	10° 18.846	3369	start time in water end time on deck
056		SAPS	192	11.07	04:02	11.07	06:02	48° 17.01	10° 18.84	48° 17.01	10° 18.84	3367	start time on bottom, end time pump off
057		Megacore	192	11.07	22:25			48° 15.890	10° 09.807			3423	4 cores, 0.36-0.41 cm, geochemistry
058		CTD	193	12.07	00:49	12.07	03:21	48° 15.925	10° 10.92			3531	start time in water end time on deck
059		SAPS	193	12.07	06:05	12.07	08:10	48° 15.93	10° 10.923			3536	start time pump on, end time pump off
060		Piston core	193	12.07	13:02			48° 15.866	10° 09.784			3425	9.65 m core
061		Piston core	193	12.07	16:47			48° 17.016	10° 18.843			3338	8.48 m core
062		Megacore	193	12.07	20:21			48° 17.011	10° 18.841			3371	3 cores, 0.18-0.44 m, geology, geochem
063		Megacore	194	13.07	00:08			48° 16.890	10° 18.742			3375	7 cores, 0.22-0.44 m, Macrofauna
064		Megacore	194	13.07	05:55			48° 16.968	10° 18.653			3382	8 cores, 0.24-0.48 m, Macofauna
065		Megacore	194	13.07	09:50			48° 17.035	48° 18.892			3373	8 cores, 0.37-0.44 m, Macrofauna
066		Megacore	194	13.07	13:24			48° 16.828	10° 18.715			3381	4 cores, 0.29-0.42, Macrofauna
067		Megacore	194	13.07	17:00			48° 16.984	10°18.817			3376	7 cores, 0.37-0.44 m, Macrofauna
068		Megacore	194	13.07	20:53			48° 17.006	10°18.834			3375	5 cores, 0.36-0.42 m, Macrofauna
069		Megacore	196	15.07	00:27			48° 09.246	10° 33.635			3668	1 core, 0.18 m, microbiology

070	112	ISIS	196	15.07	04:49	15.07	21:00	48° 09.713	10° 33.693	48° 09.876	10° 32.886	3608	
070-SW01	112	ROV swath	196	15.07	07:37	15.07	08:44	48° 09.689	10° 33.731	48° 09.666	10° 33.204	3640	
070-PUC01	112	Push core	196	15.07	09:25			48° 09.689	10° 33.164			3628	sediment/OM/Fauna/Microbes
070-PUC02	112	Push core	196	15.07	09:29			48° 9.689	10° 33.164			3628	sediment/OM/Fauna/Microbes
070-PUC03	112	Push core	196	15.07	09:31			48° 09.689	10° 33.164			3628	sediment/OM/Fauna/Microbes
070-PUC04	112	Push core	196	15.07	09:56			48° 09.685	10° 33.17			3626	sediment/OM/Fauna/Microbes
070-PUC05	112	Push core	196	15.07	09:57			48° 09.685	10° 33.17			3626	sediment/OM/Fauna/Microbes
070-PUC06	112	Push core	196	15.07	09:58			48° 09.685	10° 33.17			3627	sediment/OM/Fauna/Microbes
070-PUC07	112	Push core	196	15.07	10:12			48° 09.683	10° 33.17			3627	sediment/OM/Fauna/Microbes
070-PUC08	112	Push core	196	15.07	10:26			48° 09.684	10° 33.17			3627	sediment/OM/Fauna/Microbes
070-PUC09	112	Push core	196	15.07	10:27			48° 09.684	10° 33.17			3627	sediment/OM/Fauna/Microbes
070-PUC10	112	Push core	196	15.07	10:28			48° 09.686	10° 33.17			3627	sediment/OM/Fauna/Microbes
070-Bibo01	112	Biobox	196	15.07	14:08			48° 10.02	10° 32.658			3605	holothurian
070-Bibo02	112	Biobox	196	15.07	14:26			48° 10.106	10° 32.715			3610	holothurian psycropotes
070-SUC03	112	Suction Sampler	196	15.07	11:18			48° 09.892	10° 32.707			3601	Anemone
071		Piston core	196	15.07	23:04			48° 10.41	10° 15.29			3629	6.14 m core
072	113	ISIS	197	16.07	11:24	17.07	00:45	48° 22.292	10° 02.369	48° 21.468	10° 01.952	3202	
072-PUC01	113	Push core	197	16.07	14:59			48° 22.141	10° 02.266			3211	macrofauna: local variation/obstacles
072-PUC02	113	Push core	197	16.07	15:02			48° 22.141	10° 02.314			3211	macrofauna: local variation/obstacles
072-PUC03	113	Push core	197	16.07	15:04			48° 22.141	10° 02.319			3211	macrofauna: local variation/obstacles
072-PUC04	113	Push core	197	16.07	15:06			48° 22.141	10° 02.266			3211	macrofauna: local variation/obstacles
072-PUC05	113	Push core	197	16.07	15:09			48° 22.141	10° 02.266			3211	macrofauna: local variation/obstacles
072-PUC06	113	Push core	197	16.07	15:17			48° 22.141	10° 02.266			3211	macrofauna: local variation/obstacles
072-PUC07	113	Push core	197	16.07	15:42			48° 22.141	10° 02.266			3212	macrofauna: local variation/obstacles
072-PUC08	113	Push core	197	16.07	15:44			48° 22.141	10° 02.266			3212	macrofauna: local variation/obstacles
072-PUC09	113	Push core	197	16.07	15:47			48° 22.178	10° 02.266			3212	macrofauna: local variation/obstacles
072-PUC10	113	Push core	197	16.07	15:49			48° 22.141	10° 02.267			3212	macrofauna: local variation/obstacles
072-PUC11	113	Push core	197	16.07	15:56			48° 22.141	10° 02.267			3212	macrofauna: local variation/obstacles
072-PUC12	113	Push core	197	16.07	15:58			48° 22.141	10° 02.231			3212	macrofauna: local variation/obstacles
072-Rok01	113	Rock	197	16.07	16:08			48° 22.183	10° 02.291			3211	
072-SUC01	113	Suction Sampler	197	16.07	16:49			48° 22.172	10° 02.252			3183	Anthomastus
072-Rok02	113	Rock	197	16.07	17:02			48° 22.156	10° 02.185			3177	
072-VT01	113	Video transect	197	16.07	17:10	16.07	18:25	48° 22.156	10° 02.185	48° 22.165	10, 02.177	3177	
072-SUC02	113	Suction Sampler	197	16.07	18:25			48° 22.165	10° 02.177			3079	sea whip, Gorgonion
072-SUC03	113	Suction Sampler	197	16.07	18:36			48° 22.167	10° 02.16			3061	bush gorgonian, anthomastus, sea whip
072-SUC04	113	Suction Sampler	197	16.07	18:49			48° 22.166	10° 02.112			3042	Pennatulid, gorgonion
072-VT02	113	Video transect	197	16.07	18:53	16.07	19:50	48° 22.166	10° 02.112	48° 21.968	10° 02.112	3042	
072-SUC05	113	Suction Sampler	197	16.07	19:57			48° 21.968	10° 02.112			2931	Anemone
072-Rok03	113	Rock	197	16.07	20:04			48° 21.968	10° 0211			2932	
072-SUC06	113	Suction Sampler	197	16.07	20:13			48° 21.968	10° 02.111			2932	Crinoid
072-SUC07	113	Suction Sampler	197	16.07	20:46			48° 21.934	10° 02.036			2852	gorgonian bush gorgonian x2
072-SUC08	113	Suction Sampler	197	16.07	20:47			48° 21.934	10° 02.036			2852	Ophiuroid
072-VT03	113	Video transect	197	16.07	21:02	16.07	22:36	48° 21.905	10° 02.003	48° 21.479	10° 21.479	2822	
073		Piston core	198	17.07	02:55			48° 23.807	10° 00.364			3045	0.3 m core

074		Piston core	198	17.07	07:18			48° 23.819	09° 59.556			2963	5.37 m core, top of core lost
075		Piston core	198	17.07	11:05			48° 27.207	09° 56.994			2450	5.51 m core
076		Megacore	198	17.07	13:55			48° 27.18	09° 57.00			2452	2 cores, 0.28-0.4 m, geology, geochem
077		Megacore	198	17.07	17:14			48° 28.248	09° 59.983			1125	failed
078		Megacore	198	17.07	20:10			48° 36.248	09° 57.699			1626	6 cores, 0.09-0.14 m, geology
079		XBT	198	17.07	19:59			48° 36.239	09° 57.702			1625	
080		Megacore	198	17.07	22:25			48° 36.189	09° 57.699			1638	8 cores, 0.1-0.14 m, sediment incub.
081		Megacore	199	18.07	00:32			48° 36.188	09° 57.699			1640	5 cores, 0.1-0.14 m, sediment incub
082		Piston core	199	18.07	02:52			48° 36.208	09° 57.674			1636	1.28 m core
083		Amphipod trap	199	18.07	04:50	20.07	06:00	48° 33.074	09° 59.658	48° 32.701	09° 59.353	759	start time deployed, end time on deck
084		CTD	199	18.07	05:44	18.07	07:17	48° 36.196	09° 57.999	48° 36.18	09° 57.928	1699	start time in water end time on deck
085		SAPS	199	18.07	09:23	18.07	11:23	48° 36.17	09° 57.92	48° 36.17	09° 57.92	1701	Start time pump on, end time pump off
086	114	ISIS	199	18.07	12:52	19.07	02:50	48° 36.192	09° 58.004	48° 36.746	09° 57.28	1640	
086-SUC01	114	Suction Sampler	199	18.07	15:41			48° 36.237	09° 57.921			1359	Acanthogorana & Seastar
086-SUC02	114	Suction Sampler	199	18.07	16:05			48° 36.234	09° 57.918			1359	Rock
086-VT01	114	Video transect	199	18.07	16:10	18.07	17:03	48° 36.234	09° 57.918	48° 36.333	09° 57.747	1359	
086-SUC03	114	Suction Sampler	199	18.07	17:03			48° 36.333	09° 57.747			1359	Urchin
086-Bibo01	114	Biobox	199	18.07	17:19			48° 36.333	09° 57.747			1338	coral
086-VT02	114	Video transect	199	18.07	17:25	18.07	18:10	48° 36.333	09° 57.747	48° 36.338	09° 57.741	1338	
086-Bibo02	114	Biobox	199	18.07	18:15			48° 36.338	09° 57.741			1316	stalked chrinoid, urchin
086-BX01	114	Boxcore	199	18.07	19:24			48° 36.403	09° 57.735			1305	forams, xenophyophore
086-Bibo03	114	Biobox	199	18.07	20:37			48° 36.432	09° 57.682			1299	coral
086-VT03	114	Video transect	199	18.07	20:51	18.07	21:20	48° 36.432	09° 57.662	48° 36.442	09° 57.656	1299	
086-Bibo03	114	Biobox	199	18.07	21:22			48° 36.442	09° 57.656			1299	dead coral
086-SUC04	114	Suction Sampler	199	18.07	21:47			48° 36.442	09° 57.656			1298	purple unknown species
086-SUC05	114	Suction Sampler	199	18.07	21:49			48° 36.44	09° 57.655			1676	sponge, chrinoid
086-SUC06	114	Suction Sampler	199	18.07	21:49			48° 36.44	09° 57.655			1675	brachiopods, coral x2
086-SUC07	114	Suction Sampler	199	18.07	22:07			48° 36.44	09° 57.655			1607	gorgonians
086-SUC08	114	Suction Sampler	199	18.07	22:37			48° 36.455	09° 57.656			1607	Penatutidae
086-SUS09	114	Suction Sampler	199	18.07	22:56			48° 36.474	09° 57.644			1565	Penatutidae
086-BX02	114	Boxcore	199	18.07	23:38			48° 36.474	09° 57.602			1449	Xenophyophore & sea urchin
086-SUC10	114	Suction Sampler	200	19.07	00:03			48° 36.503	09° 57.563			1387	anthoptilium
086-SUC11	114	Suction Sampler	200	19.07	00:15			48° 36.503	09° 57.563			1358	gorgonian
086-SUC12	114	Suction Sampler	200	19.07	00:27			48° 36.503	09° 57.563			1358	benthogone
086-SUC13	114	Suction Sampler	200	19.07	00:30			48° 36.504	09° 57.555			1299	anthoptilum
086-PUC01	114	Push core	200	19.07	00:34			48° 36.504	09° 57.557			1299	organic geochemistry
086-PUC02	114	Push core	200	19.07	00:36			48° 36.504	09° 57.557			1299	organic geochemistry
086-PUC03	114	Push core	200	19.07	00:38			48° 36.504	09° 57.556			1299	organic geochemistry
086-VT04	114	Video transect	200	19.07	00:40	19.07	01:41	48° 36.504	09° 57.556	48° 36.746	09° 57.28	1299	
087	115	ISIS	200	19.07	04:56	19.07	13:33	48° 36.278	09° 58.065	48° 35.849	09° 59.084	1677	
087-PUC01	115	Push core	200	19.07	06:31			48° 36.249	09° 58.027			1694	geology
087-PUC02	115	Push core	200	19.07	06:33			48° 36.249	09° 58.027			1694	geology
087-VT01	115	Video transect	200	19.07	06:35	18.07	07:50	48° 36.249	09° 58.027	48° 36.22	09° 58.244	1694	
087-Bibo01	115	Biobox	200	19.07	07:50			48° 36.22	09° 58.244			1646	scraped outcrop into biobox

087-Bibo02	115	Biobox	200	19.07	08:15			48° 36.206	09° 58.264			1637	seastar
087-Bibo03	115	Biobox	200	19.07	08:37			48° 36.188	09° 58.287			1629	seastar
087-VT02	115	Video transect	200	19.07	08:47	18.07	09:00	48° 36.188	09° 58.287	48° 36.157	09° 58.344	1629	
087-Bibo04	115	Biobox	200	19.07	09:02			48° 36.157	09° 58.344			1622	urchin
087-SUC01	115	Suction Sampler	200	19.07	09:22			48° 36.142	09° 58.376			1619	swimming holothurian x2
087-Bibo05	115	Biobox	200	19.07	09:34			48° 36.115	09° 58.46			1610	urchins x2
087-VT03	115	Video transect	200	19.07	09:48	18.07	10:16	48° 36.115	09° 58.46	48° 36.027	09° 58.688	1610	
087-Bibo06	115	Biobox	200	19.07	10:22			48° 36.027	09° 58.688			1544	coral
087-VT04	115	Video transect	200	19.07	10:39	18.07	11:28	48° 36.027	09° 58.688	48° 35.849	09° 58.08	1544	
087-SUC02	115	Suction Sampler	200	19.07	12:09			48° 35.849	09° 59.08			1389	sponge
087-SUC03	115	Suction Sampler	200	19.07	12:12			48° 35.849	09° 59.08			1389	anemone
087-PUC03	115	Push core	200	19.07	12:16			48° 35.849	09° 59.08			1389	xenophyophore, sponge
088		Megacore	200	19.07	15:02			48° 38.217	10° 00.581			1437	5 cores, 0.31-0.43 m, geology, geochem
089	116	ISIS	200	19.07	16:41	20.07	04:50	48° 39.286	10° 01.854	48° 39.042	10° 03.047	1370	
089-VT01	116	Video transect	200	19.07	17:47	19.07	18:12	48° 39.286	10° 01.854	48° 39.252	10° 01.961	1370	
089-Rok01	116	Rock	200	19.07	18:18			48° 39.252	10° 01.961			1355	rock
089-VT02	116	Video transect	200	19.07	18:23	20.07	00:10	48° 39.252	10° 01.961	48° 39.134	10° 02.615	1355	
089-SUC01	116	Suction Sampler	201	20.07	00:19			48° 39.134	10° 02.615			1134	chrinoid (atele crinus)
089-SUC02	116	Suction Sampler	201	20.07	00:48			48° 39.125	10° 02.721			1078	chrinoid (atele crinus)
089-SUC03	116	Suction Sampler	201	20.07	00:59			48° 39.112	10° 02.744			1069	chrinoid (atele crinus)
089-SUC04	116	Suction Sampler	201	20.07	01:20			48° 39.116	10° 02.775			1054	brisingella
089-SUC05	116	Suction Sampler	201	20.07	02:02			48° 39.072	10° 02.916			949	sea urchin
089-VT03	116	Video transect	201	20.07	02:04	20.07	02:34	48° 39.072	10° 02.916	48° 39.044	10° 03.034	949	
090	117	ISIS	201	20.07	08:41	21.07	00:29	48° 27.65	09° 56.97	48° 27.60	09° 58.20	2448	
090-VT01	117	Video transect	201	20.07	10:39	20.07	11:03	48° 27.648	09° 56.964	48° 27.60	09° 57.02	2446	
090-PUC01	117	Push core	201	20.07	11:09			48° 27.60	09° 57.02			2515	no recovery
090-PUC02	117	Push core	201	20.07	11:13			48° 27.60	09° 57.127			2515	geology
090-PUC03	117	Push core	201	20.07	11:53			48° 27.563	09° 57.127			2483	organic geochemistry
090-PUC04	117	Push core	201	20.07	11:57			48° 27.563	09° 57.127			2483	foraminifera
090-PUC05	117	Push core	201	20.07	12:00			48° 27.563	09° 57.127			2483	geology
090-PUC06	117	Push core	201	20.07	12:02			48° 27.563	09° 57.127			2483	geology
090-Bibo01	117	Biobox	201	20.07	12:17			48° 27.56	09° 57.146			2471	King crab
090-Bibo02	117	Biobox	201	20.07	13:57			48° 27.465	09° 57.474			2117	Brisingid
090-SUS01	117	Suction Sampler	201	20.07	14:32			48° 27.449	09° 57.423			2117	sea whip
090-SUS02	117	Suction Sampler	201	20.07	16:01			48° 27.445	09° 57.576			2119	octocoral
090-SUS03	117	Suction Sampler	201	20.07	16:33			48° 27.483	09° 57.60			2040	cerianthid, sea spider
090-VT02	117	Video transect	201	20.07	16:38	20.07	17:10	48° 27.483	09° 57.60	48° 27.511	09° 57.097	2040	
090-SUS04	117	Suction Sampler	201	20.07	17:14			48° 27.511	09° 57.697			2021	whip coral, crinoid
090-SUS05	117	Suction Sampler	201	20.07	17:43			48° 27.53	09° 57.735			1997	solitary coral
090-VT03	117	Video transect	201	20.07	17:55	20.07	19:38	48° 27.53	09° 57.735	48° 27.574	09° 58.08	1997	
090-PUC07	117	Push core	201	20.07	19:48			48° 27.574	09° 58.08			1811	geology
090-SUS06	117	Suction Sampler	201	20.07	20:20			48° 27.561	09° 58.173			1791	Novodinia brisingid
091		Piston core	202	21.07	01:34			48° 30.68	09° 56.19			2124	no recovery
092		Piston core	202	21.07	08:01			48° 19.121	10° 23.753			3257	8.61 m core

093		Megacore	202	21.07	12:40			48° 15.886	10° 09.560			3424	8 cores, 0.29-0.44 m, Macrofauna
094		Megacore	202	21.07	16:22			48° 15.779	10° 09.574			3416	8 cores, 0.33-0.42 m, Macrofauna
095		Megacore	202	21.07	20:05			48° 15.776	10° 09.576			3429	4 cores, 0.41-0.54 m, Macrofauna
096		Megacore	203	22.07	00:02			48° 15.758	10° 09.598			3424	6 cores, 0.33-0.42 m, Macrofauna
097		Megacore	203	22.07	03:33			48° 15.886	10° 09.539			3425	5 cores, 0.29-0.45 m, Macrofauna
098		Megacore	203	22.07	07:31			48° 15.762	10° 09.596			3432	4 cores, 0.39-0.44 m, Macrofauna
099		Elevator	203	22.07	11:36	25.07	15:21	48° 15.993	10° 09.468	48° 15.689	10° 08.812	3406	start time on bottom, end time recovery
100	118	ISIS	203	22.07	12:13	22.07	22:35	48° 16.06	10° 09.58	48° 15.995	10° 09.464	3406	
100-Bibo01	118	Biobox	203	22.07	16:28			48° 15.993	10° 09.468			3406	Benthothurce?
100-Bics01	118	BICS	203	22.07	17:00	25.07	13:11	48° 15.993	10° 09.468			3406	respiation experiment, control
100-Bics02	118	BICS	203	22.07	17:26	25.07	13:11	48° 15.993	10° 09.468			3406	respiation experiment, Benthodytes
100-PUC01	118	Push core	203	22.07	18:47			48° 15.992	10° 09.468			3414	sediment/OM/Fauna/Microbes
100-Spre01	118	Spreaders	203	22.07	19:46	25.07	09:31	48° 15.994	10° 09°470			3414	pulse-chase experiment, 6 units, 2 fail
100-PUC02	118	Push core	203	22.07	20:18			48° 15.993	10° 09.465			3413	sediment/OM/Fauna/Microbes
100-PUC03	118	Push core	203	22.07	20:19			48° 15.993	10° 09.465			3413	sediment/OM/Fauna/Microbes
100-PUC04	118	Push core	203	22.07	20:21			48° 15.993	10° 09.465			3413	sediment/OM/Fauna/Microbes
100-PUC05	118	Push core	203	22.07	20:22			48° 15.993	10° 09.465			3413	sediment/OM/Fauna/Microbes
100-PUC06	118	Push core	203	22.07	20:24			48° 15.993	10° 09.465			3413	sediment/OM/Fauna/Microbes
100-PUC07	118	Push core	203	22.07	20:25			48° 15.993	10° 09.465			3413	sediment/OM/Fauna/Microbes
100-PUC08	118	Push core	203	22.07	20:27			48° 15.993	10° 09.465			3413	sediment/OM/Fauna/Microbes
100-PUC09	118	Push core	203	22.07	20:28			48° 15.993	10° 09.465			3413	sediment/OM/Fauna/Microbes
100-PUC10	118	Push core	203	22.07	20:29			48° 15.993	10° 09.465			3413	sediment/OM/Fauna/Microbes
100-PUC11	118	Push core	203	22.07	20:30			48° 15.993	10° 09.465			3413	sediment/OM/Fauna/Microbes
100-PUC12	118	Push core	203	22.07	21:00			48° 15.993	10° 09.465			3413	sediment/OM/Fauna/Microbes
100-PUC13	118	Push core	203	22.07	21:23			48° 15.995	10° 09.464			3411	organic geochemistry
100-PUC14	118	Push core	203	22.07	21:25			48° 15.995	10° 09.464			3411	organic geochemistry
100-PUC15	118	Push core	203	22.07	21:28			48° 15.995	10° 09.464			3411	
101		Amphipod trap	204	23.07	01:31	25.07	18:08	48° 23.814	10° 18.989	48° 23.71	10° 18.85	1765	
102	119	ISIS	204	23.07	05:29	23.07	11:38	48° 42.60	10° 22.701	48° 43.312	10° 23.914	800	
102-SW01	119	ROV swath	204	23.07	06:29	23.07	10:06	48° 42.654	10° 22.687	48° 43.26	10° 23.968	790	
103	120	ISIS	204	23.07	14:50	24.07	12.56	48° 27.624	09° 58.641	48° 27.376	09° 56.808	1435	
103-SW01	120	ROV swath	204	23.07	16:17	24.07	10:59	48° 27.618	09° 58.645	48° 27.388	09° 56.776	1521	
104	121	ISIS	205	24.07	19:03	25.07	02:50	48° 09.067	10° 33.832	48° 09.244	10° 34.649	3616	
104-VT01	121	Video transect	205	24.07	21:24	24.07	01:12	48° 09.22	10° 34.568	48° 09.304	10° 34.665	3696	
104-SW01	121	ROV swath	205	24.07	01:12	24.07	23:20	48° 09.304	10° 34.665	48° 09.21	10° 34.701	3649	
104-VT02	121	Video transect	205	24.07	23:20	24.07	23:37	48° 09.21	10° 34.701	48° 09.249	10° 34.646	3665	
105	122	ISIS	206	25.07	05:14	25.07	12:57	48° 15.985	10° 09.468	48° 15.944	10° 09.437	3414	
105-PUC01	122	Push core	206	25.07	07:28			48° 15.998	10° 09.466			3415	sediment/OM/Fauna/Microbes
105-PUC02	122	Push core	206	25.07	07:32			48° 15.998	10° 09.466			3415	sediment/OM/Fauna/Microbes
105-PUC03	122	Push core	206	25.07	07:37			48° 15.998	10° 09.466			3415	sediment/OM/Fauna/Microbes
105-PUC04	122	Push core	206	25.07	08:07			48° 15.996	10° 09.468			3415	sediment/OM/Fauna/Microbes
105-PUC05	122	Push core	206	25.07	08:08			48° 15.996	10° 09.468			3415	sediment/OM/Fauna/Microbes
105-PUC06	122	Push core	206	25.07	08:09			48° 15.996	10° 09.468			3415	sediment/OM/Fauna/Microbes
105-PUC07	122	Push core	206	25.07	08:34			48° 15.995	10° 09.47			3414	sediment/OM/Fauna/Microbes

105-PUC08	122	Push core	206	25.07	08:36			48° 15.995	10° 09.47			3414	sediment/OM/Fauna/Microbes
105-PUC09	122	Push core	206	25.07	08:38			48° 15.995	10° 09.47			3414	sediment/OM/Fauna/Microbes
105-PUC10	122	Push core	206	25.07	09:29			48° 15.994	10° 09.475			3414	sediment/OM/Fauna/Microbes
105-PUC11	122	Push core	206	25.07	09:30			48° 15.994	10° 09.475			3414	sediment/OM/Fauna/Microbes
105-PUC12	122	Push core	206	25.07	09:31			48° 15.994	10° 09.475			3414	sediment/OM/Fauna/Microbes
105-SUS01	122	Suction Sampler	206	25.07	09:57			48° 16.008	10° 09.434			3408	sea pen
105-SUS02	122	Suction Sampler	206	25.07	10:12			48° 16.013	10° 09.424			3405	sea pen
105-PUC13	122	Push core	206	25.07	10:18			48° 16.011	10° 09.425			3403	xenophyophore
105-PUC14	122	Push core	206	25.07	10:21			48° 16.015	10° 09.402			3403	xenophyophore
105-SUS03	122	Suction Sampler	206	25.07	10:29			48° 16.009	10° 09.407			3402	coral
106		Piston core	206	25.07	20:32			48° 23.814	10° 18.989			1769	8.43 m core
107		Piston core	206	25.07	23:52			48° 25.627	10° 18.521			1281	8.17 m core
108		CTD	207	26.07	03:57	26.07	05:15	48° 39.179	10° 01.987	48° 39.178	10° 01.982	1415	
109	123	ISIS	207	26.07	07:22	26.07	14:06	48° 39.199	10° 02.055	48° 39.17	10° 02.108	1348	
109-SW01	123	ROV swath	207	26.07	09:32	26.07	13:01	48° 39.182	10° 02.121	48° 39.151	10° 02.147	1363	