National Marine Facilities

ANNUAL REVIEW 2016/17

National Oceanography Centre
NATURAL ENVIRONMENT RESEARCH COUNCIL

NERC SCIENCE OF THE ENVIRONMENT

Contents

INTRODUCTION

National Marine Facilities (NMF) operates the Royal Research Ships (RRS) James Cook and Discovery and the National Marine Equipment Pool (NMEP) on behalf of the Natural Environment Research Council (NERC).

As part of the National Oceanography Centre (NOC), NMF is based in Southampton and has access to a quayside capable of berthing the research ships as well as housing workshops, laboratories, testing facilities, calibration labs, warehousing and logistics capabilities along with the offices supporting the worldwide operations.

NMF provides these capabilities to the whole UK Marine Science research community as a centralised and cost-effective resource. While the ships are the most visible component of this resource, the National Marine Equipment Pool (NMEP) is equally important and ranges across numerous scientific disciplines.

Who we are

NMF encompasses the mariners, engineers, technicians, project managers, logisticians and operations managers who all work together to deliver the Marine Facilities Programme (MFP). The main groups are shown in the Organisation diagram.

NMF aim

The aim of NMF is to develop,co-ordinate and provide major platforms, observing systems and technical expertise required by the UK's marine science community.

What we do

NMF undertakes approximately 15 research expeditions from the RRS James Cook and RRS Discovery every year as well as delivering and operating equipment from NMEP used on British Antarctic Survey (BAS) or European partner research ships.

In addition, we operate more and more Marine Autonomous Systems (MAS) Platforms (Autonomous Underwater Vehicles (AUVs), gliders, Unmanned Surface Vehicles (USVs), etc.) launched and recovered from the shoreline anywhere in the world, but piloted from our base in the UK.

NMF ORGANISATION DIAGRAM

- Marine Autonomous and Robotic Systems (MARS)
- NERC National Facility for Scientific Diving
- Research Ships Management
- Science and Project Support
- Programme Management
- Logistics and Warehousing
- Scientific Engineering

RESEARCH EXPEDITIONS TIMELINE

RRS JAMES COOK

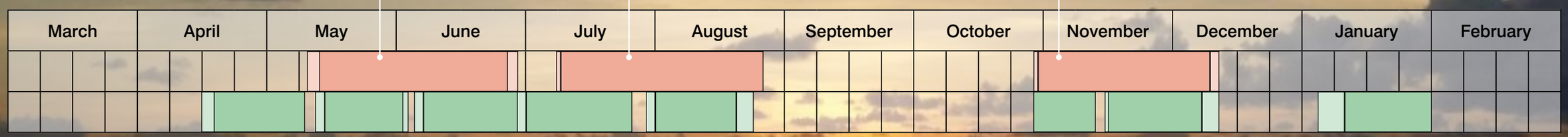
Expedition core time

Expedition lead-in and debrief

JC136
14 May - 23 Jun
Influence of population connectivity on depth-dependent diversity of deep-sea marine benthic biota

JC138
8 Jul - 24 Aug
Blue Mining - Breakthrough Solutions for the Sustainable Exploration and Extraction of Deep Sea Mineral Resources

JC142
8 Jul - 24 Aug
29 Oct - 8 DecFAPESP:
The E-Tech element potential of submarine ferromanganese deposits



DY050
18 Apr - 8 May
Biogeochemistry at the PAP sustained observatory

DY051
13 May - 3 Jun
Pressure-dependence of carbon turnover by deep-sea microorganisms

DY052
7 - 25 JunThe Extended Ellett Line (EEL)

DY053
29 Jun - 23 JulOverturning in the Subpolar North Atlantic Program (OSNAP

DY054
27 Jul - 17 AugOverturning in the Subpolar North Atlantic Program (OSNAP)

DY061
28 Oct - 8 Nov
Seismic Science Verification Period (SVP)

DY059
19 Nov - 6 DecCoring Science Verification Period (SVP)

DY063
10 Jan - 30 JanROV Science Verification Period (SVP)

RRS DISCOVERY

Expedition core time

Expedition lead-in and debrief

RESEARCH EXPEDITIONS MAP

RRS JAMES COOK

RRS DISCOVERY

RRS DISCOVERY RESEARCH EXPEDITIONS

BIOGEOCHEMISTRY AT THE PAP-SO

DY050 18 April - 8 May, 2016

Mark Stinchcombe
Principal Investigator

Antonio Gatti
Master

Nick Rundle Senior
Technician

Matt Tiahlo
Expedition Manager

North Atlantic
Location

Collaborating Institutions
Center for Marine Environmental Sciences, Bremen (MARUM)
Alfred Wegener Institute (AWI)
Natural History Museum (NHM)

NMEP Equipment
OTSB trawl
Box core
CTD
Stand Alone Pumps (SAPs)

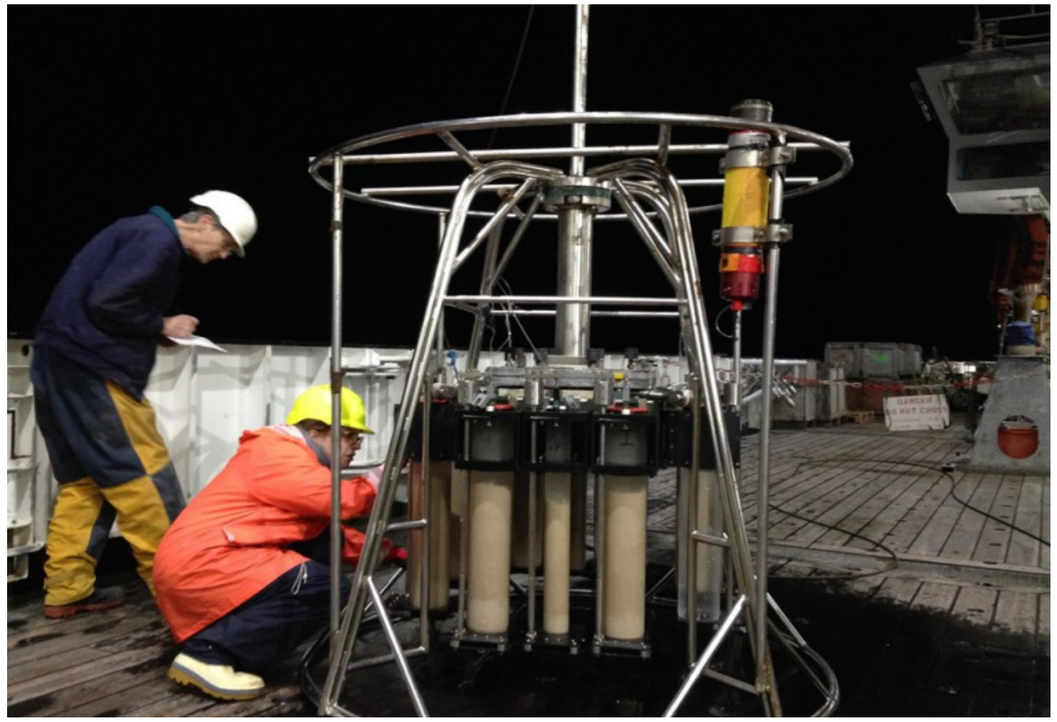
URLs
www.projects.noc.ac.uk/pap/
www.papobservatorywordpress.com/category/2016-cruise-dy050/

The Porcupine Abyssal Plain Sustained Observatory (PAP-SO) is a sustained, multidisciplinary observatory coordinated by the National Oceanography Centre. Initiated in 1989, the PAP-SO has become a major focus for international and interdisciplinary scientific research and monitoring; including water column biogeochemistry, physics and benthic biology helping us to understand the effects of climate change on the open ocean and deep-sea ecosystems.

Precis of the science outcomes:

Since 2002, a mooring has been in place with sensors taking a diverse set of biogeochemical and physical measurements of the upper 1000m of the water column. Some of these data are transmitted in near real-time via satellite. The PAP-SO is now part of the EuroSITES network of European deep ocean observatories, which will integrate and enhance nine time-series sites and coordinate missions to develop new sensors and techniques for observing changing oceans.

RRS DISCOVERY EXPEDITIONS - DY050
BIOGEOCHEMISTRY AT THE PORCUPINE ABYSSAL PLAIN SUSTAINED OBSERVATORY



- Sediment samples for eDNA are taken from a Megacore tube (Top image)
- Royal Navy assistance was provided to attend to an ODAS buoy which had experienced power issues post deployment (Bottom image)

The objective of this year's expedition was primarily to service the infrastructure required for continuous observation at the site, and to obtain observations from the ship to provide context for autonomously acquired mooring data.

This required a multi-instrument observational approach combined with direct sampling. The expedition achieved substantial sampling of the seabed by coring and trawling alongside water column measurements obtained from CTD sampling and drifting particle trap deployments.

▲ Sampled invertebrate megafauna and members of the benthic team sorting the catch

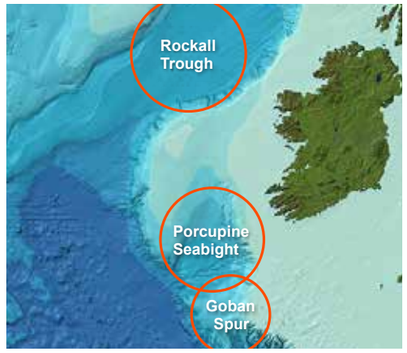
▶ Postgraduate research student Marla Spencer using the microscope on board, identifying the species, counting the individuals and photographing them

▼ The frame being deployed. It is full of sensors that will record subsurface data (such as measuring temperature, salinity, oxygen, irradiance, chlorophyll - fluorescence, nitrate and pCO2) throughout the year. Photo: Henry Ruhl

Technical Description of Equipment Deployed and Performance:

In 15 days, the team completed 124 sampling stations. These involved NMEP supplied CTDs, megacores, stand-alone pumps, benthic trawls and moorings equipment. The science party supplied marine snow catchers (PELAGRA traps), optical sampling gear and zooplankton nets. The surface buoy and a frame full of sensors were successfully deployed.

All equipment performed well with no major failures. Royal Navy assistance was requested and provided to attend to an ODAS buoy which had experienced power issues post deployment.



UNDER PRESSURE

PRESSURE-DEPENDENCE OF CARBON TURNOVER BY DEEP-SEA MICROORGANISMS

DY051 13 May - 3 June, 2016

Ursula Witte
Principal Investigator

Antonio Gatti
Master

Alan Sherring
Senior Technician

Jez Evans
Expedition Manager

Rockall trough
Location

Collaborating Institutions
Oceanlab, University of Aberdeen, University of Cardiff

NMEP Equipment
Fume hood
Laminar flow hood
Millipore system
Megacorer
NIOZ Box core
Acoustic systems (3.5kHz SBP, 12kHz ES)
Surfmet system
USBL System

URL
journals.ametsoc.org/doi/pdf/10.1175/JTECH-D-16-0248.1

DY051 visited Goban Spur and Porcupine Seabight, as well as the Rockall Trough, to trial a novel, pressure-coring, experimentation and cultivation system that enables studies of deep-sea prokaryote biodiversity and ecosystem functioning, under ambient or manipulated pressure, temperature and oxygen conditions from any medium sized ocean going research ship with deep-sea coring capability.

Precis of the Science Outcomes:

Following a successful trial of the University of Aberdeen's Multi-Autoclave-Coring and Experimentation Unit (MAC-EXP) equipment, sediment incubation experiments were run to investigate the pressure dependence of microbial OM turnover in deep-sea sediments. In addition, sediment cores were taken along depth transects at both Goban Spur and Rockall Trough using the NMF box core and mega core.

Technical Description of Equipment Deployed and Performance:

Both the Mega corer and NIOZ box corer worked well for the duration of the expedition in support of the OceanLab MAC-EXP pressure corer.

The MAC-EXP pressure corer being deployed. Photo: Oceanlab (Main picture) Location of expedition and the NMF Mega corer (Inset images)

NORTH ATLANTIC CURRENTS

THE EXTENDED ELLETT LINE

DY052 7 June - 25 June, 2016

Stefan Gary
Principal Investigator

Jo Cox
Master

Jonathan Short
Senior Technician

Laura Wedge
Expedition Manager

North East Atlantic
Location

Collaborating Institutions
Natural Research Environment Council (NERC)
Scottish Association for Marine Science (SAMS)
National Oceanography Centre (NOC)
University of Plymouth
Met Office
University of Glasgow

NMEP Equipment
CTD Frame and Instruments
Slocum glider
EM710/122 Swath bathymetry
EA640 Echosounder
Vessel mounted 150 & 75 kHz ADCP
Sea surface and meteorology sampling system
Data logging and processing system

URL
http://projects.noc.ac.uk/ExtendedEllettLine/

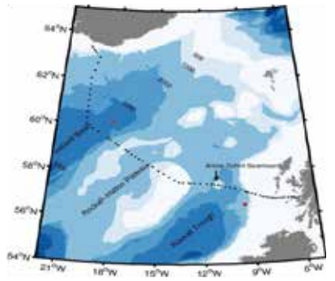
The Extended Ellett Line (EEL) is a full-depth hydrographic section between Scotland, Rockall, and Iceland. It is designed to capture the shallow, warm inflow into the subpolar gyre and the Nordic Seas and the deep, cold return flow that contributes to the lower branch of the Atlantic Meridional Overturning Circulation (AMOC). The objective is to make an annual occupation of the EEL section and create a time series of the evolution of the Northeast Atlantic.

Precis of the Science Outcomes:

This annual CTD hydrographic section from Scotland to Iceland consists of over 80 full depth CTD stations requiring 18 days to complete. In addition to the primary goals of measuring temperature, salinity, oxygen, nutrients, velocity, and carbon parameters there was other, opportunistic, data collection for gases (underway sampling), trace metals (samples taken from the extra water in the Niskin bottles), and deployments of Argo floats.

◀ **Taking the first sample from the CDT rosette Photo: Elizabeth Comer**

▶ **Location of the Extended Ellet Line**



Technical Description of Equipment Deployed and Performance:

- The standard 24 bottle, stainless steel CTD frame was deployed on 89 occasions during this expedition.
- Failures of the Seabird SBE9+ underwater unit and Seabird SBE32 carousel necessitated change for spares during the expedition.
- The Plymouth University Passive Acoustic Monitor (PAM) hydrophone was deployed using a NMEP deck mounted hydraulic winch between CTD stations to listen for marine mammals.
- The Scottish Association for Marine Science (SAMS) supplied Benthic Sledge, deployed on four occasions using the ship fitted trawling and coring winch systems. These deployments were very successful collecting many biological samples.
- iRobot Seaglider 'Eltanin' was recovered at the beginning of the expedition. Eltanin is a NMEP glider, managed and maintained by SAMS.
- The ship-fitted acoustic systems (150 & 75kHz ADCP, EM122 and 710 swath-bathymetry, EA640 echosounder) were run for duration of the expedition as were all underway and meteorology sampling systems.
- Three Argo floats were deployed

Mud glorious mud!

The CTD is lowered into the water

EQUIPMENT TRIALS

SEISMIC/CORING/ROV SCIENTIFIC VERIFICATION PERIODS (SVPS)

DY061/59/63 28 October – 30 January, 2017

Andy Henson / Dave Turner
Principal Investigators

Jo Cox / Antonio Gatti
Masters

Jez Evans / Jon Short
Senior Technicians

Jez Evans / Jon Short
Expedition Managers

Canary Basin
Location

NMEP Equipment
Piston coring suite
Seismic equipment
ROV suite

URL
http://noc.ac.uk/science/previous-expeditions (scroll down for these expeditions)

Over a number of expeditions, the RRS Discovery teams undertook several equipment testing sessions. The Piston Coring System, a full array of ROV operations and a full seismic survey were planned. These expeditions provided an ideal opportunity to deliver additional training to newer members of the NMF technical teams.

Precis of the Science Outcomes:

The main objective of these SVPs was to ensure:

- Piston coring operations can be carried out on the RRS Discovery effectively and safely. A secondary objective for the expedition was to commission and trial the recent upgrades applied to the NIOZ piston coring system. This SVP was taken as an opportunity to undertake training for NMF staff as yet unfamiliar with piston coring operations. In addition, the new containerised Lebus contingency winch with Nexans synthetic rope was installed and trialled on this vessel and the ship's crew trained in its operation.
- Seismic operations of two beams of three guns can be carried out on the RRS Discovery effectively and safely.
- ROV operations in both the port and starboard deployment positions can be carried out on the RRS Discovery effectively and safely.

◀ **ROV Umbilical on LHSX**

Technical Description of Equipment Deployed and Performance:

Ten piston cores were successfully taken in water depths between 3400 and 4500m. Multiple piston cores were taken at the same location, allowing Ocean Engineering Group (OEG) technicians the rare opportunity to adjust various parameters in the corer setup to see the effect these changes had on the core sample, independent from any changes in the seabed structure. This was done as part of the training programme, and was an attempt to maximise the length of sediment sample recovered. This had the desired effect - in one case increasing the recovered sample length by more than 25%. This training will ensure that NMF will have sufficient trained staff for piston coring expeditions in the upcoming expedition programme. It was also proven on this expedition that the upgrades to the NIOZ piston corer were successful, and allow the system to operate with a 'solid' piston for the first time (i.e. there is no longer a need to use the relief valve in the piston). In addition to these modifications a new coring workshop container was fitted out and commissioned by the OEG technicians during the expedition.

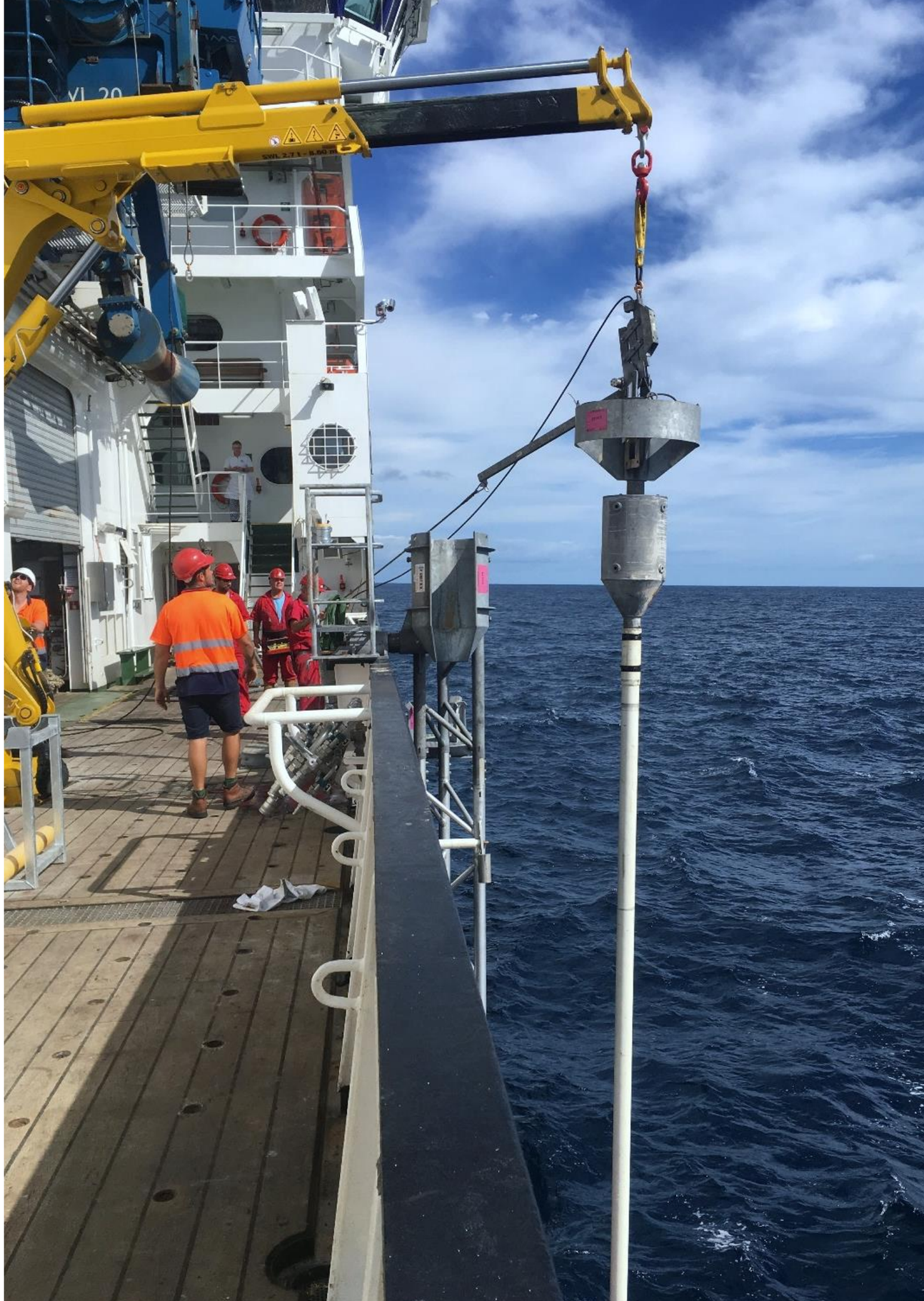
Seismic operations commenced with the deployment of a single inboard beam array. These were fired for a short duration before being recovered. Over the following days, the number of gun arrays were increased until all four were deployed and firing satisfactorily. The final trial was to test the full beam array, as well as the streamer, whilst conducting a range of vessel manoeuvres. It was proven that up to two NMEP beams with 6 Bolt 150LL airguns could be fired using the compressors and deployment systems with data recorded on a multichannel streamer.

In the period leading up to this SVP exercise major modifications were made to the RRS Discovery's starboard deployment position – the 'Bullhorn' beam was lengthened by 900mm, a new Dynacon manufactured ROV docking head was fitted as well as the manufacture of a bed frame to fit the portable ROV handing system on the hangar top. A powered sheave was also due be fitted but the manufacture and delivery was delayed and was replaced by a non-powered sheave to prove starboard side deployment was viable.

Leg 1 of the expedition concentrated on portside deployment. A Kongsberg engineer was embarked to modify the operation of the azimuth thrusters to reduce/remove thruster wash across the port side ROV deployment zone. This was very successful and, after simulated ROV operations with a dahn buoy and the Dynamic Positioning System (DP) in ROV mode, the ROV was deployed. The ROV was successfully deployed on four occasions in weather conditions varying between force 4 and 5 and wind speed up to 20kts.

Leg 2 of the expedition was planned to be deployment trials from the starboard side bullhorn beam however these trials were cancelled due to a fault on the starboard azimuth thruster. During the period alongside 20th – 29th January, the ROV bullet was fitted to the ship's deep tow cable. All operations of the new docking head (locking, rotation, pitch) were tested and ratified as well as the operation of the extended bullhorn beam. It was proved that the ROV could be launched and manipulated with the bullhorn beam and new docking head. The portable handling system was installed on the hangar top, but further trials were not carried out due to not having the powered dynacon sheave available.

The SVP confirmed that port side deployment of the ROV, in the same manner as is done on the RRS James Cook, is viable for the forthcoming programme.



▶ A piston corer ready for deployment

UK OSNAP LEG 1
OVERTURNING IN THE SUBPOLAR NORTH ATLANTIC PROGRAMME

DY053 29 June – 23 July, 2016

Stuart Cunningham
Principal Investigator

Jo Cox
Master

David Childs
Senior Technical Officer

Daniel Comben
Expedition Manager

Subpolar North Atlantic
Location

Collaborating Institutions
Scottish Association for Marine Science (SAMS)
University of Miami - Rosenstiel School of Marine and Atmospheric Sciences
Woods Hole Oceanographic Institution (WHOI)
Ocean University of China (Haida)

NMEP Equipment
CTD Frame and Instruments
Slocum glider
EM710/122 Swath bathymetry
EA640 Echosounder
Vessel mounted 150 & 75 kHz ADCP
Sea surface and meteorology sampling system
Data logging and processing system
Double Barrel Mooring winch system

URLs
www.ukosnap.org/
https://ukosnap.wordpress.com/

DY053 was the first leg of the 2016 UK OSNAP mooring refurbishment programme on RRS Discovery, sailing from Port Glasgow to Reykjavik in Iceland. The OSNAP array is designed to provide a continuous record of the full-water column, trans-basin fluxes of heat, mass and freshwater in the subpolar North Atlantic, on a section from Scotland to Newfoundland via Greenland.

Precis of the Science Outcomes:

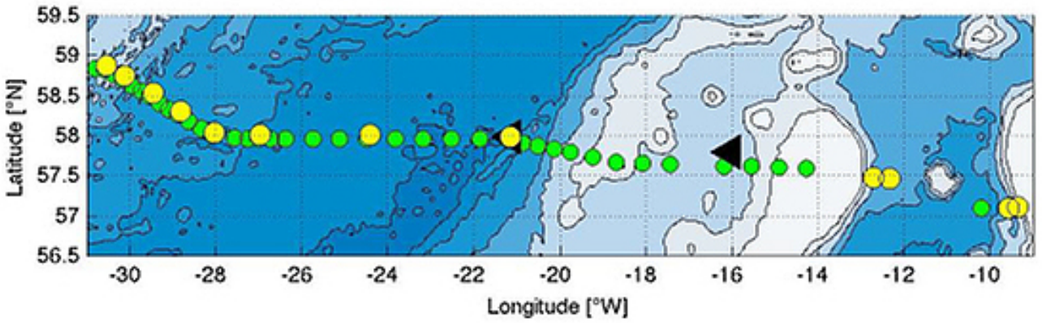
This Expedition is a contribution to the international Overturning in the Sub polar North Atlantic Program (OSNAP). Two additional scientific teams (from Rosenstiel School of Marine and Atmospheric Sciences, and Woods Hole Oceanographic Institution / Ocean University of China) participated in this expedition. The objectives were to recover and redeploy moorings in the Rockall Trough, measuring temperature, salinity, currents and bottom pressure and; recover Seaglider SG605 ‘Bowmore’ in the Hatton-Rockall Basin.

Two glider experts (Estelle and Karen) happy after the recovery of Bowmore, Photo: Loic Houpert

University of Miami group (Greg, Tiago, Mark, Cobi) and John (RRS Discovery CPOS)) deploying one of the moorings.

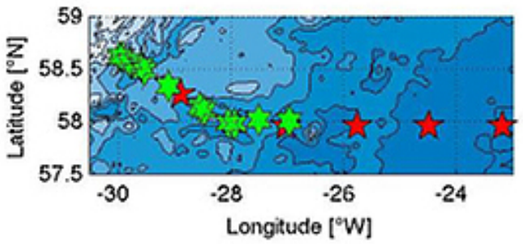
Technical Description of Equipment Deployed and Performance:

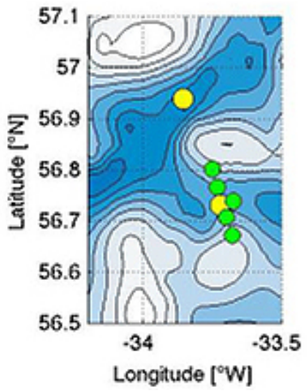
- 49 CTD casts including salinity, temperature, density, dissolved oxygen, chlorophyll fluorescence, beam transmittance and LADCP.
- 8 UK OSNAP moorings recovered, 8 deployed.
- 16 US OSNAP moorings recovered, 18 moorings deployed.
- 16 RAFOS floats deployed.
- 2 ARGO floats deployed on behalf of the UK Meteorological Office.
- 4 MRV S2A Autonomous Profiling Vehicles (S2As) were deployed for the Woods Hole Oceanographic Institution Argo Program.
- 1 AL500 trawl resistant bottom mount housed a gimbaled Nortek Signature S55, deployed Two SBE53 bottom pressure gauges were deployed.
- 1 WHOI Slocum Glider WHOUC1 Deployed.
- 1 Seaglider SG605 Bowmore recovered.



▲ Top image shows: locations of moorings (yellow circles); CTD stations (green circles) and; Slocum deployment (black triangle near 21°W) and Seaglider recovery (black triangle near 16°W).

▼ Bottom left image shows: Argo float deployments (red stars) and RAFOS float deployments (green pentangles). Bathymetry: 1000 1250 1500 1750 2000 2250 2500 2750 3000m.





▶ Deploying a RAFOS float

▼ Bottom right image shows: bathymetry of the Bight Fracture Zone with contours as middle panel. WHOI moorings (yellow circles) and CTD stations (green circles).

UK OSNAP LEG 2

OVERTURNING IN THE SUB POLAR NORTH ATLANTIC PROGRAMME

DY054 27 July – 17 August, 2016

Penny Holliday
Principal Investigator

Jo Cox
Master

Robert McLachlan
Senior Technical Officer

Daniel Comben
Expedition Manager

Subpolar North Atlantic
Location

Collaborating Institutions
- National Oceanography Centre (NOC)
- Scottish Association for Marine Science (SAMS)
- Royal Netherlands Institute for Sea Research (NIOZ)
- Woods Hole Oceanographic Institution (WHOI)
- Ocean University of China (Haida)

NMEP Equipment
- CTD Frame and Instruments
- EM710/122 Swath bathymetry
- EA640 Echosounder
- Vessel mounted 150 & 75 kHz ADCP
- Sea surface and meteorology sampling system
- Data logging and processing system
- Double Barrel Mooring winch system

URLs
www.ukosnap.org/https://ukosnap.wordpress.com/

DY054 was the second leg of the 2016 UK OSNAP mooring refurbishment programme. The RRS Discovery sailed from Reykjavik in Iceland, focusing on the Deep Western Boundary Array and the Irminger Current Array in the Irminger Sea, as well as deploying equipment in the Maury Channel of the Iceland Basin.

Precis of the Science Outcomes:

During this return UK OSNAP mooring refurbishment expedition of 2016, We retrieved 11 moorings and instruments that have been collecting deep ocean data for the past year, and deployed a new batch of instruments to replace them. We also released 29 ocean-exploring robot RAFOS floats - that will spend two years following the coldest and deepest water, tracing the many ribbons of currents that make up the southward-flowing circulation. With these data, we can gain a better understanding of the overturning circulation in the sub polar North Atlantic.

Feili and a float called Feili. Photo: Penny Holliday

Steve and John attaching a current meter to a mooring Photo: Amanda Kowalski

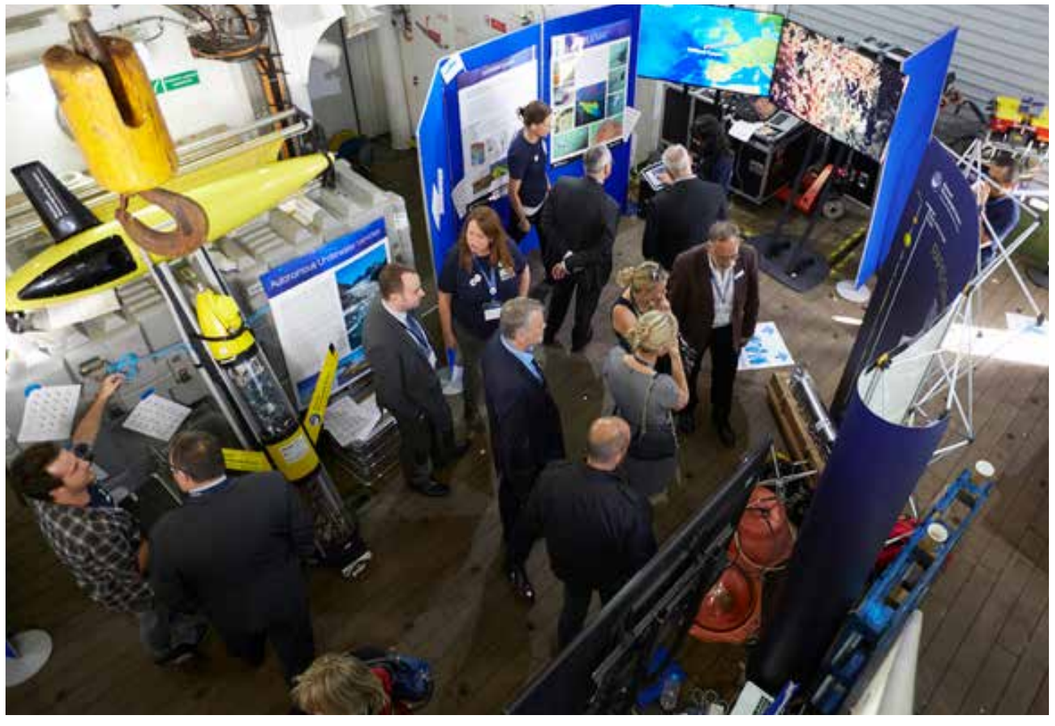
Technical Description of Equipment Deployed and Performance:

- 38 CTD casts including salinity, temperature, density, dissolved oxygen, chlorophyll fluorescence, beam transmittance & LADCP to complete a CTD/LADCP section across the Irminger Basin, from the Greenland coast to the mid-Atlantic Ridge. Nutrient samples have been taken from CTD stations for later analysis by NIOZ.
- 5 UK OSNAP moorings recovered and re-deployed in the western Irminger Sea.
- 5 Dutch OSNAP moorings recovered and re-deployed in the eastern Irminger Sea.
- 1 Dutch LOCO mooring recovered and re-deployed in the central Irminger Sea.
- 1 Argo float for the UK Met Office.
- 29 OSNAP RAFOS floats off Deployed a series of floats in the overflow waters.
- Deployed a new WHOI sound source in the Maury Channel of the Iceland Basin.

The expedition collected material for outreach programmes, including film footage, audio recordings and photography for the US OSNAP website, and material to be used in an art project.

◀ Steve and John deploying a sensor
Photo: Amanda Kowalski

▶ Mooring deployment Photo:
© Woods Hole Oceanographic Institute - Amanda Kowalski



INTO THE BLUE DISCOVERY IN LIVERPOOL

DY068 4 - 7 October, 2016

Ed Hill
Principal Investigator

Antonio Gatti
Master

Phil Harwood
Senior Technician

Laura Wedge
Expedition Manager

Liverpool, Princes Parade, Liverpool, L3 4BB UK
Location

Collaborating Institutions
- Natural Research Council (NERC)
- National Oceanography Centre (NOC)
- Met Office
- British Antarctic Survey (BAS)

NMEP Equipment
- CTD
- Autosub 3000
- Autosub Long Range (ALR)
- Megacore
- Box core
- Scanfish
- Seasoar
- Gliders
- Autonaut
- Myrtle Lander
- NOCL Tripod Lander

URL
http://intotheblue.nerc.ac.uk/liverpool

As part of NERC's celebration of science, Into the Blue, RRS Discovery visited Liverpool. The vessel was moored alongside Liverpool Waterfront for four days of events to showcase the unique marine science equipment and science that she undertakes on behalf of the UK and its science community.

Precis of the Science Outcomes:

School groups, Ambassadors, Liverpool's Maritime industry leaders, social media ballot winners and NOC Liverpool friends and family were all invited onboard for exclusive tours of the vessel and to participate in hands on science. In total 1300 visitors, including over 600 school pupils, were able to meet world leading scientists, marine technicians and the crew to hear about UK Marine Science.

◀ **RRS Discovery in Liverpool**

Onboard the vessel a range of marine science equipment was on display. The aft deck included displays of water and sediment sampling equipment, lab containers to demonstrate science and to display information from British.

▲ Chief Engineer Andrew Lewtas explains the engineering below decks

▲ School children looking at a GEBCO world map

▲ Wearing all the proper safety gear on deck!

▶ (Top) Demonstrating the C-Enduro USV

▶ (Bottom) The fascinating Discovery Collections

RRS JAMES COOK

RESEARCH EXPEDITIONS

DEEP CONNECTIONS

HOW DO SPECIES CONNECTIONS VARY WITH DEPTH?

JC136 14 May - 23 June, 2016

Kerry Howell
Principal Investigator

Michelle Taylor
Principal Investigator

John Leask
Master

Dave Turner
Senior Technician

Jonathan Short
Expedition Manager

North East Atlantic
Location

Collaborating Institutions
- Natural Research Environment Council (NERC)
- National Oceanography Centre (NOC)
- University of Plymouth
- University of Oxford
- University of Ireland
- Ministère de la Culture, France
- Joint Nature Conservation Committee (JNCC)
- BGS - British Geological Survey
- University of Bristol

NMEP Equipment
- Isis ROV
- Autosub 3
- CTD Frame and Instruments
- Mega Corer
- EM120 Swath bathymetry
- EA600 Echosounder
- Vessel mounted 150 & 75 kHz ADCP
- Sea surface and meteorology sampling system
- Data logging and processing system
- Liquid Nitrogen generator

URL
https://deeplinksproject.wordpress.com/

The JC136 expedition focused on an area of the UK's deep-sea, west of Scotland. The expedition obtained physical samples of selected animal species for molecular analysis, benthic biological survey data for community level analysis, and a small amount of oceanographic data to validate oceanographic models.

Precis of the Science Outcomes:

Moorings were deployed at the Anton Dohrn Seamount study site to measure ocean currents at different depths to provide real data to allow modelling of the dispersal of larvae in order to gain a mechanistic understanding of population connectivity.

▲ The ROV Isis being deployed

◀ The ROV Isis collects a fragile specimen

Technical Description of Equipment Deployed and Performance:

The ROV “Isis” was used to collect samples of test species from six key study sites and from four depth horizons (500m or summit depth, 1000m, 1500m, 2000m).

The Isis ROV carried out a total of 28 dives gathering 56GB of data plus video and photos.

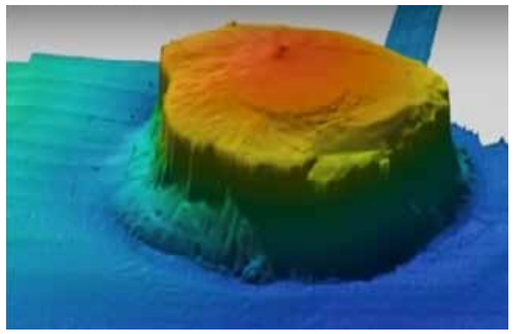
The ROV also collected physical samples using the suction sampler and the sediment core samplers and the robotic arms were used for precision picking of biological samples.

On initial deployment the AUV aborted and was recovered to deck. Adjustments were made to the payload and the proposed camera surveys in order to increase the reliability of the vehicle. This enabled the AUV to ground truth ROV video transects with the high-resolution multibeam due to the higher confidence in reliability of the AUV. The AUV eventually completed 12 deployments.

The standard CTD frame was deployed on 24 separate occasions and one ‘tow-yo’ cast of 19 undulations. The deck winch for deployment of the ser supplied camera sled was used once without any issues. Two moorings were deployed and recovered without fault. The liquid nitrogen generator operated with no issues. The supplied Megacore system was not used.

▲ Seeing many beautiful Desmophyllum (solitary stony corals)

▲ The amazing diversity of life in the ocean depths



▲ The Anton Dohrn Seamount

▲ Autosub 6000 AUV begins an autonomous mission

▲ Sorting through samples collected on an Isis dive

BLUE MINING

THE SUSTAINABLE EXPLORATION AND MINING OF DEEP SEA MINERALS

JC136 14 May - 23 June, 2016

Bramley Murton
Principal Investigator

James Gwinnell
Master

Dave Edge
Senior Technician

Matt Tiahlo
Expedition Manager

N. Atlantic: Mid-Atlantic Ridge
Location

Collaborating Institutions
- British Geological Survey (BGS)
- French Research Institute for the Exploration of the Sea (IFREMER)
- Nautilus Minerals
- Norwegian University of Science and Technology (NTNU)
- Helmholtz Centre for Ocean Research (GEOMAR)
- Lisbon University (FFCUL)
- University of Leicester

NMEP equipment
- Mega core
- Gravity core
- SMBA box core
- SVP
- HYBIS
- BGS RD2 rock drill

URL
http://www.bluemining.eu/researchcruiseblog/

The project is an ambitious 12M international programme to study processes of formation and preservation of seafloor mineral deposits, and evaluate their resource potential and recovery. The expedition sailed to the Mid-Atlantic Ridge to study a series of seafloor massive sulphide deposits that were formed by hydrothermal activity at a depth of 3500m below sea-level.

Precis of the Science Outcomes:

The RRS James Cook expedition deployed novel geophysical tools such as active source electromagnetics to capture a three-dimensional image of the deposit subsurface, as well as the robotic underwater vehicle HyBIS to map and sample the seafloor. The majority of time during the expedition was spent deploying a robotic sea-floor drilling rig, the RD2, developed by our project partners at the British Geological Survey (BGS).

RD2 is lowered into the inky black sea at night for its three and a half kilometre journey to the seafloor Photo: B. J. Murton

Inside RD2 Mission Control as the drill cores its way to the centre of the Rona Mound power issues post deployment (Bottom image)

Technical Summary of Equipment Deployed and Performance

Overall, JC138 occupied a total of 77 stations over 32.2 science days, for which 72% of the time was employed successfully while 28% of the time was beset with technical difficulties.

Of these operations, DASI, HYBIS and the coring operations were the most reliable, followed by Sputnik, COIL and the OBEM's. The RD2 was the least reliable with 16 of the 23 deployments failing due to technical issues before drilling.

This constitutes, by number of deployments, a 30% success rate of the RD2 seafloor robotic drilling system.

A total of 9.7m of drill core was recovered from six holes with a maximum depth of 12.7mbsf; 13 sediment cores were acquired with a total of 17m from a maximum depth of 2.3mbsf, 31 individual HyBIS samples were collected, one complete DASI/ Vulcan survey and two COIL/Martamis surveys occupied over the entire TAG area.

Reliability was poor with serious scrolling issues. The deep-tow cable was in a poor state with excessive grease causing traction problems on its winch, resulting in reduced hauling and veering rates, losing many hours of science time over the duration of the expedition.

▲ HyBIS engineers Dave and Russ filling the beacons with oil so that the high pressure at the ocean floor does not cause the glass to break. Photo: B. J. Murton

▲ Collecting fluids from the core barrels for analysis (Kate left, Joe centre and Sally right)

▲ Sally (right) puts her back into it as she wields a large wrench to break out a core liner from its barrel, with a little help from Garry (left)

▲ Adeline describes the gravity core after splitting the first section Photo: #Blue mining, Sofia

▲ Our chief coring technician, Richie Phipps, is a wizard at gravity coring and after a spell on deck, his apprentice, Will, quickly learnt a few tricks (photo: Gavin Haughton, #Bluemining)

ROCK BUSINESS

THE E-TECH ELEMENT POTENTIAL OF UNDERSEA DEPOSITS

JC142 29 October – 8 December, 2016

Bramley Murton
Principal Investigator

James Gwinnell
Master

James Burris
Senior Technician

Daniel Comben
Expedition Manager

North East Atlantic
Location

Collaborating Institutions
- Natural Research
- Environment Council (NERC)
- National Oceanography Centre (NOC)
- University of Sao Paulo
- HR Wallingford
- British Geological Society (BGS)

NMEP Equipment
- Isis ROV
- AUV Autosub 6000
- CTD Frame and Instruments
- EM710/122 Swath bathymetry
- EA640 Echosounder
- Vessel mounted 150&75 kHz ADCP
- Data logging and processing system
- Double Barrel Mooring winch system
- 3 instrumented scientific moorings
- Radio Nuclide containerised laboratory
- Liquid nitrogen generator
- Liquid Scintillation Analyser
- Mega Core
- SMBA box core
- Gravity Core
- Rock Dredge
- Fume Cupboard

URL
http://www.bluemining.eu/researchcruiseblog/

New technologies require considerable quantities of many metals. Of particular concern are ‘critical’ raw materials (E-tech elements) which have a high risk of supply shortage. Some of these E-tech elements are highly concentrated in seafloor deposits.
Our research programme aims to improve understanding of E-tech element concentration in seafloor mineral deposits. By gathering ecological data and experimentation, we will explore of extent of disturbance by seafloor mineral extraction.

Precis of the Science Outcomes:

Despite occurring in extreme environments, seafloor mineral deposits are becoming increasingly attractive as a future resource. This expedition aimed to identify the local scale controls on the abundance and grade of ferromanganese submarine deposits.

The Isis ROV returns from the first dive for reconnaissance and the trial plume generation experiment. Samples are ready for sample processing - including one large sponge on an even larger FeMn crust slab.

One of the many samples we recovered during our dives

Technical Summary of Equipment Deployed and Performance

Isis ROV completed 26 dives, a total run time of 4563 hours, the longest single dive was 25.18 hours and the deepest at 3979 m. The ROV included a novel in house rock drill developed as a tool to enable the taking of small core samples of manganese crusts. The system consists of a hydraulic motor, diamond tipped drill piece, vertical slider mechanism and spring loaded locking pin. The core drill was also used successfully throughout the expedition.

AUV Autosub 6000 completed a total of 17 missions collecting multibeam echo sounder, sidescan sonar and sub bottom profiler imagery of the sea bed bathymetry. In addition to this, other sensors were also used to collect data at the same time. These sensors included a Seabird CTD, Wetlabs Optical backscatter sensors (OBS), magnetometer, EH sensor and Teledyne RDI 300kHz ADCP. During some later missions a downwards looking camera and flash system were also used to collect images of the seabed.

CTD - 43 CTD casts including salinity, temperature, density, dissolved oxygen, chlorophyll fluorescence, beam transmittance & LADCP.

Moorings - Three fully instrumented moorings were deployed and recovered with strobe light and Argos beacons on all three. Instruments included: 1 600kHz ADCP; 6 SBE; 37 CTD's and 5 Nortek Acoustic Current meters.

Lander - A novel ocean bottom lander was designed and deployed using the ROV for HR Wallingford, it included sediment traps, CTD and a 600 kHz APCP.

Gravity Core - The gravity core took seven cores during the expedition taken from different sites.

◀ Ella launches the Autosub6000 robot submarine from the stern of the RRS James Cook.

▶ The Isis ROV included a novel in house rock drill developed to enable the taking of small core samples of manganese crusts

MARINE AUTONOMOUS SYSTEMS OPERATIONS

SME: 1125 OSNAP 5
SME: 1127 OSNAP 8
Deployment and recovery of gliders and moored instrumentation

EXTENDED ELLET LINE 5 and 6A
Project to measure and understand the ocean to the west of the UK


AUTOSUB


AUTONAUT


C-ENDURO


SEAGLIDER


SHARC


SLOCUM GLIDER


WAVEGLIDER

SME: 1145 MASSMO 3
The largest simultaneous deployment of marine robotic vehicles attempted in uk waters

SME: 1126 OSNAP 7
Supporting scottish association for marine science (sams) with Seagliders and slocums for the OSNAP programme

SME: 726 JC136
Deep sea connectivity

STOKES BAY WAVEGLIDER TRIAL
Deployment of sv3-waveglider in the solent

SME: 1133 MASSMO 2A-2
A survey for the world wildlife fund (wwf)

SME: 782 JR15-007 RIDGEMIX
Deployment of gliders for turbulence measurements on the mid-atlantic ridge

SME: 819 SSD-024 BOBBLE
Supporting university of east anglia (uea) with three seaglider deployments in the bay of bengal

SME: 892 JC142 FAPESP
The e-tech element potential of submarine ferromanganese deposits

Photo: Liquid Robotics, a Boeing Company

MASSMO3

MARINE AUTONOMOUS SYSTEMS IN SUPPORT OF MARINE OBSERVATIONS

MASSMO3 8 September – 18 October, 2016

Russell Wynn
Principal Investigator

Laura Wedge
Expedition Manager

North West Scotland
Location

Collaborating Institutions
- Royal Navy
- The Defence Science and Technology Laboratory (DSTL)
- Scottish Association for Marine Science (SAMS)

NMEP Equipment
- Submarine Seagliders
- Submarine Slocum gliders
- Waveglider system

URL
https://mars.noc.ac.uk/missions/massmo-3/

Marine Autonomous Systems in Support of Marine Observations (MASSMO)3 was the third installation of a multi-phase project to explore large dynamic areas of the ocean.

Precis of the Science Outcomes:

The objectives focused on real-time delivery of geospatial data collected from a fleet of submarine gliders and a waveglider, including:

- Improved piloting of gliders to better target oceanographic features
- Near real time acquisition of data and import into monitoring systems
- The acquisition and processing of enhanced environmental datasets
- Enhanced methods of presenting environmental information in a way that facilitates understanding

Technical Description of Equipment Deployed and Performance:

The mission had the largest fleet of surface and submarine vehicles to be simultaneously deployed in UK waters; two NOC shallow Slocums, four Royal Navy Slocums (two deep, two shallow), a SAMS deep Seaglider and three wavegliders. The NOC and RN gliders carried CTD, Triplet Puck (chlorophyll fluorescence, oxygen, turbidity), Altimeter and ADCP, with a SoundTrap PAM on one of the NOC gliders. Deployment of the gliders was from a support vessel on 19 Sep with the NOC gliders recovered on 2 Oct, and the RN gliders on 17 Oct. The wavegliders operated to the north and were deployed out of Stornoway.

THE NERC FACILITY FOR SCIENTIFIC DIVING

NFSD Research 2016 - 2017

Martin Sayer
Head of the NFSD

Simon Thurston
Hugh Brown
Elaine Azzopardi
Andrew Mogg
Dive Technicians

NFSD, SAMS,
Scottish Marine Institute,
Oban, Argyll PA37 1QA, UK
Location

URLs
http://www.nfsd.org.uk/
http://www.sams.ac.uk/

The NERC Facility for Scientific Diving (NFSD), hosted by the Scottish Association for Marine Science (SAMS), provides divers, equipment, training and scientific/ technical support that underpins a wide range of interdisciplinary research in the underwater environment.

Since its establishment as a National Facility, the NFSD has supported studies investigating topics as diverse as sea-level measurement, water-quality assessment, light measurement, functional ecology, cell biology, animal genomics, paleoclimatology, ocean acidification, biogeochemistry, eco-physiology, habitat mapping and science-based maritime archaeology.

From 2006 to 2017 the NFSD has contributed to over 150 ISI-rated publications with an average impact factor of 3.3 and an H-index of 27. Recent examples of techniques and technologies being developed and evaluated through the NFSD include:

Structure from Motion: The NFSD is using stereophotogrammetry underwater as an advanced mapping tool that can also provide accurate indices of habitat complexity plus selective volumetric data.

Citizen Science: using SCUBA divers as oceanographic samplers: Results from a number of our recent studies show that, with processing, dive computers can provide a useful tool with which to augment existing monitoring systems all over the globe, but especially in under-sampled or highly changeable coastal environments.

Research Highlights during 2016 – 17 are as follows:

- Sub-tidal kelp forests represent critically important marine habitats and diving surveys have assessed their structural variability along a latitudinal gradient to predict how they may respond to ocean warming. (MBA Plymouth, Aberystwyth)
- Diving supported accurate multi-scale coring, injection and extraction of samples used to determine the dynamics of pore water in subsurface sediments at the site of a controlled CO2 release experiment. (Scottish Association for Marine Science (SAMS) and others)
- Diving-based collections of long-lived bivalve molluscs have been used in a number of paleoclimatic studies that are reconstructing ocean variability over scales ranging from seasonal to multi-centennial. (Cardiff, Bangor, Exeter, Keele)
- Comparison of established and photogrammetric techniques evaluated their respective accuracy and efficiency for estimating calcification rates and carbonate budgeting of coral reef systems. (Exeter)
- Samples collected using diving supported studies of the genetic diversity, phylogeography and morphology of Elphidiidae (Foraminifera) in the Northeast Atlantic. (Edinburgh, St Andrews and others)

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