UK Ocean Acidification Research Programme
Arctic Cruise Report

Effect of Ocean Acidification on Arctic Surface Ocean Biology, Biogeochemistry and Climate.

RRS James Clark Ross (JR271)

1 June to 2 July 2012

Raymond J. G. Leakey
Principal Scientist

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ACKNOWLEDGEMENTS

This research cruise could not have been undertaken without the efforts of a large number people located in several organisations within both the UK. I am grateful for the help and assistance of all those involved including: the Master Graham Chapman, officers and crew of the *James Clark Ross*; the scientists and technical support staff of cruise JR271; the staff of the British Antarctic Survey, Cambridge, National Marine Facilities, Southampton, and the Scottish Association for Marine Science, Oban.

I am also grateful to the UK Natural Environment Research Council, the UK Department of Environment, Food and Rural Affairs (Defra), and the UK Department of Energy and Climate Change (DECC) for funding the research cruise via the UK Ocean Acidification research programme, and to the Danish, Icelandic and Norwegian diplomatic authorities for granting permission to travel and work in Greenland, Iceland and Svalbard coastal and offshore waters.

The JR271 Science Team

From left to right: Sophie Richier, Alex Poulton, Mario Esposito, Victorie Rérolle, Mark Moore, Chris Daniels, Vicky Peck, Matt Humphreys, Eric Achterberg, Ben Russell, Fred Le Moigne, Helen Smith, Ray Leakey, Brandy Robinson, Mike Zubkov, Laura Bretherton, Gianna Battaglia, Cecilia Balesteri, John Stephens, Eithne Tynan, Ian Brown, Frances Hopkins, Seth Thomas, Mariana Ribas-Ribas, Polly Hill, Tingting Shi, Jeremy Robst, Sara Fowell, Geraint Tarling, Jeremy Young, Darren Clark, Elaine Mitchell.

SCIENTIFIC AND TECHNICAL PERSONNEL

Person	Responsibility
Ray Leakey	PSO
Eric P Achterberg	Carbonate chemistry and trace metals
Cecilia Balesteri	Coccolithophore genetics
Gianna Battaglia	Trace metals
Jeffrey R Benson	Technical support – engineering
Laura M Bretherton	Phytoplankton photophysiology
Ian J Brown	Biogases - nitrous oxide and methane
Darren R Clark	Nitrogen cycling
Christopher J Daniels	Primary production and calcification
Mario Esposito	Inorganic nutrients
Sara E Fowell	Trace metals
Polly G Hill	Bacteria and protists
Frances E Hopkins	Biogases - DMS
Matthew P Humphreys	Carbonate chemistry
Frederic Le Moigne	Particle export
Elaine Mitchell	Bacteria and protists
Christopher M Moore	Phytoplankton and bioassays
Victoria Peck	Zooplankton
Benjamin J Poole	Technical Support – engineering
Alex Poulton	Primary production and calcification
Victorie C Rérolle	Carbonate chemistry and pH
Mariana Ribas-Ribas	Carbonate chemistry
Sophie H Richier	Phytoplankton and bioassays
Tiera-Brandy Robinson	Phytoplankton and bioassays
Jeremy P Robst	Technical support - IT
Benjamin C Russell	Bacterial production
Tingting Shi	Organic nutrients
Helen E Smith	Particle export
John A Stephens	Biogases - DMS
Geraint A Tarling	Zooplankton
Seth J Thomas	Technical Support – engineering
Eithne Pascual Tynan	Carbonate chemistry
Stephen P Whittle	Technical Support – engineering
Jeremy R Young	Coccolithophore morphology
Mikhail V Zubkov	Bacteria and protists

SHIPS PERSONNEL

Person	Responsibility
Graham P Chapman	Master
Robert C Patteson	Chief Officer
Piers A Alvarez-Munoz	2nd Officer
Benjamin P Thompson	3rd Officer
Charles A Waddicor	ETO (Comms)
David J Cutting	Chief Engineer
Glynn Collard	2nd Engineer
James C Ditchfield	3rd Engineer
Steven J Eadie	4th Engineer
Simon A Wright	Deck Engineer
Nicholas J Dunbar	ETO (Eng)
James S Gibson	Purser
George M Stewart	Bosun
Derek G Jenkins	Bosun's Mate
Clifford Mullaney	SG1
Colin J Leggett	SG1
John P O'Duffy	SG1
David W Triggs	SG1
Iain Grant	SG1
David J Harkes	SG1
Mark A Robinshaw	MG1
Ian B Herbert	MG1
Keith A Walker	Cook
Padraig G Molloy	2nd Cook
Kenneth Weston	Senior Steward
James Newall	Steward
Derek W Lee	Steward
Thomas R Patterson	Steward

INTRODUCTION AND OBJECTIVES

The JR271 Arctic research cruise was undertaken as part of the Sea Surface Research Consortium of the UK Ocean Acidification Research Programme, funded by the Natural Environment Research Council, the Department of Environment, Food and Rural Affairs (Defra) and the Department of Energy and Climate Change (DECC). The cruise was led by Dr Ray Leakey of the Scottish Association for Marine Science. Research scientists participated in the cruise from several UK institutions involved in the UKOA Sea Surface Research Consortium including: the British Antarctic Survey, Marine Biological Association, National Oceanographic Centre Southampton, Plymouth Marine laboratory, Scottish Association for Marine Science, the University College London and the Universities of Essex and Southampton. The research vessel, officers, crew and ships technical support were provided by the British Antarctic Survey and National Marine Facilities. The cruise was the second of three Sea Surface Research Consortium research cruises; the first focused on European coastal waters (Cruise D366 June/July 2011) and the third will focus on Southern Oceans waters (Cruise JR274 January/February 2013).

Polar seas, such as the Arctic Ocean, are expected to be especially sensitive to the effects of ocean acidification, since more CO_2 dissolves in cold water, making Arctic waters a valuable natural example of how the marine environment will respond to a high CO_2 world. Also, the sensitivity of surface seawater in the Arctic will mean that they become corrosive to calcium carbonate before anywhere else in the world, which could pose a problem for marine plankton and other organisms that use calcium carbonate for their shells or skeletons. The overall aim of the cruise was therefore to obtain a quantitative understanding of the impact of ocean acidification on the surface ocean biology and ecosystem, and on the role of the surface ocean within the Arctic.

Specifically, the high-level objectives were to:

1. Ascertain the impact of ocean acidification on planktonic organisms (in terms of physiological impacts, morphology, population abundances and community composition).
2. Quantify the impacts of ocean acidification on biogeochemical processes affecting the ocean carbon cycle (both directly and indirectly, such as via availability of biolimiting nutrients).
3. Quantify the impacts of ocean acidification on the air-sea flux of climate active gases (DMS and N2O in particular).

The primary hypotheses which were tested on the cruise were:

1. *A decline in pH and Ω_{CaCO3} as a result of rising atmospheric CO_2 concentrations will affect the rate and quality of formation of $CaCO_3$ shells by planktonic calcifiers.*
2. *Carbonate chemistry changes will influence biogeochemical rates per unit biomass, such as photosynthesis, respiration, calcification and nitrification.*
3. *Community structure will change and calcifying organisms will make up less of the total community (and consist of less strongly calcified genotypes) under lower pH/Ω_{CaCO3} conditions.*
4. *Ocean Acidification will impact on climate through reductions in ballasting by $CaCO_3$, production of albedo-altering DMS and production of the greenhouse gas N_2O.*
5. *High CO_2 will alter zooplankton:phytoplankton and phytoplankton:bacteria ratios through production of increasingly carbon-rich particulate and dissolved organics (food quality and DOC).*
6. *Some place-to-place differences in in-situ parameters are due to carbonate chemistry gradients rather than to alternative environmental gradients*.

These above objectives and hypotheses were addressed by undertaking *in situ* observations across natural carbonate chemistry gradients, and by undertaking five on-deck CO_2

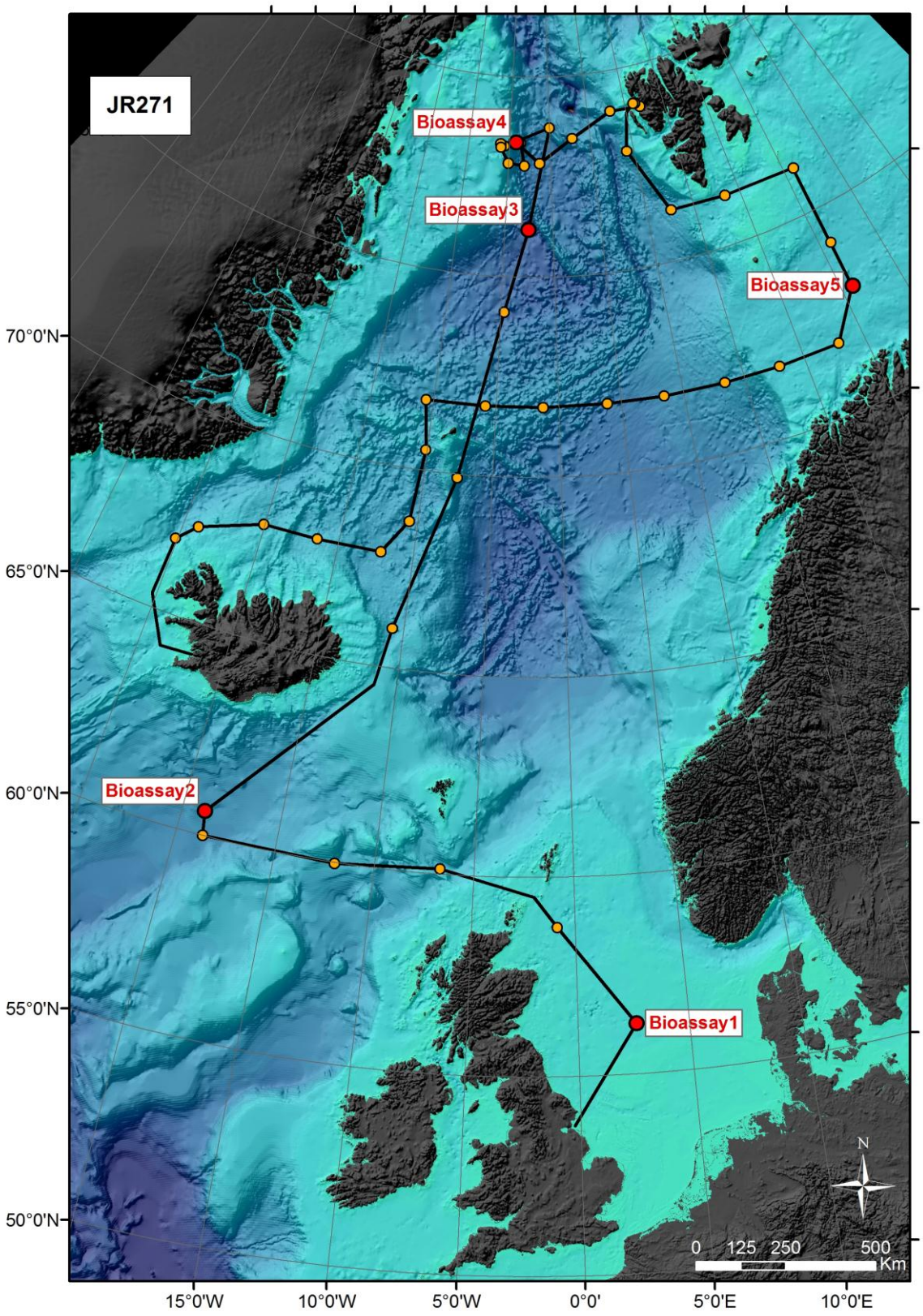
perturbation incubations (“bioassays”). To achieve this, the cruise visited the Atlantic sector of Arctic during a period of enhanced productivity and minimum sea-ice cover in June 2012. Sampling environments included:

- North Sea waters in which previous in situ observations and a bioassay experiment (E05) had been conducted during cruise D366.
- North Atlantic waters south of Iceland characterised by high coccolithophore abundance.
- N-S and E-W transects across Barents, Greenland and Norwegian Seas encompassing strong gradients of the carbonate system, nutrient concentration and ecosystem productivity.
- Ice-edge waters of the Greenland Sea encompassing strong changes in the carbonate system.
- Svalbard fjordic waters characterised by high pteropod abundance.

To our knowledge the cruise was the first attempt to link Arctic pelagic ocean carbonate system variations with sea-surface biology, biogeochemical rates and climate processes in such a comprehensive manner.

SUMMARY ITINERARY AND MAPS

- Sailed from Immingham at 14:48 GMT on 1 June 2012.
- Commenced science activities in North Sea at 02:30 GMT on 3 June 2012.
- Visited Ny Alesund, Svalbard, on 20 and 21 June 2012.
- Completed science activities in Icelandic coastal waters at 13:01 GMT on 2 July 2012.
- Docked at Reykjavik late afternoon on 2 July 2012.


JR271
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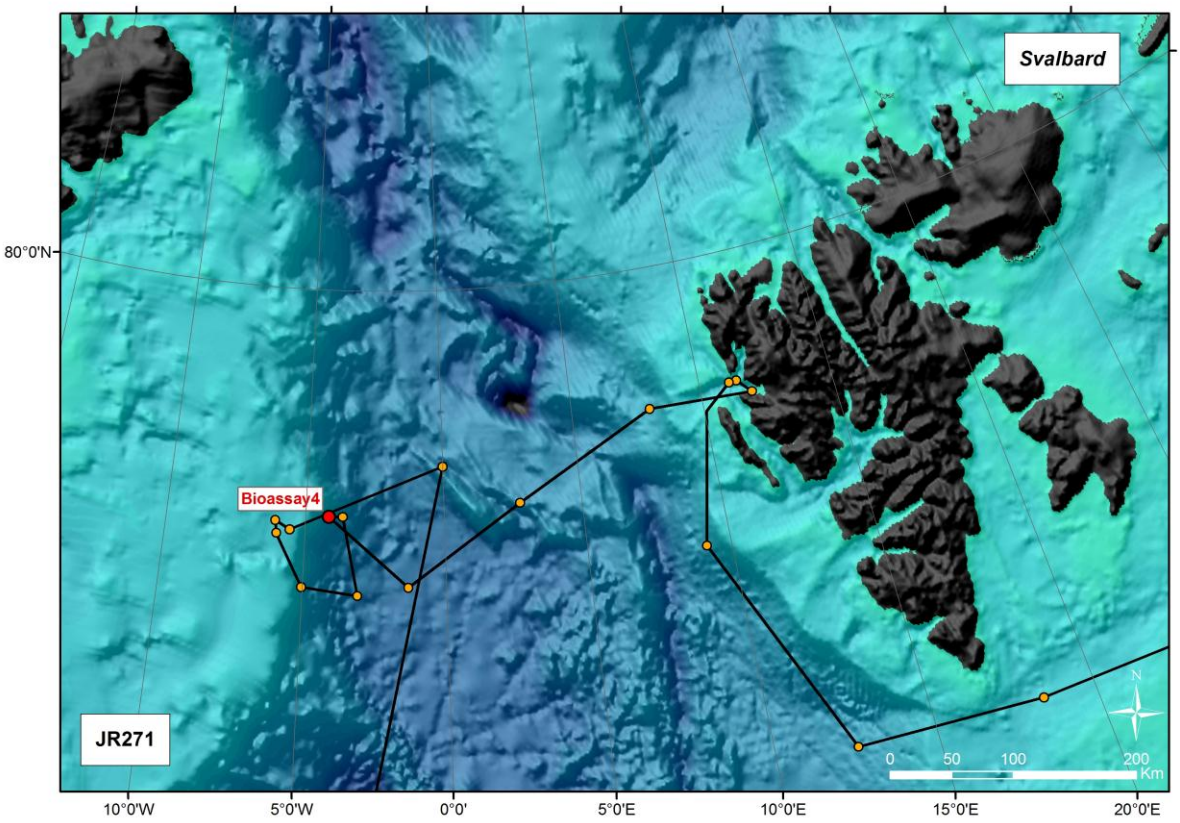
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NARRATIVE

Ray Leakey

Ships times given in GMT.

Tuesday 29th May

Mobilisation in Immingham.

Wednesday 30th May

Mobilisation in Immingham.

Thursday 31th May

Mobilisation in Immingham.

All scientists on *JCR* with cruise meeting held in the evening.

Friday 1st June

Weather: Generally grey and overcast but sunny at times.

Departed Immingham quay at 14.48 GMT (15.48 local BST) and passed into Immingham lock. Left Immingham lock and entered Humber estuary at 15.31, then headed north-east into the North Sea in calm conditions. The *JCR* 's underway water supply was switched on in the evening.

Saturday 2nd June

Weather: Calm seas with sunny intervals.

JCR's clocks set back one hour to GMT at 2 am. Continued at slow speed on route to first station passing oil rigs on route. Scientists continued setting up equipment in labs and planning sampling logistics. A cruise meeting was held in the evening.

Jeff Benson's birthday

Sunday 3rd June

Weather: Calm seas with sunny intervals in morning. Conditions deteriorating in evening with swell overnight.

Arrived at Station 1 (North Sea: 56^{o} 16'N, 02^{o} 38'E) (most southerly station on the cruise) which was the first bioassay station in approximately 75m water depth. At 02.30 deployed the titanium CTD Rosette (24 x 10 litre Niskin bottles) three times at the bottom of the mixed layer (approximately 10 - 15m) to collect water for the first bioassay experiment. This was first set-up of the bioassay and involved carrying all the Niskin bottles along the starboard deck to the trace metal clean water handling container where they were emptied before re-deployment. The set-up was successful but ran overtime.

The bioassay set-up was followed by 3 x Bongo nets, then the standard CTD Rosette (24 x 20 litre Niskin bottles) for gas and biology sampling. Some of these bottles leaked and some sensors were not working. The titanium CTD was then deployed for trace metal sample water collection.

Continued north-west to Station 2 passing more oil rigs on route, with the first underway water sampling undertaken at mid-day. *JCR* slowed at 15.18 for the first CPR deployment.

Monday 4th June

Weather: Calm to moderate sea with sunny skies.

Arrived at Station 2 (North Sea: 58^{o} 44'N, 00^{o} 51'W) and retrieved CPR at about 05.00. This was followed by Bongo nets and a standard CTD for gases and biology. Some of the bottles leaked again but sensors functioned correctly. The titanium CTD was then deployed for trace metal water collection followed by deployment of the trace metal Towfish and the CPR.

Continued north-west on route to Station 3, though the Fair Isle channel, passing Fair Isle to the north.

Jeremy Young's birthday.

Tuesday 5th June

Weather: Very calm but overcast.

Arrived at Station 3 (North Atlantic west of Shetland: 60^{o} 08'N, 06^{o} 42'W) and retrieved CPR at about 05.00. This was followed by Bongo nets, the standard CTD for gases and biology (some bottles still leaked and continued to do so on most subsequent deployments), the titanium CTD for trace metal water collection, and the first SAPS and Snow Catcher deployments (both successful). The CPR was then redeployed.

Continued west on route to Station 4.

Wednesday 6th June

Weather: Calm and sunny with clouds.

Arrived at Station 4 (North Atlantic: 59^{o} 58'N, 11^{o} 58'W) and retrieved CPR at about 05.00. This was followed by Bongo nets, the standard CTD for gases and biology, the titanium CTD for trace metal water collection and the first Micronet. The CPR was then redeployed.

Continued west on route to Station 5 with high coccolithophore numbers recorded from the underway water supply in the afternoon, and with the CPR retrieved and redeployed.

Thursday 7th June

Weather: Moderately calm and sunny, overcast and light rain in evening.

Arrived at Station 5 (North Atlantic south of Iceland: 60^{o} 01'N, 18^{o} 40'W) and retrieved CPR at about 05.00.This was followed by Bongo nets, the standard CTD for gases and biology, the titanium CTD for trace metal water collection, the Micronet, SAPS, Snow Catcher and CPR redeployment.

Continued on route to Station 6 with Jeremy Young checking for coccolithophores in order to locate a suitable sampling site for the second bioassay. Bad weather was forecast to the north. Arrived at 61^{o}N in the evening and retrieved CPR. Then weather deteriorated and we had to turn back south to find calmer waters for CTD sampling.

Friday 8th June

Weather: Strong wind and rain, rough seas gusting to Force 8 later in the day.

Arrived at Station 6 (North Atlantic south of Iceland: 60^{o} 35'N, 18^{o} 51'W) at about 01:30 at a position which was located only just north of Station 5. The titanium CTD was deployed three times at the bottom of the mixed layer (approximately 20m) and also at 60 m to collect water for the second bioassay experiment. The weather was too rough for bongo nets so continued with the standard CTD for gases and biology followed by the titanium CTD for trace metal water collection. The CPR was then redeployed.

Continued north-east to Station 7 in very rough seas at about 4 knots.

Cecelia Balesteri's birthday.

Saturday 9th June

Weather: Overcast with some sunshine and moderate seas.

Continued north-west (and east of Iceland) with no sampling in order to reduce stoppage and give a rest day. Seas got gentler overnight and *JCR* speed increased to 10 knots during the day. At about 17:30 the CPR was bought in and redeployed immediately in order to check the silk following slow-speed towage.

Sunday 10th June

Weather: Overcast with sun breaking through at times.

Arrived at Station 7 (Norwegian Sea east of Iceland: 65° 58'N, 10° 44'W) at about 05:00 and retrieved CPR. This was followed by Bongo nets, Micronet, a standard CTD for gases and biology, Snow Catcher and CPR redeployment. Water and air temperature was now much colder and lots of *Phaeocystis* and large *Calanus hyperboreis* were observed in the nets. Killer whales observed during the day.

Continued north crossing the Arctic Circle at 10:12.

Monday 11th June

Weather: Calm seas and sunny in afternoon.

Arrived at Station 8 (Norwegian Sea south of Jan Mayen: 69° 53'N, 07° 34'W) at about 05:00 and retrieved CPR. This was followed by Bongo nets, Micronet, a standard CTD for gases and biology, Snow Catcher and CPR redeployment. *Calanus hyperboreis* was again found in the nets.

Continued north in sunny seas with excellent view of Jan Mayen Island 14 miles to the west.

Tuesday 12th June

Weather: Calm seas but white cloud and fog, occasion sun and snow flurry.

Arrived at Station 9 (Greenland Sea: 74° 07'N, 04° 41'W) at about 05:00 and retrieved CPR. This was followed by Bongo nets, Micronet and a standard CTD for gases and biology. A deep titanium CTD was also deployed for trace metals and calibration (3462m – the deepest sampling on the cruise) followed by SAPS and Snow Catcher. An ARGO float was also deployed and the Towfish was bought in for repairs, followed by CPR redeployment.

Continued north deploying a second Argo float at about 18:30 accompanied by standard CTD for calibration. The Towfish was redeployed at same time.

Helen Smith's birthday.

Wednesday 13th June

Weather: Calm seas and moderately fine weather.

Arrived at Station 10 (Greenland Sea: 76° 10'N, 02° 33'W) at about 01:30 and retrieved CPR. This was followed by 3 x titanium CTDs for the third bioassay experiment, Bongo nets, Micronet, a standard CTD for gases and biology, a titanium CTD for trace metals, SAPS and CPR redeployment.

Continued north to Station 11.

Thursday 14th June

Weather: Calm seas with sunshine, especially in ice.

Arrived at Station 11 (Fram Strait: 78° 43'N, 00° 15'W) in warmer (~3°C) water on the Greenwich meridian at about 05:00 and retrieved CPR. This was followed by Bongo nets, Micronet, a standard CTD for gases and biology, GOFLO bottles for trace metals, SAPS, Snow Catcher and CPR

redeployment. Samples were taken for trace metals but using GOFLO bottles rather than the titanium CTD due to observation that a steel CTD bracket may be contaminating the samples. This extended the trace metal sample collection time.

Continued south-west for about 50 nautical miles, with sea ice visible to starboard, in order to locate a suitable place to enter the ice. Then retrieved the CPR and Towfish and entered the sea-ice. Ice cover increased but remained relatively "soft" with leads allowing good progress. The first observation of a polar bear, which visited the *JCR*'s port side, was made at dinner time (18:30). Continued west, south-west into ice and onto the Greenland shelf overnight.

Eithne Tynan's birthday.

Friday 15th June

Weather: Bright sunny conditions with no wind.

Arrived at Station 12 (Fram Strait-Greenland Shelf: 78° 15'N, 05° 33'W) in the early morning after an overnight drift of about 4 miles in 4 hours. The *JCR* was positioned in a large pool with ice to front and rear. The Bongo net winch initially failed so sampling commenced with the Micronet, a standard CTD to 360 m for gases and biology, Bongo nets and GOFLO bottles for trace metals. The CTD profile indicated very cold polar surface water overlying warmer deep water. *Calanus hyperboreus* were observed in the net samples.

Continued slowly to the west, north-west and in the afternoon arrived at Station 13 (Fram Strait-Greenland Shelf: 78° 18'N, 06° 05'W) and conducted a standard CTD for gases and biology. The bottom water was 1°C cooler than at Station 12. Continued drifting slowly to south.

Saturday 16th June

Weather: Over cast and dull day with no wind after overnight drift in ice.

Arrived at Station 14 (Fram Strait-Greenland Shelf: 78° 13'N, 06° 00'W) early morning with the *JCR* positioned in a large lead pool with ice to front and rear). Sampling conducted with Bongo nets, Micronet and standard CTD for biology and gases, GOFLO bottles for trace metals, Snow Catcher and SAPS. The CTD profile indicated cold polar shelf surface water overlying cold bottom water (1°C). This was the most heavily Arctic influenced station the cruise.

Continued south-southeast towards ice edge in afternoon through very hard and thick ice.

Sunday 17th June

Weather: Overcast and foggy morning, with windier conditions later.

Arrived at Station 15 (Fram Strait/Greenland Shelf Edge: 77° 50'N, 05° 02'W) early morning with the *JCR* positioned in a large area of open water with broken ice around but, unlike previous days, no danger of the ice closing in. The *JCR* was now several nautical miles to the south of original entry point into the ice and in deep (1000+m) water. Sampling conducted with Bongo nets, Micronet, standard CTD for gases and biology, GOFLO bottles for trace metals and Snow Catcher. CTD showed cold polar surface water overlying warmer (>3°C) bottom water. Three GOFLO bottles were lost due to a broken wire. A polar bear with two cubs was spotted in the morning concurrent with a medical incident in which a scientist slipped resulting in a damaged, immobile leg.

Continued east, south-east in afternoon to Station 16 (Fram Strait: 77° 46'N, 03° 04'W) in open water. Conducted titanium CTD to about 3000m. Then continued north, north-west to try and re-enter ice for the fourth bioassay water collection the following day.

Monday 18th June

Weather: Overcast morning with bad visibility due to fog in late afternoon and evening

Completed north, north-west run into ice overnight and arrived at Station 17 (Fram Strait: 78^{o} 22'N, 03^{o} 40'W) with *JCR* located in a pool amongst small floes. Conducted a titanium CTD for the fourth bioassay experiment at about 02:30 in ~2000m water depth, however, the water was relatively warm suggesting that the *JCR* was not yet back in cold polar shelf waters. Also the fluorescence profile suggested the presence of phytoplankton biomass which might have reduced nutrient concentrations. The bioassay sampling was therefore delayed with the *JCR* continuing west into thicker ice.

Arrived at Station 18 (Fram Strait/Greenland Shelf Edge: 78^{o} 22'N, 04^{o} 10'W) at about 06:00 with the *JCR* still in deep water (~1700m) and with thick ice ahead. Conducted a titanium CTD for the fourth bioassay experiment which indicated very cold water throughout the surface water column and low fluorescence. Continued sampling with another 2 titanium CTDs for the bioassay experiment, Bongo nets, standard CTD for gases and biology, GOFLO bottles for trace metals, Snow Catcher, and SAPS. Micronet samples revealed high concentrations of diatoms, and pteropods were observed in the Bongo net samples

Completed sampling at about 16:00 and headed slowly south-east in thick ice and fog which lifted eventually as the ice cover thinned. A polar bear seen was observed in the evening.

Victoire Rérolle's birthday.

Tuesday 19th June

Weather: Dull, overcast and misty.

Arrived at Station 19 (Fram Strait: 77^{o} 50'N, 04^{o} 10'W) just after 05:00 having cleared a few small drifting flows. Iceberg observed. Conducted Bongo nets, Micronet, standard CTD for gases and biology, GOFLO bottles for trace metals, Snow Catcher, and SAPS. Then Towfish and CPR redeployed for the first time since entering the sea-ice on 14th June.

Continued north-east towards Svalbard and arrived at Station 20 (Fram Strait: 78^{o} 25'N, 02^{o} 46'E) at about 19:00. Conducted Bongo net and standard CTD for gases and biology with CPR retrieved and re-deployed. Then continued north-east towards Svalbard.

Wednesday 20th June

Weather: Foggy, overcast day.

Arrived at Station 21 (Fram Strait/Svalbard Shelf Edge: 78^{o} 59'N, 07^{o} 58'E) at 05:00 in deep water just off the shelf. Retrieved CPR followed by Bongo nets, standard CTD for gases and biology, GOFLO bottles for trace metals and Micronet. Retreived CTD and Towfish.

Continued east into Kongsfjorden with poor views of surrounding hills arriving at Station 22 (Kongsfjorden: 78^{o} 57'N, 11^{o} 55'E) in the deep basin at about 13:00. Collected pteropods (mainly small, fragile juveniles) and water for experiments using Bongo nets and standard CTD.

Moored at Ny Alesund quay (alongside *HU Sverdrup II*) at about 16:00 for shore visits during evening.

Mariana Ribas-Ribas' birthday.

Thursday 21st June

Weather: Bright sunny mid-summer day morning but overcast at sea later in the day.

Departed Ny Alesund quay about 07:00 and arrived at Stations 23 (Kongsfjorden: 79^{o} 03'N, 11^{o} 26'E) and 24 (Kongsfjorden: 79^{o} 03'N, 11^{o} 08'E) (most northerly stations on the cruise) near the entrance to Kongsfjord about an hour later. Collected pteropods for experiments using Bongo nets then deployed Towfish and CPR.

Continued south, with blue whales spotted in afternoon, to Station 25 (Fram Strait/Svalbard Shelf Edge: 77^{o} 55'N, 09^{o} 08'E) in deep water off the shelf. Conducted Bongo net and standard CTD for

gases and biology, with CPR retrieved and re-deployed, then continued south, south-east along Svalbard shelf-edge.

Friday 22tndJune

Weather: Dull grey, overcast day with heavy seas.

Arrived at Station 26 (Greenland Sea: 76° 15'N, 12° 32'E) in deep water to the south-west of the southern tip of Svalbard at about 05:00. Retrieved CPR followed by Bongo nets, Micronet, standard CTD for gases and biology, GOFLO bottles for trace metals, Snow Catcher, SAPS and CPR redeployment.

Continued east into Barents Sea and arrived at Station 27 (Barents Sea: 76° 12'N, 18° 23'E) at about 19:00. Conducted Bongo net and standard CTD for gases and biology with CPR retrieved and re-deployed, then continued east into north Barents Sea.

Saturday 23rd June

Weather: Dull grey, overcast day with heavy seas..

Arrived at Station 28 (Barents Sea: 76° 09'N, 26° 03'E) (most easterly station on the cruise) at 05:00 (having passed Hopen Island to the north in the early morning) in cold water (1°C throughout water column) on the east side of the shallow Spitsbergen Bank in north Barents Sea. Retrieved CPR followed by Bongo nets, Micronet, standard CTD for gases and biology, GOFLO bottles for trace metals and CPR redeployment.

Continued south across the Polar Front and arrived at Station 29 (Barents Sea: 74° 05'N, 26° 00'E) at about 19:00 with warmer (~6°C) surface waters. Conducted Bongo net and standard CTD for gases and biology with CPR retrieved and re-deployed, then continued south into southern Barents Sea.

Sunday 24th June

Weather: Overcast morning with a little sunshine and calm to moderate seas.

Arrived at Station 30 (Barents Sea: 72° 53'N, 26° 01'E) at 02:00 and retrieved CPR. This was followed by 3 x titanium CTDs for the fifth bioassay, Bongo nets, Micronet, a standard CTD for gases and biology, GOFLO bottles for trace metals, Snow Catcher and CPR redeployment.

Continued south-east to the north-east Norwegian Sea and arrived at Station 31(Norwegian Sea: 71° 45'N, 22° 58'E) at about 19:00. Conducted Bongo net and standard CTD for gases and biology with CPR retrieved and re-deployed, then continued west along 71°N latitude. Chlorophyll fluorescence was a little higher at this station than at the previous bioassay station, with more coccolithophores but abundant copepod faecal pellets in net samples suggesting that the phytoplankton had been grazed.

Monday 25th June

Weather: Overcast morning with calm sea.

Arrived at Station 32 (Norwegian Sea: 71° 46'N, 17° 54'E) at about 05:00 and retrieved CPR. This was followed by Bongo nets, Micronet, a standard CTD for gases and biology, GOFLO bottles for trace metals, Snow Catcher, SAPS and CPR redeployment.

Continued west and arrived at Station 33 (Norwegian Sea: 71° 45'N, 13° 23'E) at about 19:00 with surface waters now about 8°C. Conducted Bongo net and standard CTD for gases and biology with CPR retrieved and re-deployed, then continued west.

Tuesday 26th June

Weather: Overcast morning with calm sea and occasional sunshine.

Arrived at Station 34 (Norwegian Sea: 71^{o} 45'N, 08^{o} 26'E) at about 05:00 and retrieved CPR. This was followed by Bongo nets, Micronet, a standard CTD for gases and biology, GOFLO bottles for trace metals, Snow Catcher, SAPS and CPR redeployment. Lots of coccolithophores and tintinnids observed in what appear to be more productive warm (~7^{o}C) waters.

Continued west and arrived at Station 35 (Norwegian Sea: 71^{o} 46'N, 03^{o} 51'E) at about 19:00. Conducted Bongo net and standard CTD for gases and biology with CPR retrieved and re-deployed, then continued west.

Wednesday 27th June

Weather: Overcast morning with calm sea.

Arrived at Station 36 (Norwegian Sea: 71^{o} 44'N, 01^{o} 16'W) at about 05:00 and retrieved CPR. This was followed by Bongo nets, Micronet, a standard CTD for gases and biology, GOFLO bottles for trace metals, Snow Catcher, SAPS and CPR redeployment

Continued west and arrived at Station 37 (Greenland Sea north-east of Jan Mayen: 71^{o} 46'N, 05^{o} 52'W) at about 19:00 in colder (~3^{o}C) surface waters. Conducted Bongo net and standard CTD for gases and biology with CPR retrieved and re-deployed, then continued west into Greenland Sea just north of Jan Mayen in fog and very calm seas.

Thursday 28th June

Weather: Overcast morning with light wind and calm sea. Sunny with fresh wind in afternoon and evening.

Arrived at Station 38 (Greenland Sea north-west of Jan Mayen: 71^{o} 45'N, 10^{o} 35'W) near ice-edge but in deep water at about 05:00 and retrieved CPR and Towfish. This was followed by Bongo nets, Micronet, a standard CTD for gases and biology, titanium CTD for trace metals, SAPS, and CPR and Towfish redeployment.

Continued south with good views of Jan Mayen to east and arrived at Station 39 (Greenland Sea south-west of Jan Mayen: 70^{o} 30'N, 10^{o} 05'W) at about 19:00. Cruise track had to skirt east around ice to maintain speed and CPR tow. Conducted Bongo net and standard CTD for gases and biology with CPR retrieved and re-deployed, then continued south with whales seen in the evening.

Friday 29th June

Weather: Sunny morning with no wind and very calm sea.

Arrived at Station 40 (Greenland Sea: 68^{o} 41'N, 10^{o} 34'W) in warmer (~4^{o}C) surface waters at about 05:00 and retrieved CPR. This was followed by Bongo nets, Micronet, a standard CTD for gases and biology, GOFLO bottles for trace metals, Snow Catcher, SAPS, and CPR redeployment. Pilot whales seen in the early morning.

Continued south-west and arrived at Station 41 (Greenland Sea: 67^{o} 50'N, 12^{o} 10'W) at about 19:00. Conducted Bongo net and standard CTD for gases and biology with CPR retrieved and re-deployed, then continued west.

Science team photograph taken.

Saturday 30th June

Weather: White cloud day with no wind and very calm sea.

Arrived at Station 42 (Greenland Sea: 67^{o} 49'N, 16^{o} 25'W) at about 05:00 and retrieved CPR. This was followed by Bongo nets, Micronet, a standard CTD for gases and biology, a titanium CTD for trace metals, Snow Catcher, SAPS, and CPR redeployment.

Continued west arrived at Station 43 (Greenland Sea: 67^{o} 50'N, 20^{o} 04'W) at about 19:00. Conducted Bongo net and standard CTD for gases and biology with CPR retrieved and re-deployed, then continued south-west towards Denmark Strait.

Sunday 1st July

Weather: Sunny day with no wind and very calm sea.

Arrived at Station 44 (Denmark Strait: 67^{o} 15'N, 24^{o} 02'W) at ice edge in Denmark Strait at about 05:00 and retrieved CPR. This was followed by Bongo nets, Micronet, a standard CTD for gases and biology, a titanium CTD for trace metals, SAPS, and CPR redeployment. Surface waters were cold due to ice melt but overlay warm Atlantic waters. Lots of humpback whales and birds were observed, including a couple of whales very close to the *JCR*.

Continued south-west along ice-edge and arrived at Station 45 (Denmark Strait: 66^{o} 47'N, 25^{o} 08'W) (most westerly station on the cruise) at about 15:00. This was the last sampling station on the cruise with the last sampling of the underway water supply. Conducted Bongo net and standard CTD for gases and biology with Towfish retrieved and CPR retrieved and re-deployed. Then headed to Reykjavik.

End of cruise party in evening.

Monday 2nd July

CPR recovered for final time on route to Reykjavik at 13:00.

Arrive in Reykjavik late afternoon. Commence demobilisation.

Tuesday 3rd July

Demobilisation in Reykjavik.

Wednesday 4th July

Demobilisation in Reykjavik.

Thursday 5th July

All scientists depart *JCR*.

JR271 Ship-based Scientific Event Log

Event No	Date	Start Time (GMT)	Bottom time (GMT)	End Time (GMT)	Station	Latitude	Longitude	Depth (m)	Activity	Comments	Lead
001	3/6/12	02:29	02:34	ND	Station 1 (E05)	56.26658 N	2.63326 E	60	CTD 001	Titanium CTD for Bioassay	Mark
002	3/6/12	04:23	04:30	04:41	Station 1 (E05)	56.26664 N	2.63323 E	60	CTD 002	Titanium CTD for Bioassay	Mark
003	3/6/12	05:56	06:00	ND	Station 1 (E05)	56.26665 N	2.63325 E	20	CTD003	Titanium CTD for Bioassay	Mark
004	3/6/12	06:39	-	06:43	Station 1 (E05)	56.26664 N	2.63319 E	50	Bongo 001	Bongo Net	Geraint
005	3/6/12	06:47	-	06:50	Station 1 (E05)	56.26665 N	2.63324 E	50	Bongo 002	Bongo Net	Geraint
006	3/6/12	06:51	-	06:55	Station 1 (E05)	56.26664 N	2.63326 E	50	Bongo 003	Bongo Net	Geraint
007	3/6/12	07:15	07:35	07:56	Station 1 (E05)	56.26663 N	2.63321 E	65	CTD 004	Standard CTD for Observations	Ray
008	3/6/12	08:59	09:04	09:20	Station 1 (E05)	56.26665 N	2.63323 E	60	CTD 005	Titanium CTD for Trace Metals	Eric
009	3/6/12	15:18	-	05:07	Transit to Station 2	56.97628 N	1.63225 E	-	CPR 001	CPR 167/0 Leg 1. Recovered 4/6/12	Geraint
010	4/6/12	05:21	-	05:25	Station 2	58.73980 N	0.86149 W	50	Bongo 004	Bongo Net	Geraint
011	4/6/12	05:26	-	05:29	Station 2	58.73983 N	0.86148 W	50	Bongo 005	Bongo Net	Geraint
012	4/6/12	05:31	-	05:36	Station 2	58.73980 N	0.86146 W	50	Bongo 006	Bongo Net	Geraint
013	4/6/12	06:48	06:56	07:16	Station 2	58.73969 N	0.86150 W	110	CTD 006	Standard CTD for Observations	Ray

Event No	Date	Start Time (GMT)	Bottom time (GMT)	End Time (GMT)	Station	Latitude	Longitude	Depth (m)	Activity	Comments	Lead
014	4/6/12	07:56	08:01	08:16	Station 2	58.73967 N	0.86148 W	105	CTD 007	Titanium CTD for Trace Metals	Eric
015	4/6/12	08:55	-	08:22	Station 2	58.73968 N	0.86148 W	-	Fish 001	Tow Fish Deployed until 12/6/12	Eric
016	4/6/12	09:07	-	04:59	Station 2	58.74313 N	0.86358 W	-	CPR 002	CPR 167/0 Leg 2. Recovered 5/6/12	Geraint
017	5/6/12	05:16	-	05:29	Station 3	60.13397 N	6.70423 W	200	Bongo 007	Bongo Net	Geraint
018	5/6/12	05:32	-	05:43	Station 3	60.13390 N	6.70455 W	200	Bongo 008	Bongo Net	Geraint
019	5/6/12	05:45	-	05:57	Station 3	60.13397 N	6.70933 W	200	Bongo 009	Bongo Net	Geraint
020	5/6/12	07:03	07:12	07:35	Station 3	60.13424 N	6.71209 W	300	CTD 008	Standard CTD for Observations	Ray
021	5/6/12	08:19	08:41	09:25	Station 3	60.13425 N	6.71212 W	1101	CTD 009	Titanium CTD for Trace Metals	Eric
022	5/6/12	10:35	-	13:00	Station 3	60.13424 N	6.71209 W	165	SAPS 001	SAPS Deployed	Fred
023	5/6/12	11:19	-	11:37	Station 3	60.13421 N	6.71209 W	65	Snow 001	Snow Catcher deployed	Helen
024	5/6/12	13:12	-	05:01	Station 3	60.13058 N	6.71294 W	-	CPR 003	CPR 167/0 Leg 3. Recovered 6/6/12	Geraint
025	6/6/12	05:20	-	05:29	Station 4	59.97131 N	11.97811 W	200	Bongo 010	Bongo Net	Geraint
026	6/6/12	05:30	-	05:40	Station 4	59.97124 N	11.97813 W	200	Bongo 011	Bongo Net	Geraint
027	6/6/12	05:45	-	05:57	Station 4	59.97109 N	11.97638 W	200	Bongo 012	Bongo Net	Geraint

Event No	Date	Start Time (GMT)	Bottom time (GMT)	End Time (GMT)	Station	Latitude	Longitude	Depth (m)	Activity	Comments	Lead
028	6/6/12	06:34	06:42	07:10	Station 4	59.97104 N	11.97509 W	300	CTD 010	Standard CTD for Observations	Ray
029	6/6/12	07:43	08:11	08:50	Station 4	59.97105 N	11.97509 W	1200	CTD 011	Titanium CTD for Trace Metals	Eric
030	6/6/12	07:57	-	08:06	Station 4	59.97106 N	11.97510 W	100	MICRO 001	Micronet deployment	Mike
031	6/6/12	09:04	-	19:33	Station 4	60.00766 N	15.45256 W	-	CPR 004	CPR 167/0 Leg 4. Recovered 6/6/12	Geraint
032	6/6/12	19:51	-	05:01	Station 4	60.02247 N	15.45256 W	-	CPR 005	CPR 157/1 Leg 1. Recovered 7/6/12	Geraint
033	7/6/12	05:15	-	05:28	Station 5	60.00141 N	18.67028 W	200	Bongo 013	Bongo Net	Geraint
034	7/6/12	05:30	-	05:42	Station 5	60.00144 N	18.67027 W	200	Bongo 014	Bongo Net	Geraint
035	7/6/12	05:45	-	05:56	Station 5	60.00145 N	18.67029 W	200	Bongo 015	Bongo Net	Geraint
036	7/6/12	06:35	06:43	07:08	Station 5	60.00145 N	18.67024 W	300	CTD 012	Standard CTD for Observations	Ray
037	7/6/12	07:56	08:42	10:00	Station 5	60.00143 N	18.67029 W	2500	CTD 013	Titanium CTD for Trace Metals	Eric
038	7/6/12	09:41	-	10:36	Station 5	60.00143 N	18.67024 W	100	MICRO 002	Micronet deployment	Mike
039	7/6/12	10:24	-	12:48	Station 5	60.00141 N	18.67025 W	140	SAPS 002	SAPS Deployed	Fred
040	7/6/12	10:36	-	10:46	Station 5	60.00141 N	18.67024 W	40	Snow 002	Snow Catcher deployed	Helen
041	7/6/12	12:56	-	19:34	Station 5	60.07642 N	18.66146 W	-	CPR 006	CPR 157/1 Leg 2. Recovered 7/6/12	Geraint

Event No	Date	Start Time (GMT)	Bottom time (GMT)	End Time (GMT)	Station	Latitude	Longitude	Depth (m)	Activity	Comments	Lead
042	8/6/12	02:14	02:19	02:31	Station 6	60.59420 N	18.85649 W	100	CTD 014	Titanium CTD for Bioassay	Mark
043	8/6/12	03:40	03:44	03:58	Station 6	60.59423 N	18.85646 W	100	CTD 015	Titanium CTD for Bioassay	Mark
044	8/6/12	05:30	05:32	05:44	Station 6	60.59423 N	18.85649 W	50	CTD016	Titanium CTD for Bioassay	Mark
045	8/6/12	06:11	06:20	06:44	Station 6	60.59421 N	18.85649 W	300	CTD 017	Standard CTD for Observations	Ray
046	8/6/12	07:15	07:33	08:10	Station 6	60.59420 N	18.85652 W	1000	CTD 018	Titanium CTD for Trace Metals	Eric
047	8/6/12	09:00	-	05:04	Station 6	60.59456 N	18.85481 W	-	CPR 007	CPR 157/1 Leg 3. Recovered 10/6/12	Geraint
048	10/6/12	05:18	-	ND	Station 7	65.97937 N	10.71827 W	200	Bongo 016	Bongo Net	Geraint
049	10/6/12	05:28	-	06:10	Station 7	65.97938 N	10.71825 W	100	Micro 003	Micronet deployment	Mike
050	10/6/12	05:32	-	05:44	Station 7	65.97939 N	10.71823 W	200	Bongo 017	Bongo Net	Geraint
051	10/6/12	05:46	-	05:59	Station 7	65.97938 N	10.71821 W	200	Bongo 018	Bongo Net	Geraint
052	10/6/12	06:18	06:25	06:50	Station 7	65.97940 N	10.71821 W	250	CTD 019	Standard CTD for Observations	Ray
053	10/6/12	06:31	-	06:43	Station 7	65.97939 N	10.71822 W	45	Snow 003	Snow Catcher deployed	Helen
054	10/6/12	07:01	-	14:24	Station 7	65.98028 N	10.71706 W	-	CPR 008	CPR 157/1 Leg 4. Recovered 10/6/12	Geraint
055	10/6/12	14:24	-	05:01	Transit to Station 8	67.30.470 N	9.70426 W	-	CPR 009	CPR 167/1 Leg 1. Recovered 11/6/12	Geraint

Event No	Date	Start Time (GMT)	Bottom time (GMT)	End Time (GMT)	Station	Latitude	Longitude	Depth (m)	Activity	Comments	Lead
056	11/6/12	05:09	-	05:22	Station 8	69.89571 N	7.57706 W	200	Bongo 019	Bongo Net	Geraint
057	11/6/12	05:18	-	06:17	Station 8	69.89571 N	7.57706 W	100	Micro 004	Micronet deployment	Mike
058	11/6/12	05:24	-	05:35	Station 8	69.89567 N	7.57703 W	200	Bongo 020	Bongo Net	Geraint
059	11/6/12	05:37	-	05:51	Station 8	69.89568 N	7.57706 W	200	Bongo 021	Bongo Net	Geraint
060	11/6/12	06:06	06:12	06:37	Station 8	69.89566 N	7.57712 W	250	CTD 020	Standard CTD for Observations	Ray
061	11/6/12	06:23	-	06:34	Station 8	69.89567 N	7.57711 W	50	Snow 004	Snow Catcher deployed	Helen
062	11/6/12	06:55	-	05:04	Station 8	69.90461 N	7.56829 W	-	CPR 010	CPR 167/1 Leg 2. Recovered 12/6/12	Geraint
063	12/6/12	05:14	-	05:27	Station 9	74.11645 N	4.69296 W	200	Bongo 022	Bongo Net	Geraint
064	12/6/12	05:32	-	06:29	Station 9	74.11643 N	4.69304 W	100	Micro 005	Micronet deployment	Mike
065	12/6/12	05:29	-	05:41	Station 9	74.11643 N	4.69307 W	200	Bongo 023	Bongo Net	Geraint
066	12/6/12	05:43	-	05:57	Station 9	74.11644 N	4.69308 W	200	Bongo 024	Bongo Net	Geraint
067	12/6/12	06:09	06:16	06:38	Station 9	74.11645 N	4.69305 W	250	CTD 021	Standard CTD for Observations	Ray
068	12/6/12	07:18	08:19	10:06	Station 9	74.11646 N	4.69305 W	250	CTD 022	Titanium CTD for Trace Metals	Eric
069	12/6/12	10:19	-	12:51	Station 9	74.11645 N	4.69305 W	150	SAPS 003	SAPS Deployed	Fred

Event No	Date	Start Time (GMT)	Bottom time (GMT)	End Time (GMT)	Station	Latitude	Longitude	Depth (m)	Activity	Comments	Lead
070	12/6/12	11:07	-	11:23	Station 9	74.11644 N	4.69299 W	50	Snow 005	Snow Catcher deployed	Helen
None	12/6/12	-	-	-	Station 9	74.11645 N	4.69296 W	-	Argo 001	Argo Float Deployment	Simon
071	12/6/12	13:06	-	17:52	Station 9	74.11826 N	4.69181 W	-	CPR 011	CPR 167/1 Leg 3a. Recovered 12/6/12	Geraint
None	12/6/12	18:17	18:20	18:27	Transit to Station 10	74.99051 N	3.82078 W	30	CTD 023	Standard CTD for Argo Float	Ray
072	12/6/12	18:39	-	16:18	Transit to Station 10	74.99052 N	3.82075 W	-	Fish 002	Tow Fish Deployed until 14/6/12	Eric
None	12/6/12	18:45	-	-	Transit to Station 10	74.99063 N	3.82074 W	-	Argo 002	Argo Float Deployment	Simon
073	12/6/12	18:51	-	01:23	Transit to Station 10	74.99116 N	3.81985 W	-	CPR 012	CPR 167/1 Leg 3b. Recovered 12/6/12	Geraint
074	13/6/12	02:10	02:14	02:27	Station 10	76.17525 N	2.54948 W	100	CTD 024	Titanium CTD for Bioassay	Mark
075	13/6/12	03:44	03:48	04:02	Station 10	76.17525 N	2.54948 W	100	CTD 025	Titanium CTD for Bioassay	Mark
076	13/6/12	05:33	05:36	05:48	Station 10	76.17525 N	2.54948 W	30	CTD026	Titanium CTD for Bioassay	Mark
077	13/6/12	05:39	-	06:45	Station 10	76.17525 N	2.54945 W	100	Micro 006	Micronet deployment	Mike
078	13/6/12	06:04	-	06:16	Station 10	76.17525 N	2.54950 W	200	Bongo 025	Bongo Net	Geraint
079	13/6/12	06:18	-	06:30	Station 10	76.17524 N	2.54953 W	200	Bongo 026	Bongo Net	Geraint
080	13/6/12	06:32	-	06:47	Station 10	76.17525 N	2.54947 W	200	Bongo 027	Bongo Net	Geraint

Event No	Date	Start Time (GMT)	Bottom time (GMT)	End Time (GMT)	Station	Latitude	Longitude	Depth (m)	Activity	Comments	Lead
081	13/6/12	07:00	07:06	07:30	Station 10	76.17526 N	2.54949 W	250	CTD 027	Standard CTD for Observations	Ray
082	13/6/12	07:59	08:20	08:57	Station 10	76.17525 N	2.54957 W	1000	CTD 028	Titanium CTD for Trace Metals	Eric
083	13/6/12	09:09	-	11:37	Station 10	76.17526 N	2.54943 W	140	SAPS 004	SAPS Deployed	Fred
084	13/6/12	11:53	-	04:59	Station 10	76.17690 N	2.54788 W	-	CPR 013	CPR 167/2 Leg 2. Recovered 14/6/12	Geraint
085	14/6/12	05:14	-	05:26	Station 11	78.71805 N	0.00410 W	200	Bongo 028	Bongo Net	Geraint
086	14/6/12	05:25	-	06:14	Station 11	78.71804 N	0.00395 W	100	Micro 007	Micronet deployment	Mike
087	14/6/12	05:27	-	05:40	Station 11	78.71804 N	0.00364 W	200	Bongo 029	Bongo Net	Geraint
088	14/6/12	05:41	-	06:54	Station 11	78.71809 N	0.00164 W	200	Bongo 030	Bongo Net	Geraint
089	14/6/12	06:10	06:18	06:45	Station 11	78.71806 N	0.00014 W	250	CTD 029	Standard CTD for Observations	Ray
090	14/6/12	08:00	-	09:22	Station 11	78.71806 N	0.00010 W	400	GOFLO 001	GOFLO profile for Trace Metals	Eric
091	14/6/12	09:45	-	12:10	Station 11	78.71805 N	0.00003 W	130	SAPS 005	SAPS Deployed	Fred
092	14/6/12	09:58	-	10:10	Station 11	78.71805 N	0.00000 W	30	Snow 006	Snow Catcher deployed	Helen
093	14/6/12	12:59	-	16:12	Station 11	78.67684 N	0.53522 W	-	CPR 014	CPR 167/2 Leg 2. Recovered 14/6/12	Geraint
094	15/6/12	05:28	-	06:51	Station 12	78.24771 N	5.54734 W	100	Micro 008	Micronet deployment	Mike

Event No	Date	Start Time (GMT)	Bottom time (GMT)	End Time (GMT)	Station	Latitude	Longitude	Depth (m)	Activity	Comments	Lead
095	15/6/12	05:46	05:57	06:25	Station 12	78.24527 N	5.54986 W	362	CTD 030	Standard CTD for Observations	Ray
096	15/6/12	06:39	-	06:50	Station 12	78.23941 N	5.55754 W	200	Bongo 031	Bongo Net	Geraint
097	15/6/12	06:52	-	07:04	Station 12	78.23800 N	5.55962 W	200	Bongo 032	Bongo Net	Geraint
098	15/6/12	07:05	-	07:17	Station 12	78.23657 N	5.56087 W	200	Bongo 033	Bongo Net	Geraint
099	15/6/12	07:33	-	09:04	Station 12	78.23377 N	5.56322 W	362	GOFLO 002	GOFLO profile for Trace Metals	Eric
100	15/6/12	15:46	15:55	16:15	Station 13	78.30724 N	6.08104 W	356	CTD 031	Standard CTD for Observations	Ray
101	16/6/12	05:17	-	05:29	Station 14	78.21569 N	6.00632 W	200	Bongo 034	Bongo Net	Geraint
102	16/6/12	05:40	-	05:52	Station 14	78.21158 N	6.00684 W	200	Bongo 035	Bongo Net	Geraint
103	16/6/12	05:44	-	06:40	Station 14	78.21106 N	6.00780 W	100	Micro 009	Micronet deployment	Mike
104	16/6/12	06:19	-	06:31	Station 14	78.21507 N	5.99994 W	200	Bongo 036	Bongo Net	Geraint
105	16/6/12	06:43	06:53	07:17	Station 14	78.21313 N	5.99826 W	350	CTD 032	Standard CTD for Observations	Ray
106	16/6/12	07:35	-	08:28	Station 14	78.20889 N	5.99663 W	330	GOFLO 003	GOFLO profile for Trace Metals	Eric
107	16/6/12	08:45	-	10:45	Station 14	78.20428 N	5.99320 W	180	SAPS 006	SAPS Deployed	Fred
108	16/6/12	08:57	-	09:19	Station 14	78.20366 N	5.99231 W	80	Snow 007	Snow Catcher deployed	Helen

Event No	Date	Start Time (GMT)	Bottom time (GMT)	End Time (GMT)	Station	Latitude	Longitude	Depth (m)	Activity	Comments	Lead
109	17/6/12	05:11	-	05:29	Station 15	77.83088 N	5.03106 W	200	Bongo 037	Bongo Net	Geraint
110	17/6/12	05:16	-	06:28	Station 15	77.82989 N	5.02745 W	100	Micro 010	Micronet deployment	Mike
111	17/6/12	05:39	-	05:42	Station 15	77.82681 N	5.01508 W	200	Bongo 038	Bongo Net	Geraint
112	17/6/12	05:44	-	05:57	Station 15	77.82373 N	5.00240 W	200	Bongo 039	Bongo Net	Geraint
113	17/6/12	06:10	06:21	06:50	Station 15	77.81768 N	4.97765 W	340	CTD 033	Standard CTD for Observations	Ray
114	17/6/12	07:04	-	08.14	Station 15	77.80667 N	4.93323 W	500	GOFLO 004	GOFLO profile for Trace Metals	Eric
115	17/6/12	07:26	-	07:45	Station 15	77.80127 N	4.91566 W	130	Snow 008	Snow Catcher deployed	Helen
116	17/6/12	15:18	16:11	17:45	Station 16	77.77939 N	3.07602 W	2880	CTD 034	Titanium CTD for Trace Metals	Eric
117	18/6/12	02:53	02:58	03:15	Station 17	78.35248 N	3.66429 W	100	CTD 035	Titanium CTD for Bioassay	Mark
118	18/6/12	06:26	06:31	06:44	Station 18	78.35256 N	4.16800 W	100	CTD 036	Titanium CTD for Bioassay	Mark
119	18/6/12	08:05	-	09:16	Station 18	78.32865 N	4.19148 W	100	Micro 011	Micronet deployment	Mike
120	18/6/12	08:08	08;11	08:25	Station 18	78.32816 N	4.19178 W	50	CTD 037	Titanium CTD for Bioassay	Mark
121	18/6/12	10:11	10:14	10:27	Station 18	78.29534 N	4.25183 W	50	CTD 038	Titanium CTD for Bioassay	Mark
122	18/6/12	10:36	-	10:54	Station 18	78.28862 N	4.26552 W	200	Bongo 040	Bongo Net	Geraint

Event No	Date	Start Time (GMT)	Bottom time (GMT)	End Time (GMT)	Station	Latitude	Longitude	Depth (m)	Activity	Comments	Lead
123	18/6/12	10:55	-	11:07	Station 18	78.29394 N	4.27736 W	200	Bongo 041	Bongo Net	Geraint
124	18/6/12	11:08	-	11:21	Station 18	78.28063 N	4.28433 W	200	Bongo 042	Bongo Net	Geraint
125	18/6/12	11:22	-	11:36	Station 18	78.27705 N	4.29154 W	200	Bongo 043	Bongo Net	Geraint
126	18/6/12	11:48	11:54	12:23	Station 18	78.16310 N	4.18220 W	500	CTD 039	Standard CTD for Observations	Ray
127	18/6/12	12:39	-	13:52	Station 18	78.26295 N	4.34280 W	500	GOFLO 005	GOFLO profile for Trace Metals	Eric
128	18/6/12	13:02	-	13:19	Station 18	78.25979 N	4.35579 W	30	Snow 009	Snow Catcher deployed	Helen
129	18/6/12	14:04	-	16:05	Station 18	78.25144 N	4.39487 W	130	SAPS 007	SAPS Deployed	Fred
130	19/6/12	05:36	-	05:50	Station 19	77.84251 N	1.31590 W	200	Bongo 044	Bongo Net	Geraint
131	19/6/12	05:52	-	06:03	Station 19	77.84312 N	1.31191 W	200	Bongo 045	Bongo Net	Geraint
132	19/6/12	05:52	-	07:14	Station 19	77.84312 N	1.31191 W	100	Micro 012	Micronet deployment	Mike
133	19/6/12	06:05	-	06:20	Station 19	77.84411 N	1.30701 W	200	Bongo 046	Bongo Net	Geraint
134	19/6/12	06:34	06:46	07:19	Station 19	77.84645 N	1.29586 W	500	CTD 040	Standard CTD for Observations	Ray
135	19/6/12	07:52	-	08:46	Station 19	77.85295 N	1.26999 W	500	GOFLO 006	GOFLO profile for Trace Metals	Eric
136	19/6/12	08:55	-	10:58	Station 19	77.85829 N	1.24883 W	150	SAPS 008	SAPS Deployed	Fred

Event No	Date	Start Time (GMT)	Bottom time (GMT)	End Time (GMT)	Station	Latitude	Longitude	Depth (m)	Activity	Comments	Lead
137	19/6/12	09:21	-	09:33	Station 19	77.86044 N	1.23978 W	50	Snow 010	Snow Catcher deployed	Helen
138	19/6/12	11:05	-	15:48	Station 19	77.86918 N	1.20415 W	-	Fish 003	Tow Fish Deployed until 20/6/12	Eric
139	19/6/12	11:12	-	18:25	Station 19	77.87124 N	1.20097 W	-	CPR 015	CPR 157/0 Leg 1a. Recovered 19/6/12	Geraint
140	19/6/12	18:37	-	18:51	Station 20	78.42181 N	2.76565 E	200	Bongo 047	Bongo Net	Geraint
141	19/6/12	19:06	19:15	19:42	Station 20	78.42179 N	2.76572 E	500	CTD 041	Standard CTD for Observations	Ray
142	19/6/12	19:51	-	04:58	Station 20	78.42075 N	2.78042 E	-	CPR 016	CPR 157/0 Leg 1b. Recovered 20/6/12	Geraint
143	20/6/12	05:10	-	05:22	Station 21	78.98256 N	7.97999 E	200	Bongo 048	Bongo Net	Geraint
144	20/6/12	05:22	-	06:33	Station 21	78.98343 N	7.97982 E	100	Micro 013	Micronet deployment	Mike
145	20/6/12	05:23	-	05:35	Station 21	78.98351 N	7.97982 E	200	Bongo 049	Bongo Net	Geraint
146	20/6/12	05:36	-	05:50	Station 21	78.98456 N	7.97969 E	200	Bongo 050	Bongo Net	Geraint
147	20/6/12	06:06	06:17	06:47	Station 21	78.98713 N	7.97973 E	500	CTD 042	Standard CTD for Observations	Ray
148	20/6/12	07:00	-	08:11	Station 21	78.99276 N	7.97375 E	500	GOFLO 007	GOFLO profile for Trace Metals	Eric
149	20/6/12	08:28	-	13:03	Station 21	78.99984 N	7.96836 E	-	CPR 017	CPR 157/0 Leg 2. Recovered 20/6/12	Geraint
150	20/6/12	13:30	-	13:48	Station 22	78.95566 N	11.92481 E	200	Bongo 051	Bongo Net (for pteropods)	Geraint

Event No	Date	Start Time (GMT)	Bottom time (GMT)	End Time (GMT)	Station	Latitude	Longitude	Depth (m)	Activity	Comments	Lead
151	20/6/12	13:50	-	14:08	Station 22	78.95557 N	11.92503 E	250	Bongo 052	Bongo Net (for pteropods)	Geraint
152	20/6/12	14:10	-	14:26	Station 22	78.95556 N	11.92502 E	250	Bongo 053	Bongo Net (for pteropods)	Geraint
153	20/6/12	14:30	-	14:44	Station 22	78.95553 N	11.92493 E	250	Bongo 054	Bongo Net (for pteropods)	Geraint
154	20/6/12	15:00	-	15:34	Station 22	78.95555 N	11.92503 E	340	CTD 043	Standard CTD (for pteropods)	Geraint
155	21/6/12	08:34	-	08:47	Station 23	79.05820 N	11.43840 E	200	Bongo 055	Bongo Net (for pteropods)	Geraint
156	21/6/12	08:48	-	09:01	Station 23	79.05836 N	11.43728 E	200	Bongo 056	Bongo Net (for pteropods)	Geraint
157	21/6/12	09:39	-	09:52	Station 24	79.05750 N	11.14394 E	200	Bongo 057	Bongo Net (for pteropods)	Geraint
158	21/6/12	09:53	-	10:08	Station 24	79.05750 N	11.14380 E	200	Bongo 058	Bongo Net (for pteropods)	Geraint
159	21/6/12	10:09	-	10:23	Station 24	79.05749 N	11.14384 E	200	Bongo 059	Bongo Net (for pteropods)	Geraint
160	21/6/12	10:17	-	07:04	Station 24	79.05750 N	11.14393 E	-	Fish 004	Tow Fish Deployed until 23/6/12	Eric
161	21/6/12	10:38	-	18:31	Station 24	79.05506 N	11.14164 E	-	CPR 018	CPR 157/0 Leg 3a. Recovered 21/6/12	Geraint
162	21/6/12	18:40	-	18:53	Station 25	77.92908 N	9.13659 E	200	Bongo 060	Bongo Net	Geraint
163	21/6/12	19:03	19:14	19:41	Station 25	77.92907 N	9.13648 E	500	CTD 044	Standard CTD for Observations	Ray
164	21/6/12	19:48	-	05:01	Station 25	77.92831 N	9.13234 E	-	CPR 019	CPR 157/0 Leg 3b. Recovered 22/6/12	Geraint

Event No	Date	Start Time (GMT)	Bottom time (GMT)	End Time (GMT)	Station	Latitude	Longitude	Depth (m)	Activity	Comments	Lead
165	22/6/12	05:12	-	05:24	Station 26	76.26198 N	12.54182 E	200	Bongo 061	Bongo Net	Geraint
166	22/6/12	05:25	-	05:38	Station 26	76.26195 N	12.54176 E	200	Bongo 062	Bongo Net	Geraint
167	22/6/12	05:26	-	06:55	Station 26	76.26194 N	12.54175 E	100	Micro 014	Micronet deployment	Mike
168	22/6/12	05:39	-	05:53	Station 26	76.26194 N	12.54177 E	200	Bongo 063	Bongo Net	Geraint
169	22/6/12	06:06	06:17	06:40	Station 26	76.26193 N	12.54164 E	500	CTD 045	Standard CTD for Observations	Ray
170	22/6/12	07:03	-	08:08	Station 26	76.26200 N	12.54163 E	500	GOFLO 008	GOFLO profile for Trace Metals	Eric
171	22/6/12	08:17	-	10:13	Station 26	76.26195 N	12.54165 E	160	SAPS 009	SAPS Deployed	Fred
172	22/6/12	08:38	-	08:53	Station 26	76.26195 N	12.54157 E	60	Snow 011	Snow Catcher deployed	Helen
173	22/6/12	10:23	-	18:22	Station 26	76.26186 N	12.53889 E	-	CPR 020	CPR 157/0 Leg 4a. Recovered 22/6/12	Geraint
174	22/6/12	18:34	-	18:46	Station 27	76.21155 N	18.38216 E	150	Bongo 064	Bongo Net	Geraint
175	22/6/12	18:57	19:04	19:26	Station 27	76.21164 N	18.38416 E	248	CTD 046	Standard CTD for Observations	Ray
176	22/6/12	19:56	-	04:58	Station 27	76.21268 N	18.59080 E	-	CPR 021	CPR 157/0 Leg 4b. Recovered 23/6/12	Geraint
177	23/6/12	05:09	-	05:14	Station 28	76.15948 N	26.06155 E	50	Bongo 065	Bongo Net	Geraint
178	23/6/12	05:15	-	05:19	Station 28	76.15931 N	26.06212 E	50	Bongo 066	Bongo Net	Geraint

Event No	Date	Start Time (GMT)	Bottom time (GMT)	End Time (GMT)	Station	Latitude	Longitude	Depth (m)	Activity	Comments	Lead
179	23/6/12	05:20	-	05:25	Station 28	76.15904 N	26.06281 E	50	Bongo 067	Bongo Net	Geraint
180	23/6/12	05:38	-	06:42	Station 28	76.15804 N	26.06571 E	100	Micro 015	Micronet deployment	Mike
181	23/6/12	05:49	05:55	06:17	Station 28	76.15739 N	26.06745 E	133	CTD 047	Standard CTD for Observations	Ray
182	23/6/12	06:44	-	07:13	Station 28	76.15638 N	26.07028 E	110	GOFLO 009	GOFLO profile for Trace Metals	Eric
183	23/6/12	07:32	-	18:21	Station 28	76.15545 N	26.04971 E	-	CPR 022	CPR 157/2 Leg 1a. Recovered 23/6/12	Geraint
184	23/6/12	13:48	-	07:02	Station 28	74.97687 N	25.98792 E	-	Fish 005	Tow Fish Deployed until 28/6/12	Eric
185	23/6/12	18:32	-	18:46	Station 29	74.08998 N	25.99933 E	200	Bongo 068	Bongo Net	Geraint
186	23/6/12	18:52	19:03	19:25	Station 29	74.08998 N	25.99927 E	425	CTD 048	Standard CTD for Observations	Ray
187	23/6/12	19:37	-	01:31	Station 29	74.07987 N	25.99922 E	-	CPR 023	CPR 157/2 Leg 1b. Recovered 24/6/12	Geraint
188	24/6/12	01:59	02:05	02:21	Station 30	72.89160 N	26.00171 E	100	CTD 049	Titanium CTD for Bioassay	Mark
189	24/6/12	03:31	03:36	03:53	Station 30	72.89161 N	26.00165 E	100	CTD 050	Titanium CTD for Bioassay	Mark
190	24/6/12	05:27	05:31	05:46	Station 30	72.89160 N	26.00166 E	100	CTD 051	Titanium CTD for Bioassay	Mark
191	24/6/12	05:58	-	06:11	Station 30	72.89157 N	26.00165 E	200	Bongo 069	Bongo Net	Geraint
192	24/6/12	06:12	-	06:24	Station 30	72.89080 N	26.00273 E	200	Bongo 070	Bongo Net	Geraint

Event No	Date	Start Time (GMT)	Bottom time (GMT)	End Time (GMT)	Station	Latitude	Longitude	Depth (m)	Activity	Comments	Lead
193	24/6/12	06:25	-	06:39	Station 30	72.88981 N	26.00396 E	200	Bongo 071	Bongo Net	Geraint
194	24/6/12	06:50	06:59	07:24	Station 30	72.88873 N	26.00524 E	350	CTD 052	Standard CTD for Observations	Ray
195	24/6/12	07:09	-	07:25	Station 30	72.88872 N	26.00530 E	60	Snow 012	Snow Catcher deployed	Helen
196	24/6/12	07:32	-	08:45	Station 30	72.88871 N	26.00529 E	100	Micro 016	Micronet deployment	Mike
197	24/6/12	07:41	-	08:32	Station 30	72.88871 N	26.00531 E	350	GOFLO 010	GOFLO profile for Trace Metals	Eric
198	24/6/12	08:59	-	18:22	Station 30	72.88739 N	26.00009 E	-	CPR 024	CPR 157/2 Leg 2a. Recovered 24/6/12	Geraint
199	24/6/12	18:32	-	18:44	Station 31	71.74803 N	22.97222 E	200	Bongo 072	Bongo Net	Geraint
200	24/6/12	18:54	19:04	19:27	Station 31	71.74803 N	22.97222 E	365	CTD 053	Standard CTD for Observations	Ray
201	24/6/12	19:42	-	04:53	Station 31	71.75190 N	22.93811 E	-	CPR 025	CPR 157/2 Leg 2b. Recovered 25/6/12	Geraint
202	25/6/12	05:04	-	05:16	Station 32	71.75197 N	17.90082 E	200	Bongo 073	Bongo Net	Geraint
203	25/6/12	05:17	-	05:29	Station 32	71.75197 N	17.90075 E	200	Bongo 074	Bongo Net	Geraint
204	25/6/12	05:30	-	05:44	Station 32	71.75197 N	17.90074 E	200	Bongo 075	Bongo Net	Geraint
205	25/6/12	06:06	06:14	06:35	Station 32	71.75197 N	17.90075 E	273	CTD 054	Standard CTD for Observations	Ray
206	25/6/12	06:48	-	07:47	Station 32	71.75197 N	17.90070 E	260	GOFLO 011	GOFLO profile for Trace Metals	Eric

Event No	Date	Start Time (GMT)	Bottom time (GMT)	End Time (GMT)	Station	Latitude	Longitude	Depth (m)	Activity	Comments	Lead
207	25/6/12	07:35	-	08:58	Station 32	71.75195 N	17.90080 E	100	Micro 017	Micronet deployment	Mike
208	25/6/12	08:14	-	10:01	Station 32	71.75196 N	17.90081 E	130	SAPS 010	SAPS Deployed	Fred
209	25/6/12	08:35	-	08:41	Station 32	71.75196 N	17.90073 E	30	Snow 013	Snow Catcher deployed	Helen
210	25/6/12	10:14	-	18:21	Station 32	71.77315 N	17.89801 E	-	CPR 026	CPR 157/2 Leg 3a. Recovered 25/6/12	Geraint
211	25/6/12	18:38	-	18:51	Station 33	71.75792 N	13.39111 E	200	Bongo 076	Bongo Net	Geraint
212	25/6/12	18:58	19:09	19:35	Station 33	71.76071 N	13.39492 E	500	CTD 055	Standard CTD for Observations	Ray
213	25/6/12	19:46	-	04:54	Station 33	71.76797 N	13.38512 E	-	CPR 027	CPR 157/2 Leg 3b. Recovered 26/6/12	Geraint
214	26/6/12	05:05	-	05:17	Station 34	71.74750 N	8.44275 E	200	Bongo 077	Bongo Net	Geraint
215	26/6/12	05:19	-	05:31	Station 34	71.74753 N	8.44283 E	200	Bongo 078	Bongo Net	Geraint
216	26/6/12	05:32	-	05:46	Station 34	71.74751 N	8.44280 E	200	Bongo 079	Bongo Net	Geraint
217	26/6/12	05:55	06:06	06:35	Station 34	71.74751 N	8.44282 E	500	CTD 056	Standard CTD for Observations	Ray
218	26/6/12	06:48	-	07:56	Station 34	71.74754 N	8.44273 E	500	GOFLO 012	GOFLO profile for Trace Metals	Eric
219	26/6/12	06:54	-	08:21	Station 34	71.74754 N	8.44272 E	100	Micro 018	Micronet deployment	Mike
220	26/6/12	08:05	-	10:01	Station 34	71.74753 N	8.44277 E	130	SAPS 011	SAPS Deployed	Fred

Event No	Date	Start Time (GMT)	Bottom time (GMT)	End Time (GMT)	Station	Latitude	Longitude	Depth (m)	Activity	Comments	Lead
221	26/6/12	08:30	-	08:40	Station 34	71.74754 N	8.44276 E	30	Snow 014	Snow Catcher deployed	Helen
222	26/6/12	10:11	-	18:21	Station 34	71.74769 N	8.44006 E	-	CPR 028	CPR 167/1(2) Leg 1a. Recovered 26/6/12	Geraint
223	26/6/12	18:32	-	18:46	Station 35	71.75221 N	3.86251 E	200	Bongo 080	Bongo Net	Geraint
224	26/6/12	18:55	19:06	19:33	Station 35	71.75192 N	3.87166 E	500	CTD 057	Standard CTD for Observations	Ray
225	26/6/12	19:45	-	04:54	Station 35	71.75552 N	3.88715 E	-	CPR 029	CPR 167/1(2) Leg 1b. Recovered 27/6/12	Geraint
226	27/6/12	05:05	-	05:18	Station 36	71.74527 N	1.26728 W	200	Bongo 081	Bongo Net	Geraint
227	27/6/12	05:19	-	05:31	Station 36	71.74529 N	1.26723 W	200	Bongo 082	Bongo Net	Geraint
228	27/6/12	05:32	-	05:48	Station 36	71.74526 N	1.26725 W	200	Bongo 083	Bongo Net	Geraint
229	27/6/12	05:58	06:09	06:40	Station 36	71.74527 N	1.26724 W	500	CTD 058	Standard CTD for Observations	Ray
230	27/6/12	06:54	-	07:59	Station 36	71.74529 N	1.26729 W	500	GOFLO 013	GOFLO profile for Trace Metals	Eric
231	27/6/12	07:00	-	08:20	Station 36	71.74528 N	1.26724 W	100	Micro 019	Micronet deployment	Mike
232	27/6/12	08:10	-	10:04	Station 36	71.74529 N	1.26724 W	150	SAPS 012	SAPS Deployed	Fred
233	27/6/12	08:32	-	08:43	Station 36	71.74529 N	1.26723 W	50	Snow 015	Snow Catcher deployed	Helen
234	27/6/12	10:14	-	18:19	Station 36	71.74631 N	1.26791 W	-	CPR 030	CPR 167/1(2) Leg 2a. Recovered 27/6/12	Geraint

Event No	Date	Start Time (GMT)	Bottom time (GMT)	End Time (GMT)	Station	Latitude	Longitude	Depth (m)	Activity	Comments	Lead
235	27/6/12	18:28	-	18:41	Station 37	71.75174 N	5.86396 W	200	Bongo 084	Bongo Net	Geraint
236	27/6/12	18:49	19:00	19:30	Station 37	71.75171 N	5.86381 W	500	CTD 059	Standard CTD for Observations	Ray
237	27/6/12	19:36	-	04:50	Station 37	71.75168 N	5.86864 W	-	CPR 031	CPR 167/1(2) Leg 2b. Recovered 28/6/12	Geraint
238	28/6/12	04:59	-	05:12	Station 38	71.74838 N	10.59714 W	200	Bongo 085	Bongo Net	Geraint
239	28/6/12	05:13	-	05;26	Station 38	71.74838 N	10.59717 W	200	Bongo 086	Bongo Net	Geraint
240	28/6/12	05:27	-	05:39	Station 38	71.74837 N	10.59718 W	200	Bongo 087	Bongo Net	Geraint
241	28/6/12	05:52	06:02	06:33	Station 38	71.74836 N	10.59721 W	500	CTD 060	Standard CTD for Observations	Ray
242	28/6/12	07:00	-	08:22	Station 38	71.75021 N	10.57546 W	100	Micro 019	Micronet deployment	Mike
243	28/6/12	07:03	07:54	09:09	Station 38	71.75038 N	10.57339 W	2388	CTD 061	Titanium CTD for Trace Metals	Eric
244	28/6/12	09:29	-	11:21	Station 38	71.76251 N	10.52284 W	160	SAPS 013	SAPS Deployed	Fred
245	28/6/12	11:35	-	16:04	Station 38	71.76662 N	10.48776 E	-	Fish 006	Tow Fish Deployed until 1/7/12	Eric
246	28/6/12	11:39	-	18:48	Station 38	71.76639 N	10.48898 W	-	CPR 032	CPR 167/1(2) Leg 3a. Recovered 28/6/12	Geraint
247	28/6/12	18:58	-	19:09	Station 39	70.50825 N	10.09003 W	200	Bongo 088	Bongo Net	Geraint
248	28/6/12	19:18	19:29	19:57	Station 39	70.50828 N	10.09996 W	500	CTD 062	Standard CTD for Observations	Ray

Event No	Date	Start Time (GMT)	Bottom time (GMT)	End Time (GMT)	Station	Latitude	Longitude	Depth (m)	Activity	Comments	Lead
249	28/6/12	20:05	-	04:55	Station 39	70.50786 N	10.10319 W	-	CPR 033	CPR 167/1(2) Leg 3b. Recovered 29/6/12	Geraint
250	29/6/12	05:07	-	05:19	Station 40	68.69506 N	10.57601 W	200	Bongo 089	Bongo Net	Geraint
251	29/6/12	05:20	-	05:32	Station 40	68.69504 N	10.57601 W	200	Bongo 090	Bongo Net	Geraint
252	29/6/12	05:33	-	05:47	Station 40	68.69504 N	10.57601 W	200	Bongo 091	Bongo Net	Geraint
253	29/6/12	05:56	06:06	06:35	Station 40	68.69505 N	10.57600 W	500	CTD 063	Standard CTD for Observations	Ray
254	29/6/12	06:49	-	07:56	Station 40	68.69511 N	10.57605 W	400	GOFLO 014	GOFLO profile for Trace Metals	Eric
255	29/6/12	07:05	-	08:22	Station 40	68.69508 N	10.57599 W	100	Micro 020	Micronet deployment	Mike
256	29/6/12	08:08	-	10:05	Station 40	68.69510 N	10.57600 W	160	SAPS 014	SAPS Deployed	Fred
257	29/6/12	08:32	-	08:47	Station 40	68.69510 N	10.57600 W	60	Snow 016	Snow Catcher deployed	Helen
258	29/6/12	10:12	-	18:17	Station 40	68.69506 N	10.57601 W	-	CPR 034	CPR 167/0(2) Leg 1a. Recovered 29/6/12	Geraint
259	29/6/12	18:26	-	18:38	Station 41	67.83437 N	12.17424 W	200	Bongo 092	Bongo Net	Geraint
260	29/6/12	18:46	18:57	19:27	Station 41	67.83434 N	12.17422 W	500	CTD 064	Standard CTD for Observations	Ray
261	29/6/12	19:34	-	04:54	Station 41	67.83361 N	12.17428 W	-	CPR 035	CPR 167/0(2) Leg 1b. Recovered 30/6/12	Geraint
262	30/6/12	05:07	-	05:19	Station 42	67.83043 N	16.42183 W	200	Bongo 093	Bongo Net	Geraint

Event No	Date	Start Time (GMT)	Bottom time (GMT)	End Time (GMT)	Station	Latitude	Longitude	Depth (m)	Activity	Comments	Lead
263	30/6/12	05:20	-	05:33	Station 42	67.83042 N	16.42181 W	200	Bongo 094	Bongo Net	Geraint
264	30/6/12	05:35	-	05:49	Station 42	67.83041 N	16.42184 W	200	Bongo 095	Bongo Net	Geraint
265	30/6/12	05:57	06:09	06:39	Station 42	67.83043 N	16.42183 W	500	CTD 065	Standard CTD for Observations	Ray
266	30/6/12	07:03	-	08:24	Station 42	67.83043 N	16.42178 W	100	Micro 021	Micronet deployment	Mike
267	30/6/12	07:11	07:31	08:10	Station 42	67.83043 N	16.42179 W	1025	CTD 066	Titanium CTD for Trace Metals	Eric
268	30/6/12	08:19	-	10:14	Station 42	67.83044 N	16.42180 W	160	SAPS 015	SAPS Deployed	Fred
269	30/6/12	08:39	-	08:44	Station 42	67.83045 N	16.42179 W	60	Snow 017	Snow Catcher deployed	Helen
270	30/6/12	10:22	-	18:18	Station 42	67.83074 N	16.42473 W	-	CPR 036	CPR 167/0(2) Leg 2a. Recovered 30/6/12	Geraint
271	30/6/12	18:29	-	18:42	Station 43	67.83151 N	20.06417 W	200	Bongo 096	Bongo Net	Geraint
272	30/6/12	18:49	19:01	19:32	Station 43	67.83153 N	20.06415 W	500	CTD 067	Standard CTD for Observations	Ray
273	30/6/12	19:37	-	04:58	Station 43	67.83153 N	20.06543 W	-	CPR 037	CPR 167/0(2) Leg 2b. Recovered 1/7/12	Geraint
274	1/7/12	05:25	-	0538	Station 44	67.26234 N	24.03624 W	200	Bongo 097	Bongo Net	Geraint
275	1/7/12	05:39	-	05:51	Station 44	67.26256 N	24.03704 W	200	Bongo 098	Bongo Net	Geraint
276	1/7/12	05:53	-	06:05	Station 44	67.26281 N	24.03778 W	200	Bongo 099	Bongo Net	Geraint

Event No	Date	Start Time (GMT)	Bottom time (GMT)	End Time (GMT)	Station	Latitude	Longitude	Depth (m)	Activity	Comments	Lead
277	1/7/12	06:15	06:26	06:59	Station 44	67.26418 N	24.04152 W	500	CTD 068	Standard CTD for Observations	Ray
278	1/7/12	07:07	-	08:17	Station 44	67.26934 N	24.05413 W	100	Micro 022	Micronet deployment	Mike
279	1/7/12	07:18	07:32	08:00	Station 44	67.27095 N	24.05761 W	661	CTD 069	Titanium CTD for Trace Metals	Eric
280	1/7/12	08:16	-	10:15	Station 44	67.27736 N	24.06626 W	150	SAPS 016	SAPS Deployed	Fred
281	1/7/12	10:23	-	15:09	Station 44	67.28379 N	24.06420 W	-	CPR 038	CPR 167/0(2) Leg 3a. Recovered 1/7/12	Geraint
282	1/7/12	15:18	-	15:31	Station 45	66.79138 N	25.14132 W	200	Bongo 100	Bongo Net	Geraint
283	1/7/12	15:41	15:53	16:24	Station 45	66.79251 N	25.14092 W	500	CTD 070	Standard CTD for Observations	Ray
284	1/7/12	16:31	-	13:01	Station 45	66.79034 N	25.14015 W	-	CPR 039	CPR 167/0(3) Leg 3b. Recovered 2/7/12	Geraint

SUMMARY OF PRELIMINARY RESULTS

Ray Leakey

The *JCR* visited 45 stations in 33 days. Only one day was lost to bad weather.

The diverse range of science undertaken, including the requirement for trace metal clean conditions, necessitated use of six laboratory containers positioned on the *JCR* aft deck, along with deck incubation tanks. There were few equipment failures and none sufficiently critical to compromise the core objective of the cruise.

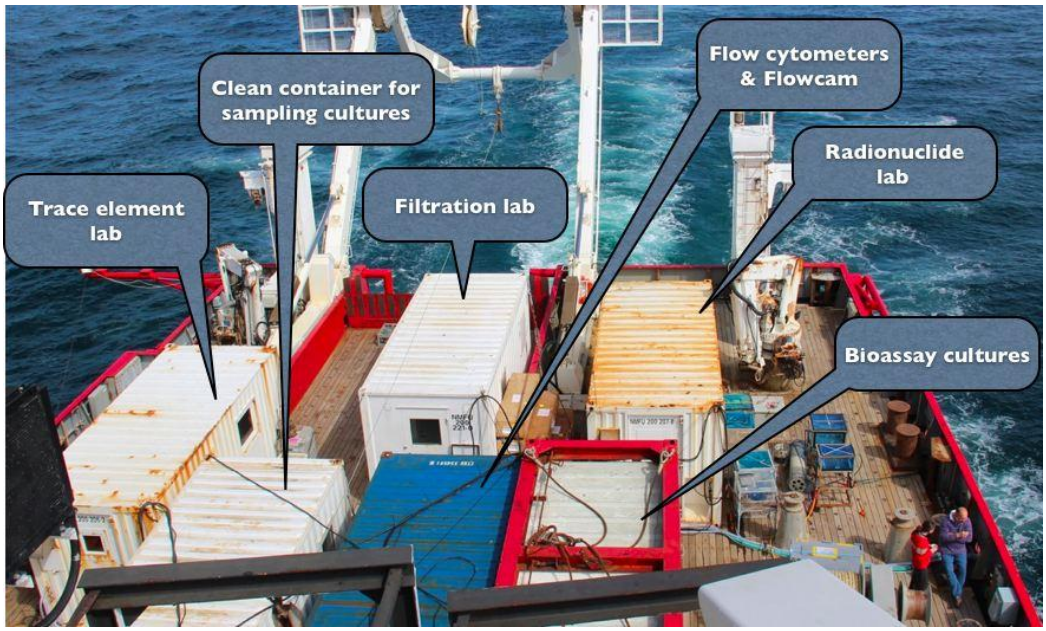
A full range of consortium core parameters was measured on water samples collected from depth profiles at most stations, and at least once each day. These samples encompassed wide range of environmental conditions, including temperature, ice-cover, carbonate chemistry, nutrients, productivity, and plankton composition.

Underway measurements were conducted throughout cruise except in ice-covered or shallow coastal waters. These included (i) continuous monitoring and discrete sampling of the *JCR*'s pumped sea water supply from 6 m depth, (ii) continuous monitoring of trace metal concentrations using the Towfish, and (iii) monitoring of zooplankton using a towed continuous plankton recorder (CPR). The cruise included the most northerly CPR sample collection undertaken to date.

Coccolithophore abundance throughout the cruise was very variable, including many samples in which they were virtually absent and others with "bloom" abundances. Coccolithophore populations were also variable in composition.

Five bioassay experiments were undertaken successfully. This was the maximum number logistically possible within the 33 cruise window. Initial conditions for experiments ranged from fully depleted dissolved inorganic nitrogen to high (~10 µM) concentrations, with initial chlorophyll concentrations from 0.3 to 3 µg l^{-1}, and high coccolithophore abundances in the second experiment (North Atlantic south of Iceland).

Preliminary on-ship data analysis indicated few clear trends in overall chlorophyll biomass between treatments within bioassays, and time series responses for chlorophyll were variable between bioassays. Acidification had no apparent effect on the rate of microbial leucine uptake or respiration, and there was no clear effect on DMS and DMSP concentrations.



View of the aft deck of the JCR showing positions of the laboratory containers and deck incubation tanks

SCIENTIFIC REPORT 1: NMF-SS Sensors & Moorings

Jeff Benson, Steve Whittle and Ben Poole

CTD system configuration

1) Two CTD systems were prepared; the first water sampling arrangement was a NOC 24-way stainless steel frame system, (s/n SBE CTD1) and the initial sensor configuration was as follows:

Sea-Bird 9plus underwater unit, s/n 09P-15759-0480
Sea-Bird 3P temperature sensor, s/n 03P-5645, Frequency 0 (primary)
Sea-Bird 4C conductivity sensor, s/n 04C-4087, Frequency 1 (primary)
Digiquartz temperature compensated pressure sensor, s/n 106017, Frequency 2
Sea-Bird 3P temperature sensor, s/n 03P-5623, Frequency 3 (secondary)
Sea-Bird 4C conductivity sensor, s/n 04C-4126, Frequency 4 (secondary)
Sea-Bird 5T submersible pump, s/n 05T-4709, (primary)
Sea-Bird 5T submersible pump, s/n 05T-4488, (secondary)
Sea-Bird 32 Carousel 24 position pylon, s/n 32-46833-0636
Sea-Bird 11plus deck unit, s/n 11P-20397-0502

2) The auxiliary input initial sensor configuration was as follows:

Sea-Bird 43 dissolved oxygen sensor, s/n 43-2290 (V0)
Tritech PA200 altimeter, s/n 244738 (V2)
Biospherical PAR irradiance sensor, DWIRR, s/n 7235 (V3)
WETLabs C-Star 25cm path transmissometer, s/n CST-1497DR (V6)
Chelsea MKIII Aquatracka fluorometer, s/n 088249 (V7)

3) Additional instruments:

Ocean Test Equipment 20L ES-120B water samplers, s/n's 1A -12A, 15A-21A, 24A, 26A, 34A, 45A, 47A
TRDI WorkHorse 300kHz LADCP, s/n 14897 (downward-looking)
BAS WorkHorse LADCP battery pack
Chelsea FRRF MKI, s/n 05-5335-001

4) Sea-Bird 9*plus* configuration file JR271_stainless.xmlcon was used for all stainless steel frame CTD casts. The LADCP command file used for all casts was SingleLADCP_script.

5) The second water sampling arrangement was a NOC 24-way titanium frame system, (s/n SBE CTD TITA2), and the initial sensor configuration was as follows:

Sea-Bird 9plus underwater unit, s/n 09P-39607-0803
Sea-Bird 3P temperature sensor, s/n 03P-4381, Frequency 0 (primary)
Sea-Bird 4C conductivity sensor, s/n 04C-2165, Frequency 1 (primary)
Digiquartz temperature compensated pressure sensor, s/n 93896, Frequency 2
Sea-Bird 3P temperature sensor, s/n 03P-4593, Frequency 3 (secondary)
Sea-Bird 4C conductivity sensor, s/n 04C-3272, Frequency 4 (secondary)
Sea-Bird 5T submersible pump, s/n 05T-5247, (primary)
Sea-Bird 5T submersible pump, s/n 05T-6320, (secondary)
Sea-Bird 32 Carousel 24 position pylon, s/n 32-24680-0346

6) The auxiliary input initial sensor configuration was as follows:

Sea-Bird 43 dissolved oxygen sensor, s/n 43-1940 (V0)
Chelsea MKIII Aquatracka fluorometer, s/n 88-2615-126 (V2)
Chelsea MKII 25cm path Alphatracka transmissometer, s/n 161047 (V3)
Tritech PA200 altimeter, s/n 6196.118171 (V4)
CTG 2pi PAR irradiance sensor, UWIRR, s/n PAR 02 (V5)
CTG 2pi PAR irradiance sensor, DWIRR, s/n PAR 04 (V6)
WETLabs light scattering sensor, s/n BBRTD-168 (V7)

7) Additional instruments:

Ocean Test Equipment 10L ES-110B trace metal-free water samplers, s/n's 1T through 24T
TRDI WorkHorse 300kHz LADCP, s/n 13399 (downward-looking)
NOC WorkHorse LADCP battery pack, s/n WH008T

8) Sea-Bird 9*plus* configuration file JR271_titanium.xmlcon was used for the first four titanium CTD casts. From cast 007t onwards JR271_titanium_oxy.xmlcon was the configuration file. The LADCP command file used for all casts was SingleLADCP_script.

9) The PAR sensors were not installed as the majority of deployments were deeper than 500 metres, and PAR profiles were obtained from the stainless steel casts on each station.

Other instruments

Autosal salinometer---One salinometer was configured for salinity analysis, and the instrument details are as below:

Guildline Autosal 8400B, s/n 65763, installed in Chemistry Laboratory as the primary instrument, Autosal set point 24C.

Fast Repetition Rate Fluorometer---One FRRF system was installed as follows:

Chelsea MKI, s/n 05-5335-001---Configured for CTD sampling, Protocol 1.

3) Stand Alone Pump System---SAPS were deployed on the core wire, serial numbers as follows:

03-02, 03-03, 03-04 and 03-05---Serial numbers 03-03 & 03-05 were deployed for 16 casts to a maximum depth of 165m. Pump delays were typically 42 minutes, with pump times set for 1 to 1.5 hours.

4) OTE 10L C-Free Water Samplers---Up to 12 samplers were deployed for the profiles, on a single wire, to a depth of up to 500 metres. All serial numbers, with the exception of s/n 05, were used for the casts. They were clamped to a plastic coated 6mm diameter wire, and opened/closed with plastic coated metallic messengers.

SCIENTIFIC REPORT 2: CTD data processing

Rachael Sanders and Matthew Palmer

Report Overview

This report contains information about the processing of CTD data from cruise JR271. Two CTDs were used; one on a titanium rosette with serial number 09P-39607-0803 and one on a stainless steel rosette with serial number 09P-15759-0480. The majority of the data was fine, however there were three main issues:

For the stainless steel CTD, the oxygen channels of different casts required different levels of alignment with temperature (see figure 5). An average correction was applied which will be too low for some casts, so caution should be applied when requiring high accuracy oxygen concentrations from this CTD.

Soaks were missing from some of the casts so a large amount of surface data had to be removed from these files. See Appendix B which casts and the amount of data removed.

For the titanium CTD, there was a lack of data for the bottle salinities and the available data showed an inconsistent offset in the salinity channel (see figure 6), so no correction could be applied. Caution should be applied when using high accuracy salinity from this CTD.

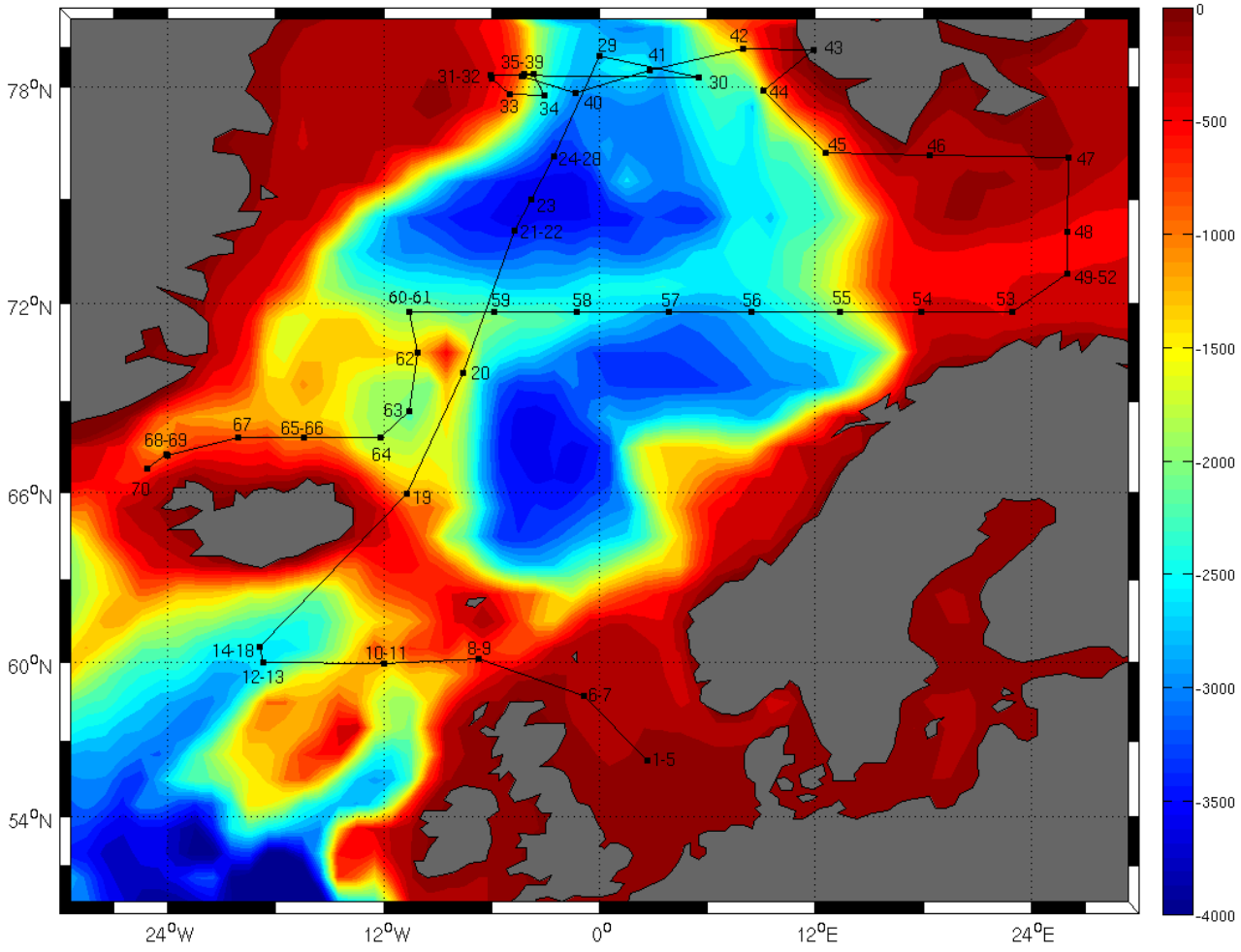


Figure 1: Location of CTD casts and bathymetry of the area in metres (TerrainBase, NGDC).

Data Conversion

Each raw CTD file was converted to ASCII format using the SBE Data Processing Software, SBE Data Conversion. The converted titanium CTD files contain time elapsed (s), pressure (db), depth (m), primary and secondary temperature (°C), primary and secondary conductivity (S/m), oxygen concentration (ml/l), raw oxygen (V), fluorescence (µg/l), PAR/irradiance, turbidity (m^{-1}/sr), sound velocity (m/s), voltage channels 0-7, beam attenuation (m^{-1}) and beam transmission (%). The converted stainless steel CTD files contain the same channels apart from turbidity and beam transmission, and have an added secondary sound velocity channel. For the conversion of oxygen concentration, a window size of 2 was used and tau and hysteresis corrections were applied.

Pressure

SBE Wild Edit was used to remove spikes in the pressure. Wild Edit was applied to the pressure and depth channels of each cast, flagging any values that differed from the mean by more than two standard deviations on the first pass, or more than twenty standard deviations on the second pass, using 100 scans per block.

Conductivity

In the majority of the casts, large conductivity spikes were present, so SBE Wild Edit was used on the primary and secondary conductivity channels. Any values that differed from the mean by more than four standard deviations on the first pass, or by more than twenty standard deviations on the second pass, using 100 scans per block, were flagged. This did not remove all visible spikes so the data was sorted through by hand. For each cast, the conductivity was plotted, and any obvious spikes that had not been flagged previously, were replaced with the mean of the adjacent conductivity values. See Appendix A for the index numbers of the replaced values.

Temperature Alignment

To ensure that later derivations would be done using the temperature and conductivity data from the same parcel of water, the alignment of the conductivity channels with temperature was checked for both CTDs. Using three randomly selected casts from the each CTD, the primary conductivity and temperature were plotted on the same axis against time, and the axes set up so that it was possible to see if any sudden changes in conductivity were aligned with those in the temperature channel (figures 2 and 3). The process was repeated for the secondary conductivity and temperature from the same casts.

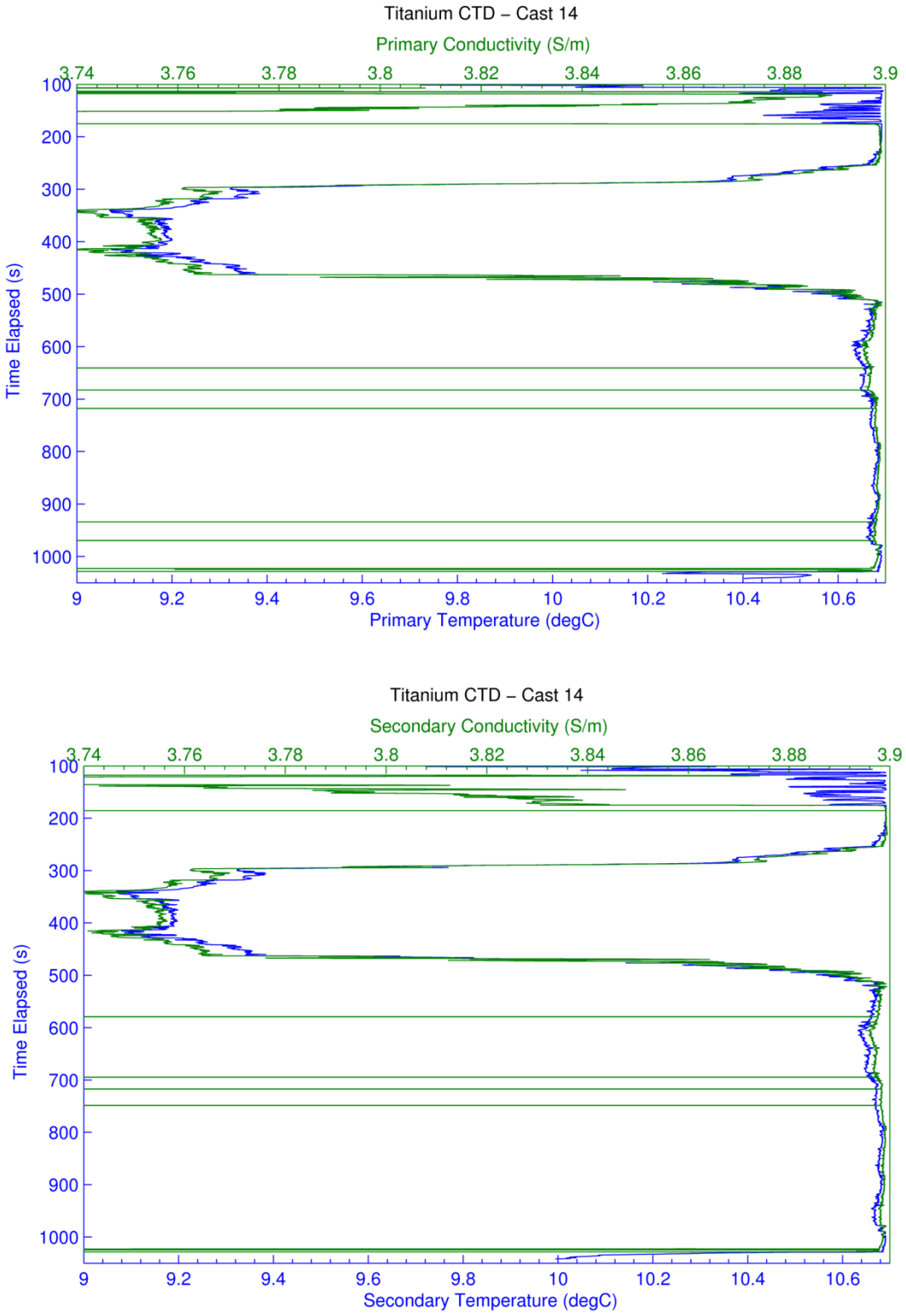


Figure 2: Conductivity and temperature plots for cast 14t. The upper plot shows the primary temperature and conductivity, and the lower plot the secondary.

No correction was required for the titanium CTD, as the changes in conductivity were well aligned with those in temperature (figure 2).

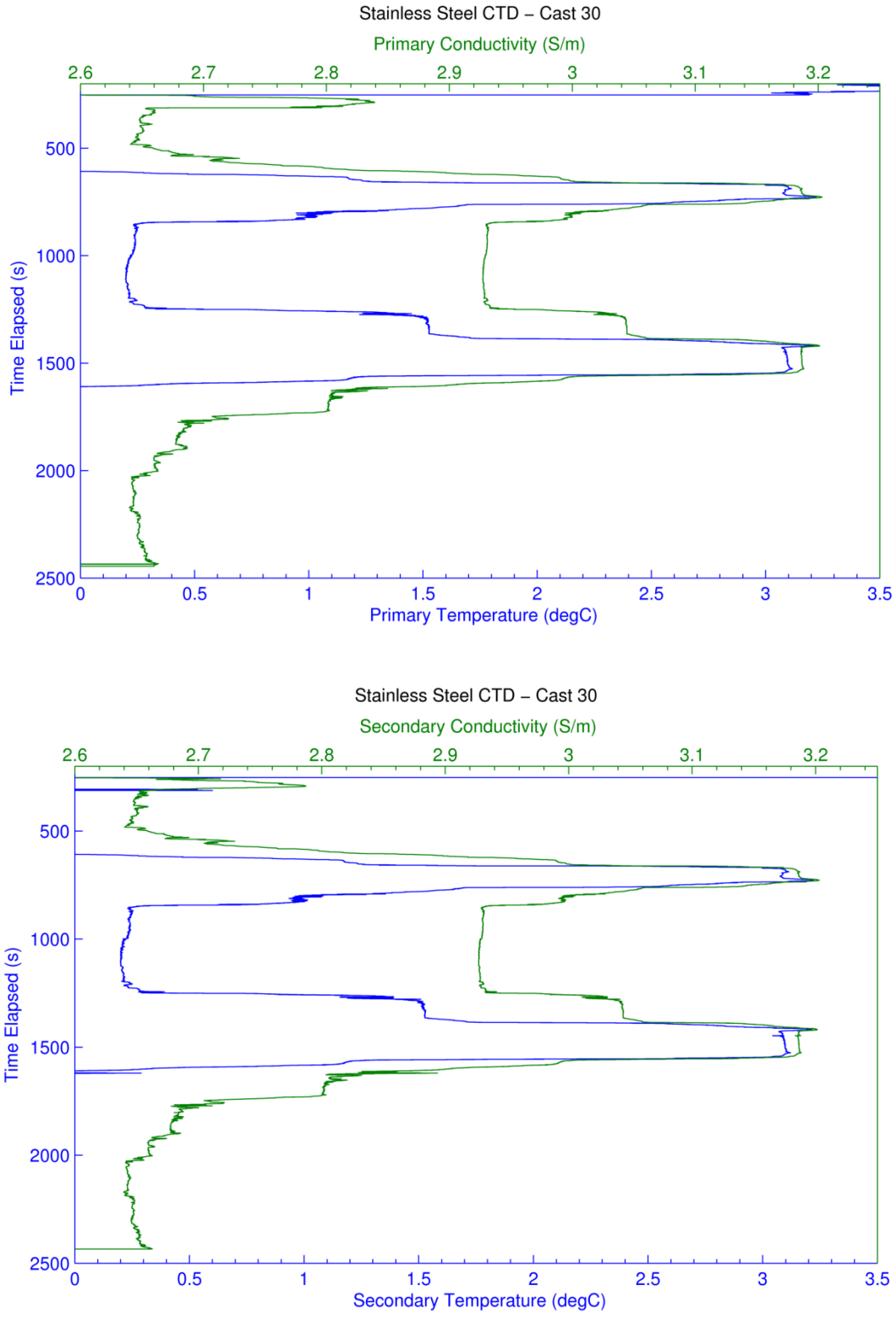


Figure 3: Conductivity and temperature plots for cast 30. The upper plot shows primary conductivity and temperature, and the lower plot the secondary.

No correction was required for the stainless steel CTD as the changes in conductivity aligned with those in temperature (figure 3).

Oxygen Alignment

To ensure that the oxygen concentration corresponded to the correct pressure, the alignment of the oxygen channel was checked for both CTDs. Oxygen concentration was plotted against temperature, with the up- and downcasts on the same axes; this was repeated for a selection of casts, including at least one deep one. Time adjustments were applied to the oxygen channel by shifting the values along with respect to pressure, and the data plotted again. These plots were then compared (figures 4 and 5) to find which time adjustment caused the up- and downcasts to show the most similarity.

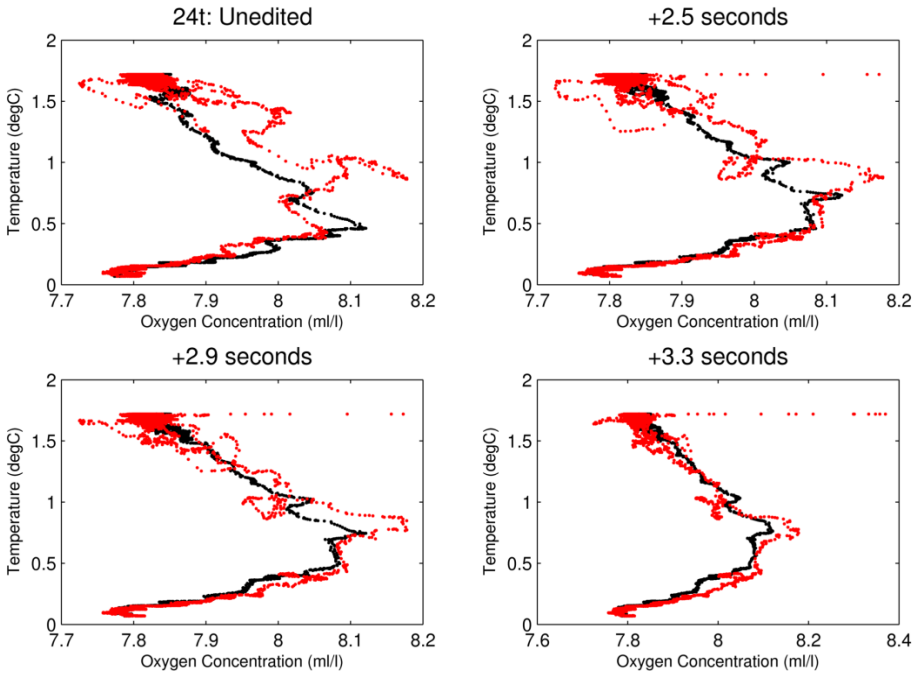


Figure 4a: Oxygen Alignment for the titanium CTD, cast 24. Black points show the downcast and red, the upcast

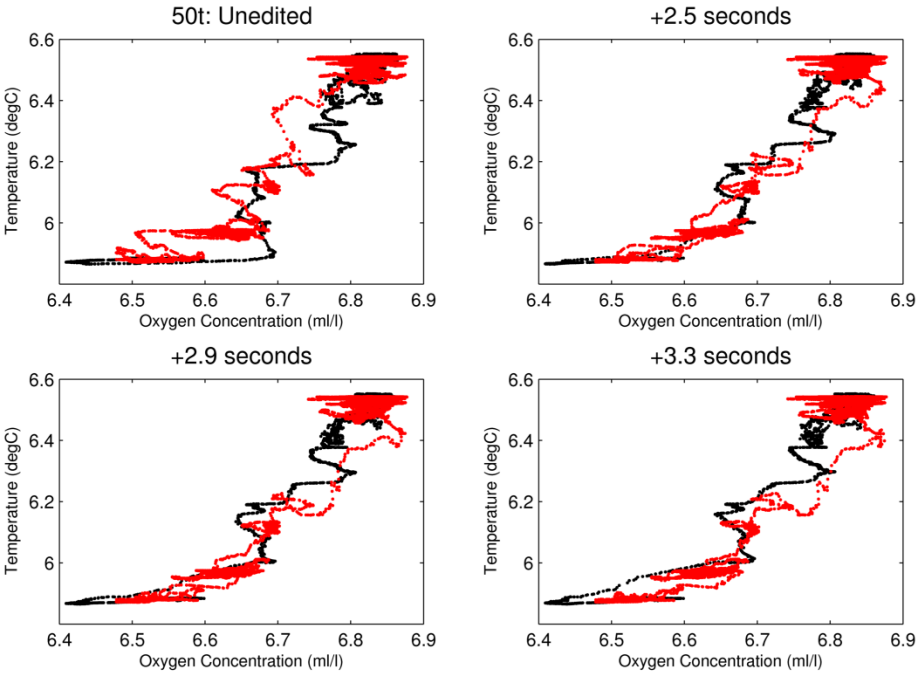


Figure 4b: Oxygen Alignment for the titanium CTD, cast 50. Black points show the downcast and red, the upcast.

For casts 24 and 50 of the titanium CTD, the difference between the up- and downcast was least when the oxygen channel was adjusted by 2.9 seconds (figure 4), so using SBE Align, a correction of 2.9 seconds was applied to the oxygen channel of each titanium CTD cast.

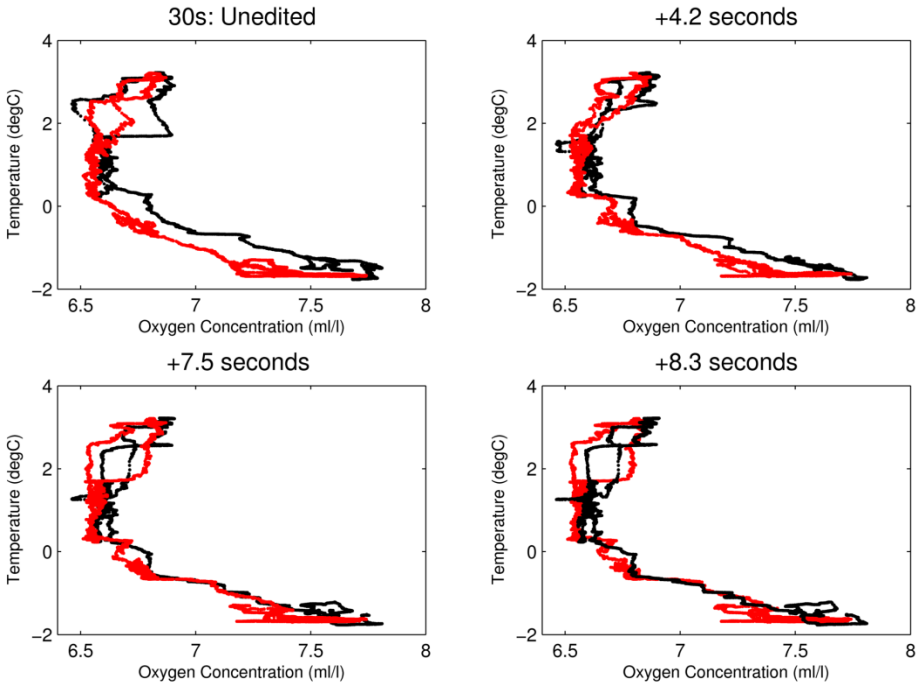


Figure 5a: Oxygen Alignment for stainless steel CTD, cast 30. Black points show the downcast, red, the upcast.

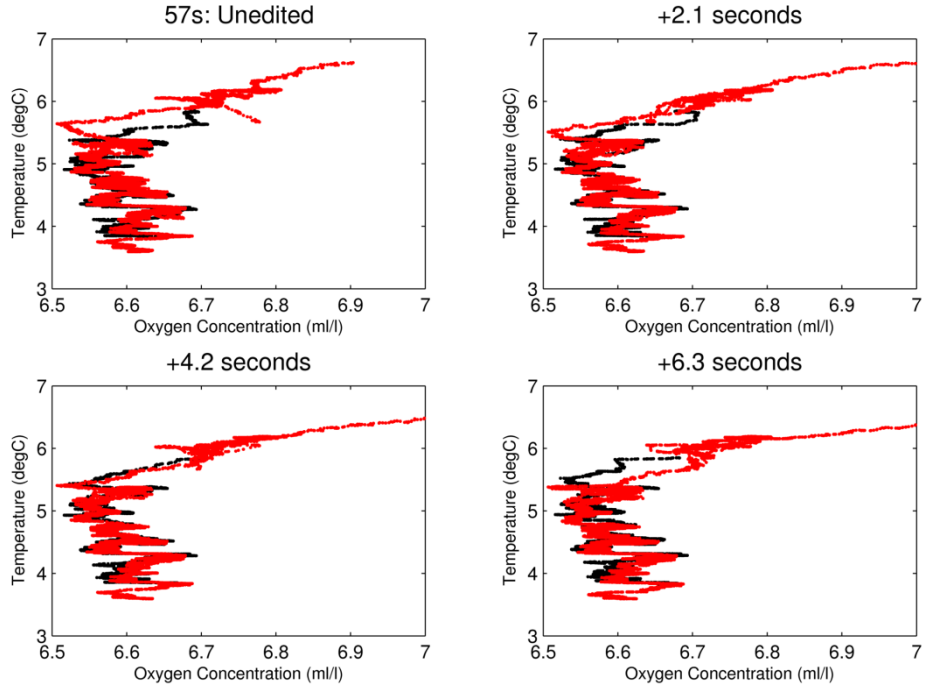


Figure 5b: Oxygen Alignment for stainless steel CTD, cast 57. Black points show the downcast, red, the upcast.

For cast 30s, the time correction needed for the stainless steel CTD was at least 8.3 seconds (figure 5a). For cast 57s, a time correction of 4.2 seconds was required (figure 5b). Because of this difference, each cast was plotted and the majority showed that a correction of around 4.2 seconds was best, so SBE align was used to correct the oxygen channel by 4.2 seconds. Since the oxygen channel will not be properly aligned for some of the stainless steel CTD casts, there may be some issues when requiring high accuracy oxygen data from this CTD.

Cell Thermal Mass Correction

SBE Cell Thermal Mass was used to remove conductivity cell thermal mass effects from the primary and secondary conductivity channels. The values used for the thermal anomaly amplitude and thermal anomaly constant were 0.03 and 7 respectively, following the instructions in 'Processing Sea-Bird 911 plus CTD data'.

Soak Removal

The soak was removed from each cast by inputting the index numbers for the end of the soak into SBE Section. Casts 14t, 15t, 16t, 18t and 4s had no soak. See Appendix B for the index number at which each soak was removed.

Derivations

SBE Derive was used to derive the depth, nitrogen saturation, oxygen concentration, primary and secondary practical salinity, primary and secondary density and the primary and secondary sigma t values. For the derivation of oxygen, a window size of 2 was used and tau and hysteresis corrections were applied.

Bin Averaging

SBE Bin Average was used to separate the data into 1m bins. Three files were produced for each cast – one for the downcast, one for the up, and one for the complete cast.

For each complete cast file, the surface bin minimum value used was 1m. This was the same for each up- and downcast file except in the case of casts 14t, 66t, 69t, 33s and 40s. For 14t, 66t, 69t and 40s, the surface bin minimum value for the upcast was 3m, and for 33s, the downcast value was 5m. These values were used due to unreliable data for the derived variables being observed below 1m.

The surplus depth and oxygen channels were then removed from each file using SBE Strip.

Salinity Correction

The error and drift in the salinity channel was calculated using an Excel spreadsheet (see Appendix C) provided by Dr. Jeffrey Benson (NOCS). The values provided for the average measured conductivity, were multiplied by two and entered into SBE SeaCalc to determine the values for the 'autosal' bottle salinity. The primary and secondary CTD salinity values taken from the .btl files were then subtracted from their corresponding bottle salinity to calculate the primary and secondary error. Note, some bottle salinity values could not be calculated due to missing conductivity data from crates 17 (8th June) and A (12th-19th June). Two bottles were also labelled as 3-15, one labelled 3-10 and another 3-10-2, so none of these bottles were used.

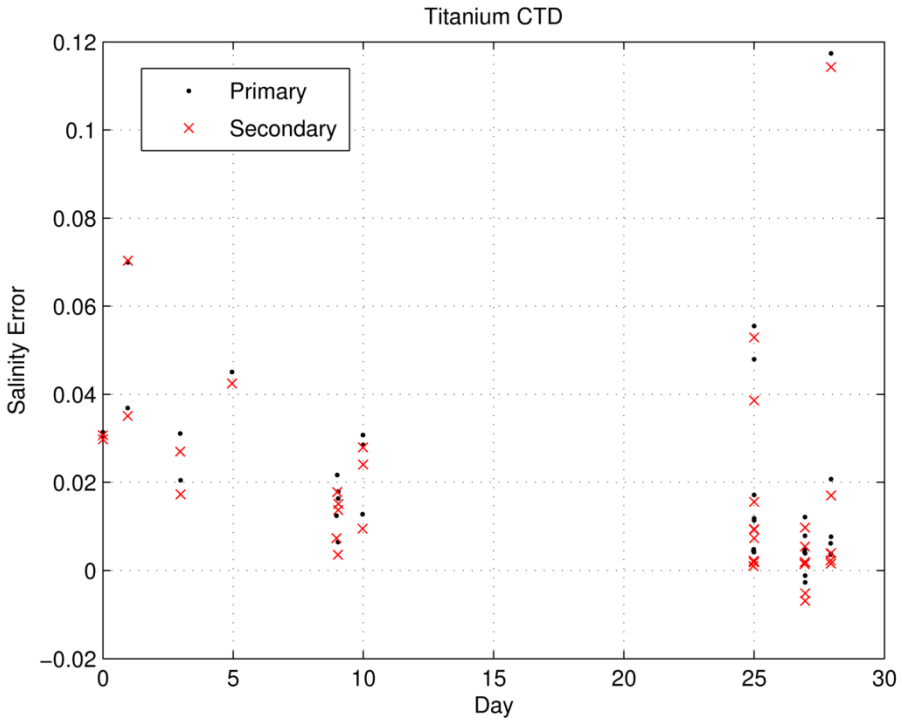


Figure 6: Error in the salinity data taken from the titanium CTD.

There was inconsistent offset in the salinity data from the titanium CTD (figure 6) so no correction could be applied to the salinity channel. Caution should be applied when requiring high accuracy salinity data from the titanium CTD.

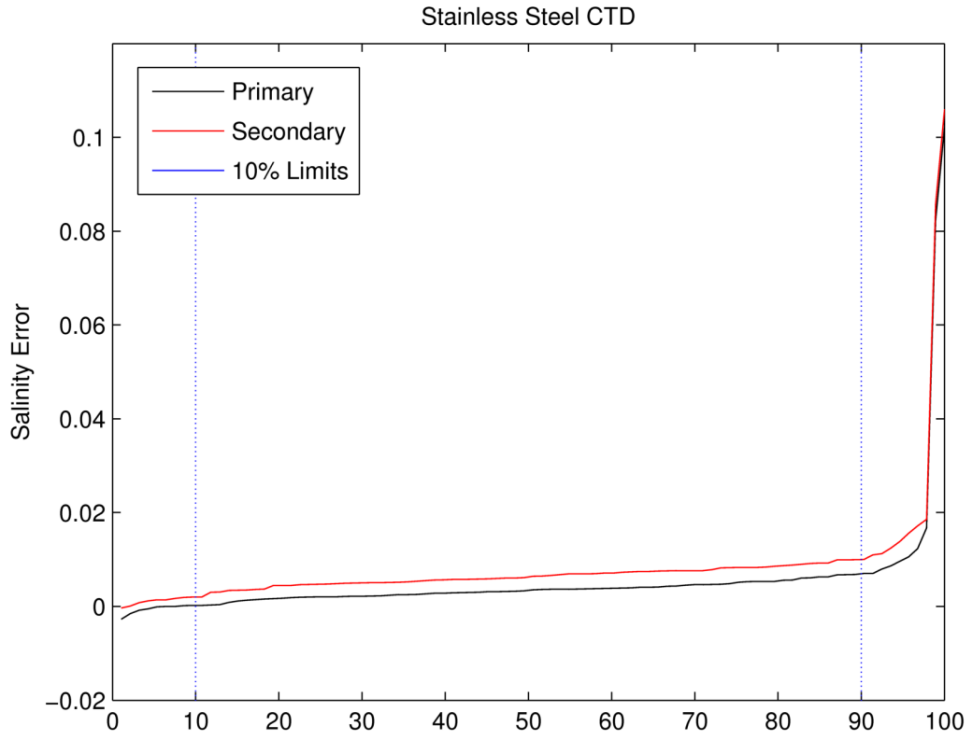


Figure 7: Salinity Error in the stainless steel CTD in ascending order.

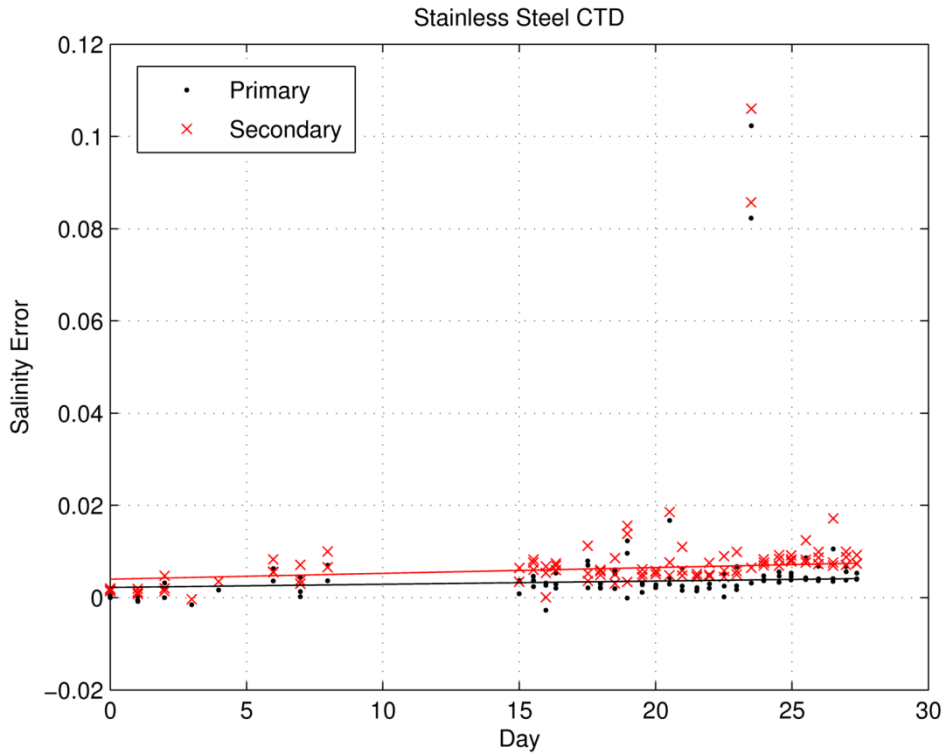


Figure 8: Salinity Error in the stainless steel CTD.

There was a consistent drift in the salinity channel of the stainless steel CTD (figure 8). To calculate the drift and offset in the data, a polynomial regression of order one was used; to prevent any anomalous values affecting the corrections, the regression was only used once the lower and upper 10% of the error had been disregarded. The 10% limits were chosen because the increase in the error was reasonably constant between these points (figure 7).

The values obtained for the gradient and intercept of the line for the primary error were $6.914*10^{-5}$ and $2.217*10^{-3}$ respectively, and the values obtained for the gradient and intercept of the line for secondary error were $1.264*10^{-4}$ and $4.005*10^{-3}$.

Where Day0 is June 4th 2012, the corrected primary salinity was calculated using:

Corrected Salinity = Salinity+Day*$6.914*10^{-5}$+$2.217*10^{-3}$

and the corrected secondary salinity was calculated using:

Corrected Salinity = Salinity+Day*$1.264*10^{-4}$+$4.005*10^{-3}$

Oxygen Correction

Spreadsheets containing the bottle oxygen concentrations were provided by Chris Daniels (NOCS), the average bottle concentrations (where two had been calculated at a single depth) were calculated and converted from µmol/l to ml/l by dividing by 44.66 (divided by the molar density of O_2 at standard temperature and pressure and multiplied by 10^{-3}).

The error in the oxygen channel of each CTD was then calculated by subtracting the CTD oxygen concentration from the corresponding average bottle concentration. Any flagged error values were ignored when calculating the correction in the oxygen channel.

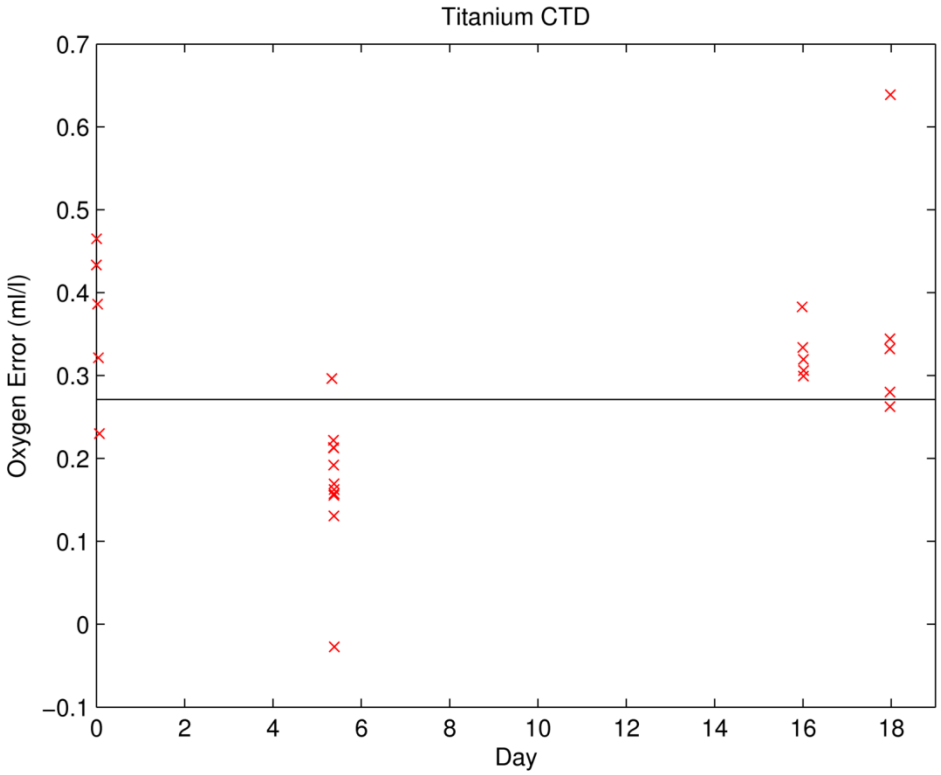


Figure 9: Oxygen error in the titanium CTD. The black line shows the average error, ignoring the lower and upper 10% of the values.

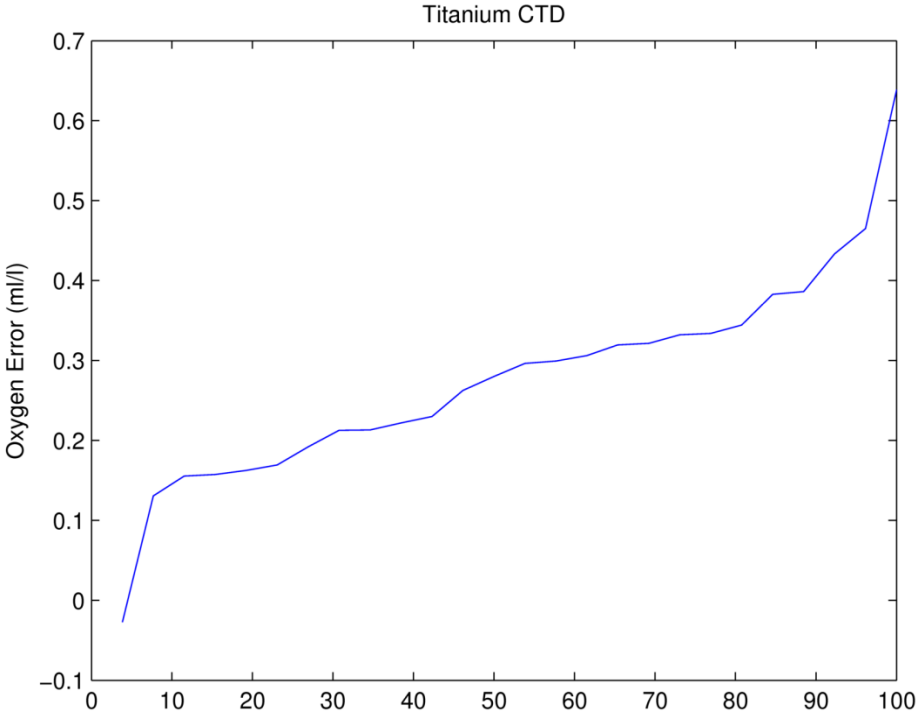


Figure 10: Oxygen error in the titanium CTD in ascending order.

Since there was no significant drift in the oxygen sensor for the titanium CTD, only an offset (figure 9), and there was major increase in the oxygen error in the lower and upper 10% (figure 10), the average offset was calculated, ignoring the lower and upper 10% of the data. This value was

0.2711ml/ = $C(O_2)$
+ 0.2711.

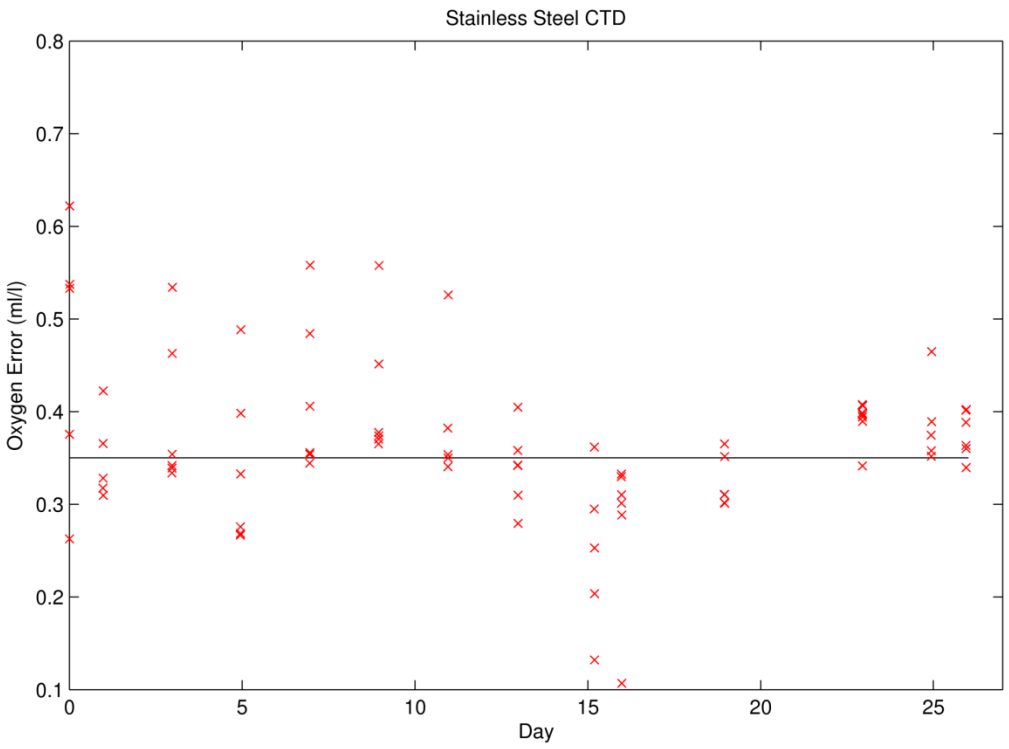


Figure 11: Oxygen error in the stainless steel CTD. The black line shows the average error, ignoring the lower 10% and upper 20% of the values.

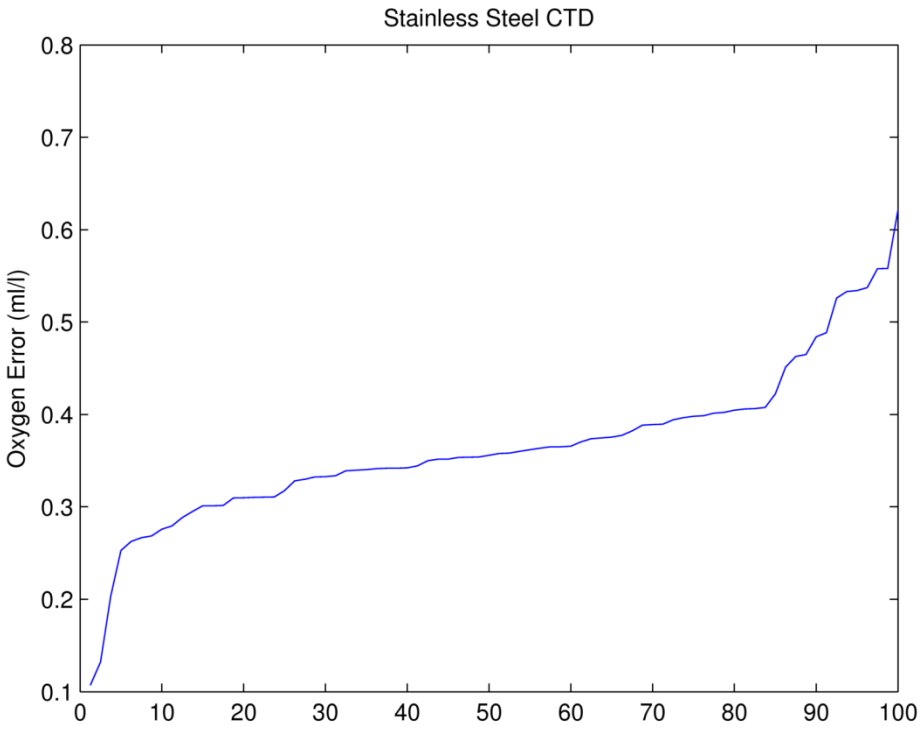


Figure 12: Oxygen error in the stainless steel CTD in ascending order.

There was no significant drift in the oxygen sensor of the stainless steel CTD, only an offset (figure 11) and the error rises significantly in the lower 10% and upper 20% (figure 12), so a mean offset

was calculated, ignoring the lower 10% and upper 20% of the values and found to be 0.3501ml/l. The oxygen channel in the stainless steel CTD was corrected using: Corrected $C(O_2) = C(O_2) + 0.3501$.

Oxygen Saturation

The oxygen saturation in ml/l was calculated using the following equation (Garcia and Gordon, 1992):

$$O_2Sat = \exp\{A_0+A_1(Ts)+A_2(Ts)^2+A_3(Ts)^3+A_4(Ts)^4+A_5(Ts)^5+S*[B_0+B_1(Ts)+B_2(Ts)^2+B_3(Ts)^3]+C_0(S)^2\}$$

Where:

O_2Sat = Oxygen Saturation (ml/l)
S = Salinity (psu)
T = Water Temperature (°C)
$Ts = \ln[(298.15–T) / (273.15+T)]$
$A_0 = 2.00907$, $A_1 = 3.22014$, $A_2 = 4.0501$, $A_3 = 4.94457$, $A_4 = - 0.256847$, $A_5 = 3.88767$
$B_0 = -0.00624523$, $B_1 = -0.00737614$, $B_2 = -0.010341$, $B_3 = -0.00817083$
$C_0 = -0.000000488682$

The percentage oxygen saturation was then calculated using:

O_2Sat (%) = (Corrected Oxygen concentration/Oxygen saturation)*100% and an oxygen saturation channel was added to each of the CTD files.

APPENDIX A: List of index numbers of conductivity values removed and replaced with the mean of the adjacent values.

Titanium CTD:

1t: Conductivity 1 - 16571
Conductivity 2 - 15710, 18185, 18187

2t: Conductivity 1 - 13644
Conductivity 2 - 8285, 8288, 10947, 10996-10997, 16647

3t: Conductivity 1 - 5719-5724

5t: Conductivity 1 - 14935-14937, 25886, 26709, 27608-27611, 27135-27136
Conductivity 2 - 14766-14767, 18928-18929 27301-27302, 27415, 28440

7t: Conductivity 1 - 8035-8036, 13287, 15416, 15642, 16251-16252, 17629, 17631, 18561-18562
Conductivity 2 - 9855, 15934, 20498

9t: Conductivity 2 - 16941, 16943, 70911

11t: Conductivity 1 - 13027, 14199-14200, 87162, 87164, 90008
Conductivity 2 - 88480-88481, 90113, 90998-90100

13t: Conductivity 1 - 173092, 174881
Conductivity 2 - 46735, 48286, 48289, 13864, 13866, 173162-173163, 175135

14t: Conductivity 1 - 4894, 17565, 23604, 13747-13748, 22751, 22753, 5018, 22012-22013, 21931, 15715
Conductivity 2 - 4791, 4794, 6513-6514, 13079-13081, 16787, 17014, 18305, 18307, 20239-20240, 5038-5039, 8293-8295, 21970, 20741, 21723, 21716, 21969-2197

15t: Conductivity 1 - 20048-20049, 17868, 18255, 18347, 18349, 24363
Conductivity 2 - 4730, 4732, 17259, 17261, 17329-17330, 18330, 21642, 21644, 24411, 24626, 24628, 25526, 25528

16t: Conductivity 1 - 4888, 4890, 15769, 15948, 17069, 17071, 18088, 9651, 15292
Conductivity 2 - 7645-7647, 9537, 9538, 9731, 19343, 19839, 17827, 17829, 8235, 19342-19344, 17033

18t: Conductivity 1 - 5485
Conductivity 2 - 5596, 76090, 78420

22t: Conductivity 2 - 132090-123091

26t: Conductivity 1 - 2947-2949
Conductivity 2 - 2946, 2948-2951

28t: Conductivity 1 - 83029, 93031
Conductivity 2 - 15444-15446, 66629-66630, 76903, 76966, 76968, 77121-77122

34t: Conductivity 1 - 22157, 184928, 184930, 203728-203729
Conductivity 2 - 22696, 22698, 171490-171492

35t: Conductivity 1 - 17160, 23748-23750
Conductivity 2 - 7786

36t: Conductivity 1 - 7679
Conductivity 2 - 5989-5991, 7952, 7954, 25126

37t: Conductivity 2 - 15676, 18645-18647

49t: Conductivity 1 - 6064, 6985-6986, 15173, 15175, 27074-27076, 27927, 22291, 22293, 29874, 18961, 28773, 12791-12794
Conductivity 2 - 22825-22826, 26896, 27486-27487, 29206, 30691-30692

50t: Conductivity 1 - 16114, 19242, 20092, 20094
Conductivity 2 - 16300, 18793, 18795, 20787

51t: Conductivity 1 - 5073-5079, 15307, 16187, 16189, 27355, 9492-9493, 20811
Conductivity 2 - 2118-2120, 5681-5682, 11571, 16164, 23882, 27069, 17798, 17811

61t: Conductivity 2 - 162928, 162930

66t: Conductivity 1 - 64605-64606
Conductivity 2 - 24309, 24311, 68904-68905

69t: Conductivity 2 - 36414

Stainless Steel CTD:

4s: Conductivity 1 - 11456-11459, 13132-13134, 5154-5156, 6132-6134, 25243, 24915-24916, 3311-3312, 3860, 3862
Conductivity 2 - 3104-3105, 3955-3956, 16044-16045, 12523-12525, 18781, 11704, 11696, 6851, 12961-12962, 4389, 30322, 30324

6s: Conductivity 1 - 16813-16814, 13058, 22416, 15269
Conductivity 2 - 11261, 11263, 12141, 17962-17964, 15200-15202, 9104-9106, 9158-9160, 9213-9214, 21379, 21381, 10132, 16817

8s: Conductivity 1 - 42447
Conductivity 2 - 7678-7680, 7122-7127, 32792, 36924-36925, 24364-24365, 37433, 37435
10s: Conductivity 1 - 36702
Conductivity 2 - 26967, 46801-46803, 49504, 49506-49507, 47154-47155, 47567-57568, 45843-45845
12s: Conductivity 1 - 6820, 39394, 39396, 41425-41427, 40740-40741, 44753-44754, 41943, 41945-41946
Conductivity 2 - 83794-83795, 43057-43058, 45675, 45678
17s: Conductivity 1 - 31407-31410, 41537, 41540
Conductivity 2 - 38843, 39171-39173, 45257, 45259, 39637, 39639
20s: Conductivity 2 - 44152-44155
23s: Conductivity 1 - 4140-4142, 11544
29s: Conductivity 1 - 38420, 38422, 38258
Conductivity 2 - 36041-36042, 39233-39234, 38946-38947, 38592-38593
31s: Conductivity 1 - 39794-39795
Conductivity 2 - 38119-38120
32s: Conductivity 1 - 32338-32340, 41615, 41617-41618, 38489-38491, 46902-46903
Conductivity 2 - 5654, 38317, 38319
33s: Conductivity 2 - 51687
39s: Conductivity 1 - 5739-5741
Conductivity 2 - 5124
40s: Conductivity 1 - 60514, 60626, 60746, 49125-49126, 51385-51386, 51457-51459, 57565, 51274, 51276, 48792, 48794, 55164, 55167
Conductivity 2 - 6822-6823, 6879, 41186, 41188, 57960-57962, 56556-56558, 53528-53529, 54365-54366, 56565-56566, 52138-52139, 55395-55397, 48058, 58774-58775, 49324-49325, 52180-52181, 55002-55003
41s: Conductivity 2 - 6605, 37100-37101
42s: Conductivity 1 - 23997-23999
Conductivity 2 - 43865-43866
43s: Conductivity 1 - 8777-8779, 30258-30259, 10042-10043
Conductivity 2 - 32714, 33322-33324, 30204-30205
45s: Conductivity 1 - 9748
46s: Conductivity 1 - 37450-37452, 38473-38474, 38476, 37576-37577, 40358-40359, 41529-41530
Conductivity 2 - 41107, 9663, 37415, 39430, 38788-38789, 38880, 42989-42991, 41210, 41212
48s: Conductivity 1 - 43279-43280
Conductivity 2 - 31923-31924
52s: Conductivity 1 - 34482, 34484-34485, 34881, 34884, 38948-38953, 40247-40249, 48186, 48188, 43575, 43577, 43759-43761, 42077, 42708-42715, 41323, 38682, 38685, 38904, 41678-41680, 46583-46585, 47702, 47704
Conductivity 2 - 35522-35524, 35531-35533, 37253-37254, 38479, 38481, 41315-41317, 44597-44599, 37895-37897, 40034-40036, 41488, 48061-48063, 48115, 45780-45782 47047-47048, 47465-47467, 48959-48960, 47450-47452
54s: Conductivity 1 - 28957-28958
Conductivity 2 - 35700, 35702, 7082-7083
55s: Conductivity 2 - 19006-19007, 46734-46735
56s: Conductivity 1 - 54137-54139, 7656-7658
Conductivity 2 - 30866-30867
57s: Conductivity 1 - 4788, 28970-28972
Conductivity 2 - 28265-28266
58s: Conductivity 2 - 15912, 15914, 56815
59s: Conductivity 2 - 19708-19709
60s: Conductivity 2 - 30551
62s: Conductivity 2 - 7119-7120, 18761-18763
63s: Conductivity 1 - 41711-41713, 14597
Conductivity 2 - 7642-7643, 13488
64s: Conductivity 1 - 54629-54633
67s: Conductivity 1 - 21006, 47016-47018
68s: Conductivity 1 - 55453-55455, 47843, 47845
Conductivity 2 - 16741-16743, 13412-13413, 16357-16359
70s: Conductivity 2 - 10668-10670

APPENDIX B: List of index numbers at which the earlier data was removed due to the soak.

Titanium Rosette:

1t - 17750
2t - 9377
3t - 6265
5t - 11233
7t - 5900
9t - 5500
11t - 9420
13t - 5200
14t - 4900 (no soak)
15t - 4010 (no soak)
16t - 3525 (no soak)
18t - 4870 (no soak)
22t - 5240
24t - 4578
25t - 3975
26t - 3735
28t - 11820
34t - 8350
35t - 6470
36t - 7940
37t - 4440
38t - 3815
49t - 5885
50t - 4270
51t - 3130
61t - 6040
66t - 4190
69t - 6650

Stainless Steel Rosette:

4s - 1600 (no soak)
6s - 4840
8s - 4800
10s - 9415
12s - 7240
17s - 4520
19s - 4400
20s - 4450
21s - 4700
23s - 4410
27s - 4100
29s - 5120
30s - 9880
31s - 4450
32s - 5480
33s - 4920
39s - 5050
40s - 5200
41s - 5800
42s - 4980
43s - 5400
44s - 7125
45s - 4500
46s - 6460
47s - 6600
48s - 5680
52s - 4440
53s - 5000
54s - 5250
55s - 4850
56s - 4600
57s - 5840
58s - 4600
59s - 3950
60s - 4380
62s - 4500
63s - 3850
64s - 3350
65s - 5550
67s - 5050
68s - 4400
70s – 5800

APPENDIX C: Salinity data from the titanium and stainless steel CTD

CTD Station No.	CTD Type	Sample Bottle No.	Julian Day/Time (GMT)	Autosal Corrected S	Primary SBE S	Primary SBE Error	Secondary SBE S	Secondary SBE Error	Primary Error - Secondary Error
E05	t	1, 7-7	155/0904	35.1604	35.1300	0.03039	35.1297	0.03069	0.0003
E05	t	15, 7-8	155/0912	35.1354	35.1040	0.03137	35.1056	0.02977	-0.0016
2	s	1, 3-1	156/0658	35.3343	35.3343	0	35.3329	0.0014	0.0014
2	s	3, 3-2	156/0701	35.3343	35.3339	0.0004	35.3323	0.002	0.0016
2	s	5, 3-3	156/0703	35.3251	35.3249	0.0002	35.3234	0.0017	0.0015
2	t	1, 7-5	156/0803	35.3717	35.3348	0.0369	35.3366	0.0351	-0.0018
2	t	8, 7-6	156/0813	35.4021	35.3322	0.0699	35.3318	0.07033	0.0004
3	s	2, 3-4	157/0715	35.4078	35.4083	-0.0005	35.4066	0.0012	0.0017
3	s	3, 3-5	157/0719	35.4350	35.4347	0.0003	35.4331	0.0019	0.0016
3	s	5, 3-6	157/0721	35.4378	35.4386	-0.0008	35.4370	0.0008	0.0016
4	s	1, 3-7	158/0647	35.2627	35.2627	0	35.2613	0.0014	0.0014
4	s	3, 3-8	158/0651	35.2962	35.2930	0.00321	35.2915	0.00471	0.0015
4	s	5, 3-16	158/0655	35.2765	35.2745	0.002	35.2745	0.002	0
4	t	3, 7-9	158/0821	35.2774	35.2463	0.03109	35.2504	0.02699	-0.0041
4	t	12, 7-10	158/0846	35.3294	35.3089	0.02048	35.3121	0.01728	-0.0032
5	s	3, 3-14	159/0648	35.1924	35.1939	-0.00155	35.1927	-0.00035	0.0012
6	s	3, 3-11	160/0625	35.1763	35.1746	0.00167	35.1728	0.00347	0.0018
6	t	24, 7-23	160/0806	35.2515	35.2065	0.04504	35.2091	0.04244	-0.0026
7	s	1, 3-17	162/0630	34.8794	34.8758	0.0036	34.8738	0.0056	0.002
7	s	3, 3-18	162/0634	34.8268	34.8207	0.0061	34.8185	0.0083	0.0022
7	s	5, 3-19	162/0636	34.8334	34.8271	0.0063	34.8279	0.0055	-0.0008
8	s	1, 3-20	163/0618	34.8968	34.8966	0.0002	34.8938	0.003	0.0028
8	s	3, 3-21	163/0622	34.9465	34.9420	0.0045	34.9394	0.0071	0.0026
8	s	5, 3-22	163/0624	34.9730	34.9717	0.0013	34.9693	0.0037	0.0024
9	s	1, 3-23	164/0619	34.9170	34.9133	0.00368	34.9104	0.00658	0.0029
9	s	4, 3-24	164/0622	34.9176	34.9106	0.00701	34.9076	0.01001	0.003
9	t	1, 7-3	164/0820	34.9226	34.9102	0.01243	34.9153	0.00733	-0.0051
9	t	7, 7-4	164/0904	34.9303	34.9086	0.02169	34.9125	0.01779	-0.0039
9	t	14, 7-21	164/0942	34.9170	34.9105	0.00648	34.9134	0.00358	-0.0029
9	t	18, 7-22	164/0956	34.9223	34.9059	0.01637	34.9085	0.01377	-0.0026
9	t	24, 7-24	164/1003	34.9144	34.8965	0.01792	34.8993	0.01512	-0.0028
10	t	1, 7-13	165/0822	34.9190	34.9062	0.01278	34.9095	0.00948	-0.0033
10	t	6, 7-14	165/0845	34.9528	34.9221	0.03073	34.9249	0.02793	-0.0028
10	t	11, 7-15	165/0854	34.9544	34.9259	0.02848	34.9303	0.02408	-0.0044
19	s	3, 2-1	171/0657	34.9807	34.9798	0.00086	34.9772	0.00346	0.0026
19	s	5, 2-2	171/0701	35.0217	35.0180	0.00372	35.0153	0.00642	0.0027
20	s	1, 2-3	171/1920	34.9391	34.9345	0.00464	34.9315	0.00764	0.003
20	s	3, 2-4	171/1925	35.0643	35.0605	0.00375	35.0582	0.00605	0.0023
20	s	5, 2-5	171/1927	35.0723	35.0699	0.00238	35.0640	0.00828	0.0059
21	s	1, 2-6	172/0618	35.0161	35.0129	0.00316	35.0093	0.00676	0.0036
21	s	4, 2-7	172/0623	35.0858	35.0885	-0.00271	35.0857	9E-05	0.0028
21	s	5, 2-8	172/0626	35.1310	35.1283	0.00268	35.1256	0.00538	0.0027
22	s	1, 2-16	172/1510	34.9839	34.9819	0.00204	34.9765	0.00744	0.0054
22	s	3, 2-15	172/1510	34.9836	34.9807	0.00288	34.9776	0.00598	0.0031
22	s	6, 2-14	172/1513	34.9935	34.9882	0.00532	34.9866	0.00692	0.0016
25	s	1, 2-13	173/1915	35.0905	35.0825	0.00795	35.0792	0.01125	0.0033
25	s	3, 2-12	173/1919	35.0762	35.0692	0.00701	35.0726	0.00361	-0.0034
25	s	5, 2-11	173/1923	35.0769	35.0748	0.00214	35.0717	0.00524	0.0031
26	s	1, 2-10	174/0618	34.9559	34.9537	0.00223	34.9502	0.00573	0.0035
26	s	3, 2-9	174/0624	35.0550	35.0530	0.00203	35.0501	0.00493	0.0029
26	s	5, 2-17	174/0629	35.1314	35.1284	0.00304	35.1254	0.00604	0.003
27	s	1, 2-18	174/1905	35.0664	35.0644	0.00195	35.0613	0.00505	0.0031
27	s	3, 2-19	174/1908	35.0893	35.0832	0.00606	35.0862	0.00306	-0.003
27	s	5, 2-20	174/1911	35.0672	35.0620	0.00517	35.0586	0.00857	0.0034

CTD Station No.	CTD Type	Sample Bottle No.	Julian Day/Time (GMT)	Autosal Corrected S	Primary SBE S	Primary SBE Error	Secondary SBE S	Secondary SBE Error	Primary Error - Secondary Error
28	s	1, 2-21	175/0556	34.8667	34.8668	-8E-05	34.8633	0.00342	0.0035
28	s	3, 2-22	175/0559	34.7644	34.7548	0.00962	34.7506	0.01382	0.0042
28	s	5, 2-23	175/0602	34.7163	34.7040	0.01229	34.7007	0.01559	0.0033
29	s	1, 2-24	175/1905	35.0506	35.0494	0.00116	35.0461	0.00446	0.0033
29	s	3, 3-1	175/1910	35.0948	35.0916	0.00323	35.0887	0.00613	0.0029
29	s	5, 3-2	175/1912	35.1067	35.1039	0.0028	35.1016	0.0051	0.0023
30	s	1, 3-4	176/0659	35.0903	35.0880	0.00227	35.0846	0.00567	0.0034
30	s	3, 3-3	176/0704	35.1356	35.1334	0.00215	35.1305	0.00505	0.0029
30	s	5, 3-5	176/0707	35.1246	35.1218	0.00279	35.1188	0.00579	0.003
31	s	1, 3-6	176/1906	35.1408	35.1379	0.00294	35.1360	0.00484	0.0019
31	s	3, 3-7	176/1911	35.0591	35.0548	0.00434	35.0515	0.00764	0.0033
31	s	5, 3-8	176/1914	34.9818	34.9650	0.01675	34.9632	0.01855	0.0018
32	s	2, 3-9	177/0615	35.1636	35.1620	0.00158	35.1588	0.00478	0.0032
32	s	3, 3-10	177/0618	35.1477	35.1452	0.00249	35.1418	0.00589	0.0034
32	s	5, 3-11	177/0621	35.0556	35.0493	0.00628	35.0446	0.01098	0.0047
33	s	1, 3-12	177/1910	35.0768	35.0753	0.00146	35.0721	0.00466	0.0032
33	s	3, 3-13	177/1914	35.1491	35.1469	0.00216	35.1439	0.00516	0.003
33	s	5, 3-14	177/1919	35.1691	35.1672	0.00186	35.1646	0.00446	0.0026
34	s	1, 3-15	178/0607	35.0465	35.0416	0.00485	35.0389	0.00755	0.0027
34	s	3, 3-16	178/0612	35.1418	35.1397	0.00206	35.1368	0.00496	0.0029
34	s	5, 3-17	178/0617	35.1583	35.1553	0.00298	35.1536	0.00468	0.0017
35	s	1, 3-18	178/1907	35.0641	35.0588	0.00527	35.0551	0.00897	0.0037
35	s	3, 3-19	178/1911	35.1344	35.1342	0.00016	35.1299	0.00446	0.0043
35	s	5, 3-20	178/1916	35.1463	35.1438	0.00252	35.1405	0.00582	0.0033
36	s	1, 3-21	179/0610	34.9070	34.9053	0.00173	34.9020	0.00503	0.0033
36	s	4, 3-22	179/0615	34.8986	34.8961	0.00254	34.8929	0.00574	0.0032
36	s	5, 3-23	179/0619	34.9602	34.9535	0.00672	34.9503	0.00992	0.0032
37	s	1, 3-24	179/1901	34.9918	34.9095	0.08229	34.9061	0.08569	0.0034
37	s	3, 7-1	179/1907	34.9988	34.8965	0.10231	34.8928	0.10601	0.0037
37	s	5, 7-2	179/1912	34.8922	34.8890	0.00317	34.8857	0.00647	0.0033
38	s	1, 7-3	180/0603	34.9221	34.9184	0.00368	34.9151	0.00698	0.0033
38	s	3, 7-4	180/0608	34.9000	34.8953	0.00471	34.8917	0.00831	0.0036
38	s	5, 7-5	180/0613	34.8961	34.8922	0.00389	34.8885	0.00759	0.0037
38	t	6, 10-15	180/0816	34.9156	34.9111	0.00451	34.9146	0.00101	-0.0035
38	t	13, 10-16	180/0846	34.9156	34.9108	0.00481	34.9134	0.00221	-0.0026
38	t	15, 10-8	180/0852	34.9045	34.9003	0.00418	34.9025	0.00198	-0.0022
38	t	16, 10-7	180/0854	34.9006	34.8963	0.00426	34.8987	0.00186	-0.0024
38	t	19, 10-6	180/0859	34.8517	34.8403	0.01137	34.8424	0.00927	-0.0021
38	t	20, 10-5	180/0900	34.8299	34.8127	0.01718	34.8143	0.01558	-0.0016
38	t	21, 10-4	180/0902	34.8066	34.7948	0.01183	34.7993	0.00733	-0.0045
38	t	22, 10-3	180/0903	34.7984	34.7866	0.01182	34.7890	0.00942	-0.0024
38	t	23, 10-2	180/0904	34.7655	34.7100	0.05551	34.7126	0.05291	-0.0026
38	t	24, 10-1	180/0906	34.4997	34.4517	0.04797	34.4611	0.03857	-0.0094
39	s	1, 7-6	180/1930	34.9038	34.9005	0.00334	34.8969	0.00694	0.0036
39	s	3, 7-7	180/1934	34.9037	34.8981	0.00556	34.8944	0.00926	0.0037
39	s	5, 7-8	180/1939	34.9067	34.9020	0.00467	34.8983	0.00837	0.0037
40	s	1, 7-9	181/0607	34.9017	34.8979	0.00384	34.8939	0.00784	0.004
40	s	3, 7-10	181/0611	34.8978	34.8932	0.00462	34.8895	0.00832	0.0037
40	s	5, 7-11	181/0616	34.8395	34.8342	0.00534	34.8304	0.00914	0.0038
41	s	1, 7-12	181/1858	34.9009	34.8970	0.00392	34.8933	0.00762	0.0037
41	s	3, 7-13	181/1902	34.8968	34.8925	0.00432	34.8886	0.00822	0.0039
41	s	5, 7-14	181/1908	34.8044	34.7958	0.00864	34.7920	0.01244	0.0038

CTD Station No.	CTD Type	Sample Bottle No.	Julian Day/Time (GMT)	Autosal Corrected S	Primary SBE S	Primary SBE Error	Secondary SBE S	Secondary SBE Error	Primary Error - Secondary Error
42	s	1, 7-15	182/0610	34.9055	34.9018	0.00368	34.8982	0.00728	0.0036
42	s	4, 7-16	182/0616	34.8876	34.8808	0.00681	34.8777	0.00991	0.0031
42	s	5, 7-17	182/0619	34.8205	34.8164	0.00409	34.8118	0.00869	0.0046
42	t	1, 10-23	182/0732	34.9131	34.9089	0.00415	34.9116	0.00145	-0.0027
42	t	6, 10-22	182/0742	34.9105	34.9057	0.0048	34.9086	0.0019	-0.0029
42	t	12, 10-14	182/0753	34.8872	34.8751	0.01214	34.8775	0.00974	-0.0024
42	t	14, 10-13	182/0756	34.8270	34.8191	0.00786	34.8215	0.00546	-0.0024
42	t	16, 10-12	182/0759	34.8305	34.8266	0.00392	34.8287	0.00182	-0.0021
42	t	17, 10-11	182/0801	34.8302	34.8313	-0.00115	34.8353	-0.00515	-0.004
42	t	22, 10-10	182/0806	34.8442	34.8393	0.0049	34.8423	0.0019	-0.003
42	t	24, 10-9	182/0807	34.8782	34.8809	-0.00269	34.8851	-0.00689	-0.0042
43	s	1, 7-18	182/1902	34.9101	34.9060	0.00413	34.9025	0.00763	0.0035
43	s	3, 7-19	182/1907	34.9007	34.8972	0.00354	34.8938	0.00694	0.0034
43	s	5, 7-20	182/1912	34.8178	34.8072	0.01055	34.8006	0.01715	0.0066
44	s	1, 7-21	183/0627	34.9137	34.9099	0.00379	34.9066	0.00709	0.0033
44	s	3, 7-22	183/0632	34.8799	34.8731	0.00675	34.8699	0.00995	0.0032
44	s	5, 7-23	183/0637	34.8626	34.8570	0.00562	34.8538	0.00882	0.0032
44	t	1, 10-24	183/0733	34.9146	34.9110	0.0036	34.9123	0.0023	-0.0013
44	t	3, 10-21	183/0738	34.9119	34.9057	0.00617	34.9080	0.00387	-0.0023
44	t	5, 10-19	183/0744	34.8828	34.8790	0.00377	34.8812	0.00157	-0.0022
44	t	7, 10-20	183/0749	34.8352	34.8275	0.00767	34.8312	0.00397	-0.0037
44	t	11, 10-18	183/0756	34.9172	34.7998	0.11736	34.8029	0.11426	-0.0031
44	t	12, 10-17	183/0758	34.6541	34.6333	0.02075	34.6370	0.01705	-0.0037
45	s	1, 7-24	183/1553	34.9078	34.9038	0.00396	34.9003	0.00746	0.0035
45	s	3, 4-1	183/1558	34.8963	34.8922	0.00407	34.8889	0.00737	0.0033
45	s	5, 4-2	183/1602	34.8179	34.8126	0.00533	34.8087	0.00923	0.0039

APPENDIX D: Oxygen data for the titanium CTD. Values highlighted in red were flagged in the original oxygen spreadsheets.

Date	Time	CTD No.	Depth (m)	$C(O_2)$ 1 (umol/l)	$C(O_2)$ 2 (umol/l)	Ave. $C(O_2)$ (umol/l)	Ave. $C(O_2)$ (ml/l)	CTD $C(O_2)$ (ml/l)	Error (ml/l)
12-Jun-12	10:03:22	22	10	369.7	371.8	370.8	8.3017	8.07167	0.2300
12-Jun-12	08:30:09	22	3000	310.3	307.9	309.1	6.9218	6.45677	0.4650
12-Jun-12	09:04:36	22	2000	312.2	309.6	310.9	6.9617	6.57549	0.3862
12-Jun-12	09:30:31	22	1000	340.3	339.6	340.0	7.6124	7.29104	0.3214
12-Jun-12	08:20:49	22	3500	306.8	307.4	307.1	6.8768	6.44352	0.4333
17-Jun-12	17:39:02	34	20	316.1	316.0	316.1	7.0773	7.10475	-0.0274
17-Jun-12	17:36:02	34	100	316.7	318.4	317.6	7.1109	6.94155	0.1694
17-Jun-12	17:34:02	34	150	315.0	314.0	314.5	7.0413	6.88396	0.1573
17-Jun-12	17:32:06	34	200	314.6	314.5	314.6	7.0434	6.88089	0.1625
17-Jun-12	17:30:12	34	250	314.5	315.9	315.2	7.0579	6.90235	0.1555
17-Jun-12	17:26:50	34	375	-	316.8	316.8	7.0932	6.9627	0.1305
17-Jun-12	17:23:20	34	500	329.5	328.5	329.0	7.3665	7.17459	0.1919
17-Jun-12	17:20:09	34	625	329.0	328.3	328.7	7.3590	7.14649	0.2125
17-Jun-12	17:16:34	34	750	329.6	330.3	329.9	7.3877	7.17464	0.2130
17-Jun-12	17:12:54	34	875	327.5	327.2	327.4	7.3299	7.10817	0.2218
17-Jun-12	16:23:57	34	2500	302.3	302.7	302.5	6.7737	6.47724	0.2964
28-Jun-12	07:57:08	61	2300	303.8	305.8	304.8	6.8242	6.44159	0.3826
28-Jun-12	08:16:30	61	1500	308.3	308.3	308.3	6.9027	6.56887	0.3338
28-Jun-12	08:35:33	61	700	326.0	325.4	325.7	7.2935	6.97397	0.3195
28-Jun-12	08:38:34	61	800	323.7	323.4	323.5	7.2438	6.94449	0.2993
28-Jun-12	08:41:30	61	500	321.8	323.6	322.7	7.2258	6.91976	0.3060
30-Jun-12	07:32:47	66	1026	305.9	305.9	305.9	6.8491	6.51708	0.3320
30-Jun-12	07:36:36	66	900	313.8	312.7	313.3	7.0150	6.75239	0.2626
30-Jun-12	07:39:42	66	800	315.7	315.9	315.8	7.0706	6.79065	0.2800
30-Jun-12	07:39:42	66	700	316.4	317.5	316.9	7.0967	6.75239	0.3443
30-Jun-12	07:50:55	66	100	337.1	338.1	337.6	7.5592	6.92035	0.6388

APPENDIX E: Oxygen data for the stainless steel CTD. Values highlighted in red were flagged in the original spreadsheets, values highlighted in blue were either missing or incorrect in the original spreadsheet, so the information was taken from the .btl files.

Date	Time	CTD No.	Depth (m)	C(O2) (umol/l)	C(O2) 2 (umol/l)	Ave. C(O2) (umol/l)	Ave. C(O2) (ml/l)	CTD C(O2) (ml/l)	Error (ml/l)
03-Jun-12	07:38:05	4	60	270.9	270.7	270.8	6.0629	5.68543	0.3775
03-Jun-12	07:41:44	4	40	287.7	287.4	287.6	6.4387	6.17606	0.2627
03-Jun-12	07:45:37	4	20	326.3	327.4	326.9	7.3193	6.69744	0.6219
03-Jun-12	07:48:52	4	10	318.4	318.7	318.6	7.1330	6.60004	0.5330
03-Jun-12	07:52:23	4	1	299.9	300.0	300.0	6.7169	6.17958	0.5373
03-Jun-12	07:07:04	5		319.6	324.2	321.9	7.2087	6.67467	0.5341
04-Jun-12	06:58:44	6	100	288.6	288.7	288.6	6.4633	6.14573	0.3175
04-Jun-12	07:01:13	6	60	288.1	288.0	288.0	6.4498	6.12172	0.3281
04-Jun-12	07:03:36	6	40	292.8	292.5	292.7	6.5534	6.18773	0.3656
04-Jun-12	07:07:28	6	20	301.4	301.6	301.5	6.7515	6.4419	0.3096
04-Jun-12	07:12:59	6	5	317.8	317.8	317.8	7.1153	6.6929	0.4224
06-Jun-12	06:47:42	10	275	273.0	273.5	273.2	6.1183	5.78444	0.3338
06-Jun-12	06:51:53	10	150	286.6	286.0	286.3	6.4108	6.07189	0.3390
06-Jun-12	06:55:15	10	100	289.1	288.6	288.9	6.4683	6.12651	0.3418
06-Jun-12	07:00:35	10	35	314.8	313.7	314.3	7.0365	6.6826	0.3539
06-Jun-12	07:04:03	10	30	318.6	319.2	318.9	7.1409	6.67803	0.4629
06-Jun-12	07:07:04	10	5	319.6	324.2	321.9	7.2087	6.67467	0.5341
08-Jun-12	06:22:09	17	275	265.7	267.0	266.3	5.9635	5.6968	0.2667
08-Jun-12	06:25:50	17	150	273.4	271.4	272.4	6.0998	5.83121	0.2686
08-Jun-12	06:28:20	17	100	277.3	278.1	277.7	6.2173	5.9415	0.2758
08-Jun-12	06:36:02	17	30	302.6	302.3	302.5	6.7724	6.43962	0.3328
08-Jun-12	06:37:36	17	20	303.0	303.2	303.1	6.7872	6.38908	0.3981
08-Jun-12	06:39:30	17	5	302.0	302.6	302.3	6.7698	6.2814	0.4884
10-Jun-12	06:29:59	19	250	321.8	321.8	321.8	7.2064	6.85253	0.3538
10-Jun-12	06:34:16	19	100	336.7	337.0	336.9	7.5431	7.19878	0.3443
10-Jun-12	06:36:35	19	50	349.6	350.2	349.9	7.8352	7.47934	0.3558
10-Jun-12	06:40:02	19	25	387.5	387.0	387.3	8.6716	8.2657	0.4059
10-Jun-12	06:41:28	19	20	395.2	395.0	395.1	8.8477	8.36354	0.4841
10-Jun-12	06:47:24	19	5	387.2	387.4	387.3	8.6724	8.11439	0.5580
12-Jun-12	06:19:06	21	250	341.4	339.9	340.7	7.6278	7.26268	0.3651
12-Jun-12	06:24:33	21	100	347.7	346.6	347.1	7.7732	7.40283	0.3703
12-Jun-12	06:26:44	21	50	360.8	361.2	361.0	8.0830	7.70554	0.3775
12-Jun-12	06:28:31	21	30	366.2	367.2	366.7	8.2110	7.8372	0.3738
12-Jun-12	06:31:41	21	15	372.5	373.0	372.7	8.3459	7.89458	0.4513
12-Jun-12	06:35:38	21	5	372.1	371.1	371.6	8.3211	7.76338	0.5577

Date	Time	CTD No.	Depth (m)	C(O2) (umol/l)	C(O2) 2 (umol/l)	Ave. C(O2) (umol/l)	Ave. C(O2) (ml/l)	CTD C(O2) (ml/l)	Error (ml/l)
14-Jun-12	06:24:52	29	250	317.0	316.7	316.9	7.0949	6.71272	0.3822
14-Jun-12	06:29:30	29	100	319.4	318.5	318.9	7.1416	6.78806	0.3536
14-Jun-12	06:32:18	29	40	356.4	355.7	356.0	7.9718	7.63138	0.3404
14-Jun-12	06:35:43	29	20	377.7	378.5	378.1	8.4659	8.11589	0.3500
14-Jun-12	06:42:03	29	5	412.1	410.3	411.2	9.2078	8.68183	0.5260
16-Jun-12	06:55:00	32	340	308.5	307.1	307.8	6.8926	6.53446	0.3582
16-Jun-12	07:00:04	32	220	309.0	308.6	308.8	6.9138	6.57205	0.3418
16-Jun-12	07:03:04	32	100	347.7	347.4	347.5	7.7820	7.37729	0.4047
16-Jun-12	07:07:09	32	60	348.0	348.1	348.0	7.7925	7.45023	0.3422
16-Jun-12	07:10:20	32	25	351.2	351.7	351.5	7.8695	7.55963	0.3099
16-Jun-12	07:14:14	32	5	363.5	364.2	363.8	8.1463	7.86699	0.2793
18-Jun-12	12:14:55	39	25	342.5	-	342.5	7.6683	7.30649	0.3618
18-Jun-12	12:16:53	39	20	343.9	-	343.9	7.7014	7.49795	0.2035
18-Jun-12	12:19:23	39	10	350.7	351.1	350.9	7.8574	7.60447	0.2529
18-Jun-12	12:21:09	39	5	362.3	362.1	362.2	8.1098	7.97784	0.1320
18-Jun-12	12:05:05	39	350	314.1	313.7	313.9	7.0288	6.73382	0.2950
19-Jun-12	06:50:52	40	350	320.9	320.7	320.8	7.1837	6.85384	0.3298
19-Jun-12	06:57:40	40	250	336.3	335.7	336.0	7.5236	7.19106	0.3325
19-Jun-12	07:01:04	40	150	323.2	323.4	323.3	7.2393	6.93821	0.3011
19-Jun-12	07:04:21	40	60	341.2	341.4	341.3	7.6423	7.33206	0.3102
19-Jun-12	07:13:03	40	10	356.3	356.4	356.4	7.9792	7.69079	0.2884
19-Jun-12	07:15:13	40	5	366.6	365.5	366.1	8.1964	8.08956	0.1069
22-Jun-12	06:24:11	45	350	310.6	310.8	310.7	6.9574	6.64697	0.3104
22-Jun-12	06:29:08	45	150	310.5	310.1	310.3	6.9489	6.64725	0.3016
22-Jun-12	06:33:54	45	60	316.7	316.6	316.6	7.0901	6.77941	0.3107
22-Jun-12	06:36:46	45	37	324.0	323.9	324.0	7.2542	6.88904	0.3651
22-Jun-12	06:39:23	45	20	328.2	328.1	328.2	7.3478	7.04659	0.3012
22-Jun-12	06:43:44	45	5	328.0	327.7	327.8	7.3409	6.98925	0.3517
26-Jun-12	06:07:34	46	500	314.3	312.4	313.3	7.0158	6.61722	0.3986
26-Jun-12	06:12:17	46	350	312.8	312.2	312.5	6.9972	6.58969	0.4075
26-Jun-12	06:20:34	46	50	318.3	318.3	318.3	7.1276	6.73105	0.3966
26-Jun-12	06:22:27	46	30	326.0	325.8	325.9	7.2980	6.95654	0.3414
26-Jun-12	06:26:52	46	20	330.5	331.0	330.7	7.4055	7.01598	0.3895
26-Jun-12	06:32:16	46	5	331.0	331.3	331.1	7.4141	7.00768	0.4064
26-Jun-12	06:17:55	46	110	313.0	312.2	312.6	7.0000	6.60568	0.3943
28-Jun-12	06:03:16	60	500	321.0	321.7	321.4	7.1960	6.82133	0.3747
28-Jun-12	06:08:47	60	300	335.2	335.3	335.2	7.5066	7.14885	0.3577
28-Jun-12	06:13:30	60	120	332.2	331.8	332.0	7.4340	7.08232	0.3517
28-Jun-12	06:24:50	60	12	374.2	374.2	374.2	8.3783	7.91347	0.4648
28-Jun-12	06:27:13	60	6	363.8	363.2	363.5	8.1392	7.75006	0.3891
29-Jun-12	06:07:24	63	500	316.8	315.9	316.3	7.0833	6.68179	0.4015
29-Jun-12	06:11:43	63	350	321.8	321.8	321.8	7.2057	6.84218	0.3635
29-Jun-12	06:16:30	63	150	354.9	354.4	354.6	7.9408	7.55237	0.3884
29-Jun-12	06:19:14	63	75	355.3	356.0	355.6	7.9633	7.60317	0.3602
29-Jun-12	06:23:45	63	30	383.6	346.6	383.6	8.5900	8.25043	0.3396
29-Jun-12	06:31:31	63	5	356.1	355.3	355.7	7.9654	7.56308	0.4024

SCIENTIFIC REPORT 3: Bioassay set up

Sophie Richier and Mark Moore

Introduction

During JR271 we performed 5 bioassay experiments, designed to evaluate the short-term response to artificial carbonate system manipulation of multiple organisms and processes. Below we describe the generic logistical aspects of the bioassay experiments. Readers are referred to individual sections of the cruise report for specific scientific investigations within the overall experimental program alongside preliminary analysis and example plots of data etc.

Bioassays were set up in 5 different locations along the cruise track (Fig. 1) with different initial environmental conditions (listed in Table 1), reflecting both spatial variability within the study region and likely the temporal progression of the bloom (Fig. 1).

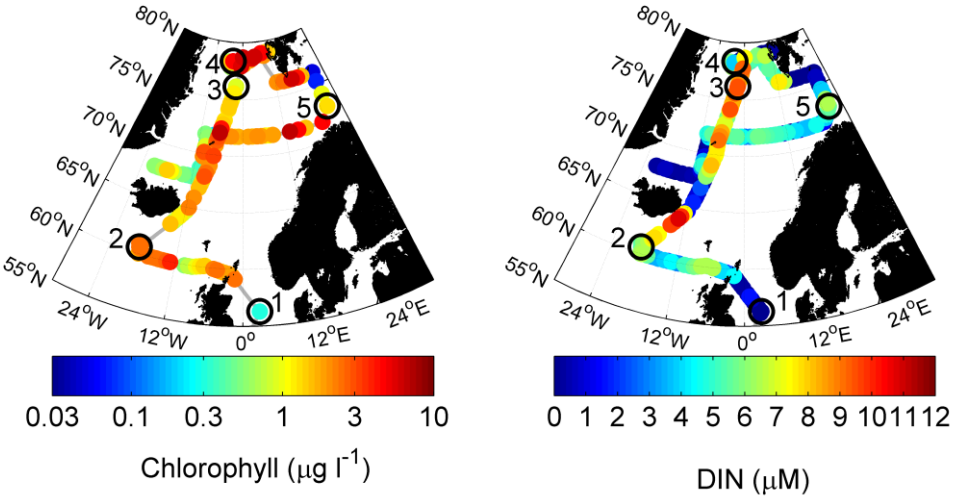


Figure 1: Map showing locations of bioassay experiments set up during JR271. Locations of experiments (labelled 1-5) are shown superimposed on the cruise track (solid gray line) and with surface Chlorophyll (left) and DIN (Nitrate + Nitrite) (right) concentrations to provide some environmental context. Initial conditions for experiments thus ranged from fully depleted DIN to high (~10 µM) concentrations, with corresponding ranges in initial phytoplankton biomass, as indicted by bulk chlorophyll (Table 1).

Methods

Surface seawater was collected from titanium Niskin bottles (24x10L) over three successive casts in order to provide enough water for the large number of final measurements (see individual sections of cruise reports). Once on deck the Niskin bottles were immediately transfer in a positive pressure Class-100 filtered trace metal clean container to avoid contamination. Unfiltered water containing the unperturbed full suite of microbial groups was dispensed into 4.5L polycarbonate incubation bottles using acid-cleaned silicon tubing and closed pending carbonate chemistry manipulation.

A further set of 1 L glass (Schott) bottles was also filled in parallel with water taken of one of the CTD casts and was amended with hand-picked copepods (~5-10 per bottle) *Calanus finmarchicus* or *glacialis* in the Arctic (see zooplankton section for more details).

Deep-sea water was also collected during one of the three casts associated with each bioassay in order to investigate nitrification processes (e.g. N_2O measurements). Depths and initial conditions for each deep bioassay are listed in Table 2.

Each experimental bottle was individually manipulated to achieve 3 different target pCO_2 levels (550, 750 and 1000 µatm), according to the initial carbonate chemistry of the seawater at the time of the water collection. The manipulation of the carbonate system was achieved through additions of $NaHCO_3^-$ + HCl (Borowitzka, 1981; Gattuso and Lavigne, 2009; Schulz et al., 2009), and immediately verified by total alkalinity (TA) and DIC analyses. Following manipulation of pCO_2, bottles were sealed with septum lids, parafilmed and incubated.

The incubation was performed within a purpose-built experimental laboratory container allowing precise temperature and light control. The temperature was adjusted to the *in situ* value at the time of the water collection. Temperature within a dummy incubation bottle was monitored using a traceable thermometer, while two recording thermometers were used to monitor air temperature in the incubator. The light conditions in the incubator were set up with a 10/14h light dark/cycle for the first two experiments (E01 and E02) and no dark phase for the 3 successive experiments which were sampled under conditions of 24 hour sunlight during summer within the Arctic Circle. Each experiment was run for 96h total including three collection time points: T0, T1 (48h) and T2 (96h). Each condition was run in triplicate bottles. Detailed records were kept of the CTD and Niskin bottle used to fill each of the experimental bottles. Additionally records were kept of the people who filled each bottle. A total of 72 bottles were incubated within each of the main experiments, consisting of 9 bottles required for all the water utilized at each timepoint (3 sets of triplicates for different sets of analyses) and the two post initial timepoints.

Table 1: Main bioassay initial conditions.

Exp.	Lat. (N)	Long. (W)	CTD	SST	Salinity	DIC	TA	Chla (µg.l^{-1})	Nitrates (µM)	Phosphate (µM)	Silicate (µM)
E01	56 16.000	002 37. 997	1	10.78	35.12	2082.16	2325	0.32	0.05	0.09	0.02
			2	10.78	35.12	2081.8	2325.06	0.33	0.04	0.07	0.02
			3	10.78	35.12	2082.79	2325.78	0.29	0.05	0.07	0.03
E02	60 35.62	018 51.390	14	10.65	35.25	2085.86	2321.17	1.65	4.93	0.34	0.13
			15	10.65	34.24	2087.57	2322.6	1.59	5.11	0.34	0.12
			16	10.55	35.25	2087.47	2327.6	2.21	5.01	0.37	0.12
E03	76 10.5180	002 32.9595	24	1.67	34.93	2121.06	2297.78	0.96	9.22	0.65	3.95
			25	1.69	34.93	2121.02	2309.9	0.87	10.1	0.73	3.4
			26	1.69	34.93	2136.35	2308.53	0.86	9.24	0.65	3.96
E04	78 21. 150	003 39.850	36	-1.6	32.59	2100.03	2231.72	2.69	4.3	0.79	10.32
			37	-1.58	32.57	2110.82	2237.49	3.33	4.02	0.79	10.31
			38	-1.53	32.57	2108.43	2234.51	3.07	4.28	0.79	10.27
E05	72 53.49	026 00.0878	49	6.55	34.97	2104.1	2311.1	1.29	4.79	1.79	1.79
			50	6.53	34.98	2107	2311.08	0.94	5.53	1.97	1.97
			51	6.46	35	2108.4	2311.19	1.37	5.85	2.09	2.09

Table 2: Deep bioassay set up and initial conditions

Exp.	CTD	SST	Salinity	DIC	TA	Nitrates (µM)	Phosphate (µM)	Silicate (µM)
E01	2	6.7	35.14	2139.15	2329.81	-	-	-
E02	15	9.49	35.19	2128.92	2316.1	9.18	1.5	0.66
E03	25	0.16	34.91	2136.35	2308.53	10.1	3.4	0.73
E04	36	-1.76	33.9	2117.60	2266.80	4.16	10.07	0.79
E05	49	6.01	35.065	2140.71	2311.19	8.76	2.64	0.61

References

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SCIENTIFIC REPORT 4: pH measurements

Victoire Rerolle and Sara Fowell

Introduction

The carbonate system is a key component of the chemical perspective of oceanography as it plays an important role in the oceans' capacity to take up atmospheric CO_2. Dissolved inorganic carbon (DIC) is present in seawater in three forms (CO_{2aq}, HCO_3^- and CO_3^{2-}) which are in equilibrium on timescale longer than a few minutes. In oceanography, the carbonate system can be determined by four parameters: DIC, pCO_2, alkalinity and pH.

This project aims to measure seawater pH. This cruise was an opportunity to test the spectrophotometric pH sensor I am developing for my PhD. Two pH sensors were used: one automated sensor running continuously on the non-toxic water supply and a second to analyse discrete samples from Bioassays and CTD casts.

Method

Sampling: Profiles of pH were sampled from the Stainless Steel CTD (see Table 1 for list of the stations and depths sampled). Water for pH was sampled after oxygen and before DIC and alkalinity. A piece of silicone tubing was used for the sampling and care was taken to prevent any air bubbles being trapped in the sample. The sample was stored in a 20 mL borosilicate vial bottle, which was first rinsed with the sample in order to remove traces of a previous sample. The tubing was inserted at the bottom of the bottle which was then filled and water was left to overflow by two or three bottle volume. Samples were left in water bath (25 degC) for 10 minutes minimum to equilibrate before analysis.

pH sensor: pH is measured by adding a colored indicator to the seawater sample and measuring the color of the mix. The indicators used are 2 mM Thymol Blue for the underway system and 2 mM meta-Cresol Purple for the discrete samples. The pH sensors have been developed at the NOCS (Sensor group).

Underway measurements: The automated pH system was running continuously on the non-toxic water supply from the 01/06/2012 to the 01/07/2012. Measurements were only interrupted for system performance checking and maintenance and in the ice when the non-toxic water supplied was stopped.

Discrete sample measurements: Measurements were performed at 25 degC. Temperature was controlled thanks to a water bath. Analysis took 20 mins per sample to rinse and then analyze the sample four times.

The performance of the system is evaluated by running certified reference material (Tris buffer and DIC/TA) provided by the Scripps Institution of Oceanography. The consistency of the data will be checked thanks to continuous pCO2 measurements (see Scientific Report 5), DIC/Alkalinity sampled on the underway supply every two hours (see Scientific Report 6) and trends in other parameters such as chlorophyll, temperature, salinity and nutrients.

Table 1: List of the stations and depths sampled for pH analysis.

Cast	Niskin Btl	Depth
4	1	60
	3	50
	5	40
	7	30
	9	25
	11	20
	13	15
	17	10
	21	5
	23	1
6	1	100
	3	60
	5	40
	7	30
	11	20
	17	12
	19	8
	23	5
8	2	300
	3	100
	5	65
	8	40
	9	30
	11	20
	15	14
	19	10
	23	5
10	1a	275
	1b	275
	3	150
	5	100
	7a	50
	7b	50
	11	35
	15	30
	17	20
	21	5
12	1	275
	3	200
	5	150
	7	100
	9	65
	11	40
	13	30
	15	20
	19	10
	23	5

Cast	Niskin Btl	Depth
	1b	275
	3	150
	5	100
	7	80
	9	60
	11	40
	13	30
	17	20
	21a	5
	21b	5
19	1	250
	3	100
	5	50
	8	30
	9	20
	11	20
	15	15
	19	10
	23	5
20	1	250
	1	250
	3	100
	5	60
	7	40
	9	25
	11	20
	17	15
	17	15
	19	10
	23	5
21	1	250
	3	150
	5	100
	7	50
	9	30
	11	20
	15	15
	19	10
	23	5

Cast	Niskin Btl	Depth
22	1	3500
	2	3050
	3	3000
	4	2750
	5	2500
	7	2000
	9	1750
	11	1250
	12	100
	13	750
	14	500
	15	250
27	1	200
	3	150
	5	80
	7	40
	11	25
	13	20
	17	15
	19	10
	23	5
28	1	1000
	2	800
	3	600
	4	400
29	1	250
	3	100
	5	35
	7	40
	9	25
	13	20
	15	15
	19	10
	23	5
	3	280
	5	200
	7	100
	12	50
	13	35
	16	20
	19	10
	24	5

Cast	Niskin Btl	Depth
31	1	340
	3a&b	230
	5a&b	150
	8	80
	9	50
	13	30
	15	20
	19	10
	23	5
32	1	340
	4a	220
	4b	220
	5	100
	7	85
	11	60
	13	50
	15	25
	21	10
	23	5
33	1	340
	3	180
	5	130
	7	50
	9	35
	13	25
	17	15
	21	10
	23	5
34	1	2900
	2	2750
	3	2500
	5	2000
	6	1900
	7	1800
	9	1600
	10	1500
	11	1400
	12	1200
	14	875
	15	700
	16	625
	17	500
	18	375
	19	250
	20	200
	21	150
	22	100
	24	20

Cast	Niskin Btl	Depth
39	1	350
	3	175
	5	60
	9	25
	13	20
	17	10
	21	5
40	1	350
	3	200
	5	150
	7	60
	9	25
	13	18
	17	10
	21	5
41	1	350
	3	120
	5	90
	7	50
	9	30
	11	25
	13	20
	17	18
	21	5
42	1	500
	4	350
	5	250
	7	50
	9	25
	13	20
	17	15
	21	10
44	1	500
	3	350
	5	180
	7	50
	9	35
	13	30
	15	20
	19	10
	23	5
45	1	500
	1	500
	3	350
	5	150
	7	90
	9	60
	11	37
	11	37
	15	20
	19	15
	23	5

Cast	Niskin Btl	Depth
46	1	230
	3	150
	5	70
	7	55
	9	45
	13	20
	17	10
	21	5
47	1	125
	1	125
	5	60
	9	30
	13	25
	13	25
	15	20
	19	10
	23	5
48	1	350
	3	100
	5	60
	7	40
	9	30
	13	20
	17	10
	21	5
52	1	350
	3	150
	5	100
	7	50
	9	40
	11	25
	15	18
	23	5
53	1	315
	3	150
	7	50
	9	25
	15	15
	23	5
54	2	275
	3	150
	5	60
	7	25
	9	20
	15	15
	19	10
	21	5

Cast	Niskin Btl	Depth
55	1	500
	3	350
	5	150
	7	50
	9	25
	11	20
	15	15
	19	10
	23	5
56	1	500
	3	350
	5	110
	7	50
	9	30
	17	15
	19	10
	23	5
57	1a	500
	1b	500
	1c	500
	3	350
	5	150
	7	70
	9	35
	17	15
	23	5
58	1	500
	4	350
	5	225
	7	125
	9	47
	11	35
	15	20
	17	15
	19	10
	23	5

Cast	Niskin Btl	Depth
59	1	500
	3	300
	5	100
	7	70
	9	35
	11a	28
	11b	28
	15	20
	19	10
	23	5
60	1	500
	1	500
	3	300
	5	120
	7	75
	9	50
	11	35
	15	25
	23	5
61	1	2180
	2	2330
	3	2300
	4	1900
	5	1700
	6	1500
	7	1301
	10	702
	11	600
	12	500
62	3	350
	5	150
	7	80
	9	50
	15	30
	17	20
	19	10
	23	5

Cast	Niskin Btl	Depth
63	1	500
	3	300
	5	150
	9	45
	11	30
	15	20
	21	10
	23	5
65	1	500
	4	300
	5	150
	7	50
	9	35
	13	25
	15	20
	19	10
	23	5
66	1	1040
	2	900
	3	800
	4	700
67	1	500
	3	350
	5	175
	7	100
	9	50
	11	30
	13	20
	17	15
	23	5
68	1	500
	3	300
	5	150
	7	75
	9	40
	11	35
	15	25
	17	15
	19	10
	23	5
69	1	660
	2	600

Table 2: List of Bioassay samples for pH analysis

E1	E2	E3	E4	E5
E1T0s1	E2T0I1s2	E3T0I1	E4T0I1	E5T0I1
E1T0s2	E2T0I1s3	E3T0I2	E4T0I2	E5T0I2
E1T0s3	E2T0I2s1	E3T0I3	E4T0I3	E5T0I3
E1T0s4	E2T0I3s1	E3T0B79	E4T0B79	E5T0B79
E1T0s5	E2T0I3s2	E3T0B80	E4T0B80	E5T0B80
E1T0s6	E2T0I3s3	E3T0B81	E4T0B81	E5T0B81
E1T0s7	E2T1B1	E3T0B82	E4T0B82	E5T0B82
E1T1B7	E2T1B2	E3T2B10	E4T1B1	E5T1B1
E1T1B8	E2T1B3	E3T2B11	E4T1B3	E5T1B2
E1T1B9	E2T1B19	E3T2B12	E4T1B19	E5T1B3
E1T1B25	E2T1B20	E3T2B28	E4T1B20	E5T1B19
E1T1B26	E2T1B21	E3T2B29	E4T1B21	E5T1B20
E1T1B27	E2T1B37	E3T2B30	E4T1B37	E5T1B21
E1T1B43	E2T1B38	E3T2B46	E4T1B38	E5T1B37
E1T1B44	E2T1B39	E3T2B47	E4T1B39	E5T1B38
E1T1B45	E2T1B55	E3T2B48	E4T1B56	E5T1B39
E1T1B61	E2T1B56	E3T2B64	E4T1B57	E5T1B55
E1T1B62	E2T1B57	E3T2B65	E4T2B10	E5T1B56
E1T1B63	E2T2B10	E3T2B66	E4T2B11	E5T1B57
E1T2B16	E2T2B11		E4T2B12	E5T2B10
E1T2B17	E2T2B12		E4T2B28	E5T2B11
E1T2B18	E2T2B28		E4T2B29	E5T2B12
E1T2B34	E2T2B29		E4T2B30	E5T2B28
E1T2B35	E2T2B30		E4T2B46	E5T2B29
E1T2B36	E2T2B46		E4T2B47	E5T2B30
E1T2B52	E2T2B47		E4T2B48	E5T2B46
E1T2B53	E2T2B48		E4T2B64	E5T2B47
E1T2B54	E2T2B64		E4T2B65	E5T2B48
E1T2B70	E2T2B65		E4T2B66	E5T2B64
E1T2B71	E2T2B66			E5T2B65
E1T2B72				E5T2B66

SCIENTIFIC REPORT 5: In situ observations of partial pressure of carbon dioxide on JR271

Mariana Ribas-Ribas

Partial pressure of CO_2 in surface water and marine air

Continuous measurements of the partial pressure of CO_2 (pCO_2) in surface water and marine air were made throughout the cruise by infrared detection on a LI-COR 7000. The ship's seawater supply provided water for underway sampling from 5 m depth at the bow to the main lab. Temperature and salinity of the intake water were determined by the ship's sensors.

Seawater flowed through an equilibrator. Part of the water went to waste via a bypass. The equilibrator was operated at a flow rate of 0.8 to 1.8 l min^{-1}. The water flow rate has been recorded twice a day.

Marine air was pumped through tubing from the monkey island. Two Pt-100 probes accurately determined the water temperature in the equilibrator. A long vent kept the headspace of the equilibrator close to atmospheric pressure. The CO_2 content and the moisture content of the headspace were determined by an infrared LI-COR 7000 analyser. The analysis of the CO_2 content in the headspace was interrupted at regular intervals for that of the CO_2 content in marine air and in four CO_2 standards. Samples from the equilibrator headspace and marine air were partly dried to 10°C below the ambient temperature in an electric cool box. The standards bought from BOC of 0, 250, 350 and 450 µmol CO_2 mol^{-1} in a nitrogen and oxygen mixture had been calibrated against certified NOAA standards prior to the cruise and will be recalibrated after the cruise at UEA. The analyses were carried out for a flow speed of 100 ml min^{-1} through the LI-COR at a slight overpressure. A final analysis for each parameter was made at atmospheric pressure with no flow. The flow and overpressure did not have a discernible effect on the CO_2 and moisture measurements, once the pressure had been corrected for. The correction by Takahashi et al. (1993) will be used to correct for warming of the seawater between the ship's water intake and the equilibrator. The pCO_2 measurements will be time stamped by our own GPS positions. The pCO_2 data await data quality control.

References

Takahashi, T., J. Olafsson, J.G. Goddard, D.W. Chipman, S.C. Sutherland (1993) Seasonal variation of CO_2 and nutrients in the high-latitude surface oceans: a comparative study. *Global Biogeochemical Cycles* 7, 843-878.

SCIENTIFIC REPORT 6: Dissolved inorganic carbon and total alkalinity from underway and CTD samples

Matthew Humphreys, Eithne Tynan and Mariana Ribas-Ribas

Sampling protocol

Samples for total alkalinity (TA) and dissolved inorganic carbon (DIC) were collected in 250 ml Schott Duran borosilicate glass bottles with glass stoppers that provided an air-tight seal, held shut with rubber bands. 2.5 ml headspace was left in each bottle and 50 µl saturated mercuric chloride solution added directly after sampling. Samples were stored in dark, insulated boxes until analysis.

Samples for $\delta^{13}C$ of DIC were collected in 100 ml soda-lime glass bottles with ground glass stoppers. Preparation for storage was as recommended by Dickson et al. (2007) for TCO_2 samples: soon after collection, 1 ml of sample was removed for headspace and 20µl of saturated mercuric chloride added. The stopper was dried and Apiezon L grease was added to make the seal air-tight. Electrical tape was wrapped around the bottle and stopper to hold the lid shut.

Analysis

Measurements of DIC and TA were carried out at sea with VINDTA (3C) #038 (Marianda) connected to a CM5015 CO_2 coulometer (UIC, Inc.). Samples were warmed in a water bath at 25°C for an hour before analysis.

A set volume of the sample is acidified by addition of excess 10% phosphoric acid, which converts all inorganic carbon species to CO_2. This is carried into the coulometric cell by an inert carrier gas (CO_2-free N_2 that is first passed through a magnesium perchlorate and Ascarite II scrubber), and a coulometric titration determines the amount of CO_2, which is equal to DIC.

Small increments of 0.1 M hydrochloric acid are added to a set volume of sample while the electromotive force is measured by a glass and reference electrode system. The amount of acid added to reach the carbonic acid equivalence point is equal to the TA.

Regular measurements of both TCO_2 and TA were made from batch 117 Certified Reference Material (CRM) from A. G. Dickson (Scripps Institution of Oceanography) and used to calibrate the results for each session of analysis as follows:

$$TCO_2^{\text{sample, corrected}} = TCO_2^{\text{sample, measured}} \times (TCO_2^{\text{CRM, certified}} / TCO_2^{\text{CRM, measured}})$$

$$TA^{\text{sample, corrected}} = TA^{\text{sample, measured}} \times (TA^{\text{CRM, certified}} / TA^{\text{CRM, measured}})$$

To obtain the final results in units of µmol kg^{-1}, a correction for density (ρ) due to salinity (S) variations was then applied using salinity measured from Niskin bottle samples and an equation of the form (Zeebe and Wolf-Gladrow 2001):

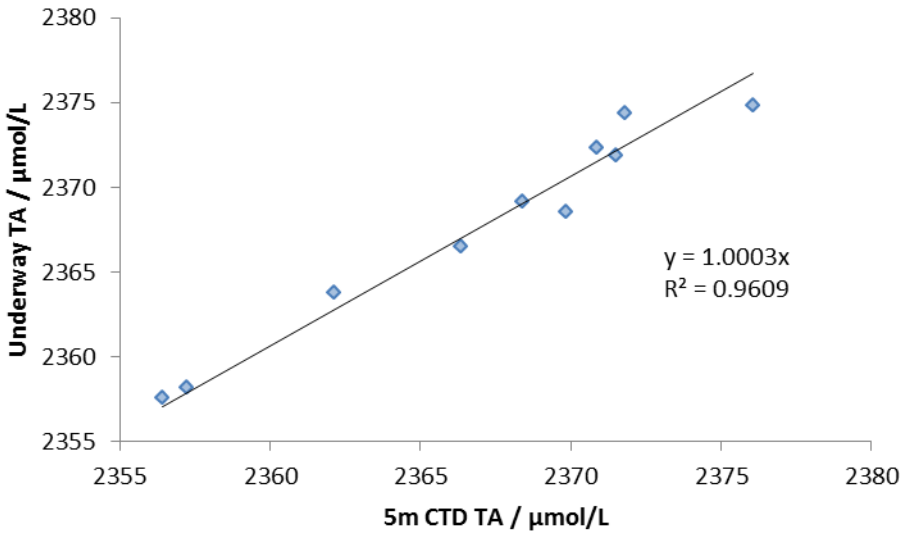
$$\rho_{\text{sea water, 25°C}} = \rho_{\text{pure water, 25°C}} + AS + BS^{1.5} + CS^2$$

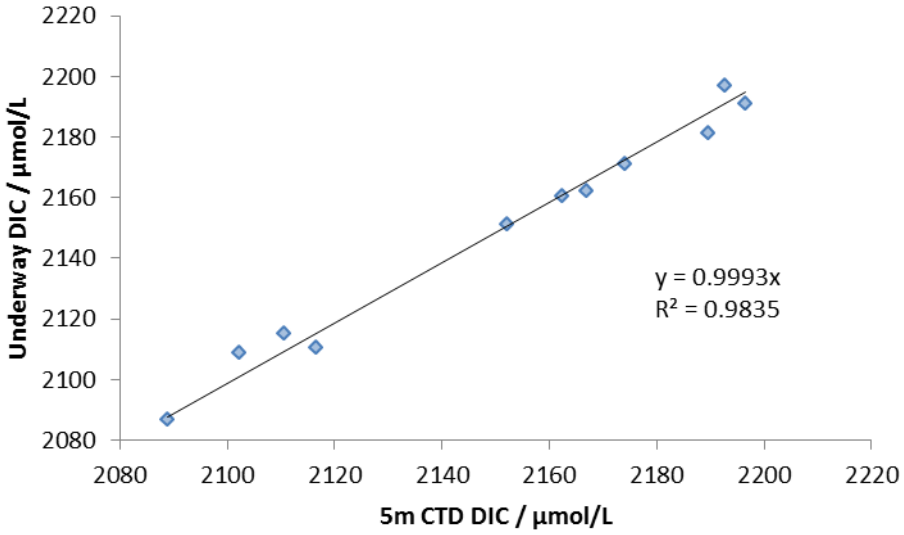
CTD sample list

Cast number	DIC & TA samples	$\delta^{13}C$ samples
04	1, 5, 7, 9, 11, 13, 17, 21, 23	
06	1, 3, 5, 7, 11, 17, 19, 23	
08	2, 3, 5, 8, 9, 11, 15, 19, 23	
10	1, 3, 5, 7, 11, 15, 17, 21	1, 3, 5, 7, 11, 15, 17, 21
12	1, 3, 5, 7, 9, 11, 13, 15, 19, 23	1, 3, 5, 7, 9, 11, 13, 15, 19, 23
13	1 – 5, 7 – 15	
17	1, 3, 5, 7, 9, 11, 13, 17, 21	1, 3, 5, 7, 9, 11, 13, 17, 21
19	1, 3, 5, 8, 9, 11, 15, 19, 23	1, 3, 5, 8, 9, 11, 15, 19, 23
20	1, 3, 5, 7, 9, 11, 17, 19, 23	1, 3, 5, 7, 9, 11, 17, 19, 23
21	1, 4, 5, 7, 9, 11, 15, 19, 23	1, 4, 5, 7, 9, 11, 15, 19, 23
22	1 – 5, 7, 9, 11 – 15, 24	1 – 5, 7, 9, 11 – 15, 24
27	1, 3, 5, 7, 11, 13, 17, 19, 23	1, 3, 5, 7, 11, 13, 17, 19, 23
28	1 – 4	1 – 4
29	1, 4, 5, 7, 13, 15, 19, 23	1, 4, 5, 7, 13, 15, 19, 23
30	1, 3, 5, 7, 12, 13, 16, 19, 24	1, 3, 5, 7, 12, 13, 16, 19, 24
31	1, 3, 5, 8, 9, 13, 15, 19, 23	1, 3, 5, 8, 9, 13, 15, 19, 23
32	1, 4, 5, 7, 11, 13, 15, 21, 23	1, 4, 5, 7, 11, 13, 15, 21, 23
33	1, 3, 5, 7, 9, 13, 17, 21, 23	1, 3, 5, 7, 9, 13, 17, 21, 23
34	1 – 3, 5 – 7, 9 – 12, 14 – 22, 24	1 – 3, 5 – 7, 9 – 12, 14 – 22, 24
39	1, 3, 5, 9, 13, 17, 21	
40	1, 3, 5, 7, 9, 13, 17, 21	1, 3, 5, 7, 9, 13, 17, 21
41	1, 3, 5, 7, 9, 11, 13, 17, 21	1, 7, 21
42	1, 4, 5, 7, 9, 13, 17, 21, 23	1, 5, 21
44	1, 3, 5, 7, 9, 13, 15, 19, 23	3, 7, 15
45	1, 3, 5, 7, 9, 11, 15, 19, 23	3, 7, 9, 19
46	1, 3, 5, 7, 9, 13, 17, 21	3, 17
47	1, 5, 9, 13, 15, 19, 23	1, 13, 19
48	1, 3, 5, 7, 9, 13, 17, 21	3, 9, 17
52	1, 3, 5, 7, 9, 11, 15, 19, 23	3, 11, 15, 19
53	1, 3, 7, 9, 15, 23	3, 23
54	2, 3, 5, 7, 9, 15, 19, 21	3, 15, 21
55	1, 3, 5, 7, 9, 11, 15, 19, 23	1, 5, 7, 19
56	1, 3, 5, 7, 9, 15, 17, 19, 23	1, 5, 19
57	1, 3, 5, 9, 13, 17, 19, 23	3, 7, 19
58	1, 4, 5, 7, 9, 11, 15, 17, 19, 23	4, 9, 19
59	1, 3, 5, 7, 9, 11, 15, 19, 23	3, 7, 19
60	1, 3, 5, 7, 9, 11, 19, 23	3, 5, 7, 19
61	1 – 7, 10 – 12	1, 3, 4, 6, 7, 10 – 12
62	3, 5, 7, 9, 15, 17, 19, 23	3, 7, 19
63	1, 3, 5, 7, 9, 11, 15, 21, 23	3, 5, 7, 21
64	1, 3, 5, 7, 9, 13, 15, 19, 23	
65	1, 4, 5, 7, 9, 13, 15, 19, 23	
66	1 – 4	
67	1, 3, 5, 7, 9, 11, 13, 17, 23	
68	1, 3, 5, 7, 9, 11, 15, 17, 19, 23	
69	1, 2	
70	1, 3, 5, 7, 9, 11, 13, 15, 17, 21, 23	

Underway samples

Additionally, samples for DIC and TA were collected from the underway seawater system at approximately 2-hour intervals while moving between stations throughout the cruise. For several stations, an underway sample was collected at the same time as the 5 metre depth Niskin bottles were closed, to test for any systematic offset in DIC or TA results – no significant offset was found, as illustrated below.





References

Dickson, Andrew G., Christopher L. Sabine, and J. R. Christian. (2007). *Guide to Best Practices for Ocean CO_2 Measurements*. PICES Special Publication 3.

Zeebe, Richard E., and D. A. Wolf-Gladrow. (2001). *CO_2 in Seawater: Equilibrium, Kinetics, Isotopes*. Elsevier Oceanography Series 65.

SCIENTIFIC REPORT 7: Dissolved inorganic carbon and total alkalinity from on-board experiments

Eithne Tynan, Mariana Ribas-Ribas and Matthew Humphreys

Objectives

The objectives on this cruise were to provide carbonate chemistry measurements from the bioassays in order to determine the initial conditions and to monitor the carbonate chemistry throughout the experiments. Dissolved Inorganic Carbon (DIC) and Total Alkalinity (TA) samples were collected from the bioassay CTDs before any experiment bottles were filled. The samples were analysed immediately in order to determine the initial conditions and to calculate the amount of bicarbonate and hydrochloric acid solutions to add for each treatment. DIC and TA were also measured in each treatment just after spiking in order to check the initial targets.

Sampling protocol

The sampling procedure used for the initial Dissolved Inorganic Carbon and Total Alkalinity measurements followed Dickson et al. (2007). For the initial conditions, one surface sample from each of the CTDs, plus one deep sample from the deeper cast were collected in 250 ml Schott Duran borosilicate glass bottles with glass stopper. Samples were taken straight after the Niskin bottle was opened. A piece of silicone tubing was used for the sampling and care was taken to prevent any air bubbles being trapped in the sample. The bottle was air-tight sealed with a glass stopper and the samples were analysed immediately (within 1 hour of sampling).

The T0 samples were collected directly after carbonate chemistry manipulation. They were immediately poisoned with a saturated solution of mercuric chloride (10 µl) and analysed the same day.

T1 and T2 samples were collected in 40 ml EPA vials after 48 and 96 hr incubation respectively. They were immediately poisoned with a saturated solution of mercuric chloride (10 µl) and analysed within two days.

Samples collected

Samples for initial DIC and TA were collected from each bioassay cast and samples for DIC and TA monitoring were collected from all experiment time-point bottles.

Sample analysis

The instrument used for the determination of DIC was the Apollo AS-C3 (Apollo SciTech, USA; Figure 1). The system uses a LI-COR (7000) CO_2 infrared analyser as a detector, a mass-flow-controller to precisely control the carrier gas (N_2) flow, and a digital pump for transferring accurate amounts of reagent and sample. Phosphoric acid (10%) was used to convert all the CO_2 species. The sample volume was set to 0.75 ml for the whole cruise. The system generally achieved a precision of 0.1% or better. Certified Reference Materials (batch 109) from A.G. Dickson (Scripps Institution of Oceanography) were used as standards to calibrate the system at the beginning of each day of analysis.

The instrument used for the determination of TA was the Apollo AS-ALK2 (Apollo SciTech, USA; Figure 1). The system is equipped with a combination pH electrode (8102BNUWP, Thermo Scientific, USA) and temperature probe for temperature control (Star ATC probe, Thermo Scientific, USA) connected to a pH meter (Orion 3 Star benchtop pH meter, Thermo Scientific, USA). Each seawater sample was titrated with hydrochloric acid 0.1 M using an open-cell titration (Dickson et al. 2007). All TA samples were analyzed at 25 ºC (±0.1 ºC) with temperature regulation using a water-bath (GD120, Grant, UK). The acid is added in small increments and the electromotive force monitored for every step until the carbonic acid equivalence point is reached (protonation of carbonate and bicarbonate ions). The system conducts an automated Gran titration. Certified Reference Materials (batch 109) from A.G. Dickson (Scripps Institution of Oceanography) were used as standards to standardize the acid at the beginning of each day of analysis.

All DIC and TA samples were analysed on board. No major problem was encountered with the analysis.

Figure 1: Apollo AS-C3 (left) and AS-ALK2 (right) used for the determination of Dissolved Inorganic Carbon and Total Alkalinity.

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SCIENTIFIC REPORT 8: Dissolved oxygen

Chris Daniels and Helen Smith

Introduction

Water samples were collected from a selected number of CTD casts for calibration of the CTD oxygen sensor. Seventeen CTDs (see Table 1) were sampled for dissolved oxygen (DO) which were the first samples to be drawn from the Niskin bottles. Duplicate samples were collected from on average 6 depths. Seawater was collected directly into pre-calibrated glass bottles using a Tygon® tube. Before the sample was drawn, the bottles were flushed with seawater for several seconds (for about 3 times the volume of the bottle) and the temperature of the water was recorded simultaneously using a handheld thermometer. The fixing reagents (i.e., manganese chloride and sodium hydroxide/sodium iodide solutions) were then added. Care was taken to avoid bubbles inside the sampling tube and sampling bottle. Samples were thoroughly mixed following the addition of the fixing reagents and were then kept in a dark plastic crate for 30-40 min to allow the precipitate to settle to <50% the volume of the bottle. Once the precipitate had settled all samples were thoroughly mixed for a second time in order to maximize the efficiency of the reaction.

Method

DO determinations were made using a Winkler Ω-Metrohm titration unit (794 DMS Titrino) with an amperometric system to determine the end point of the titration (Culberson and Huang, 1987). Chemical reagents were previously prepared at NOCS following the procedures described by Dickson (1994). Recommendations given by Dickson (1994), and by Holley and Hydes (1994) were adopted. In general, thiosulphate calibrations were carried out twice a week using a 1.667mmol L^{-1} certified OSIL iodate standard, with the aid of a Ω-Metrohm 776 Dosimat unit. Calibration values are summarised in Table 2 and shown in Figure 1. The thiosulphate solution was prepared at the beginning of the cruise by dissolving 50g of sodium thiosulphate in 1L of Milli-Q water. This solution was left to stabilise for 24 hours before the initial calibration, with a subsequent calibration 12 hours later to ensure the thiosulphate had stabilised. Calculation of oxygen concentrations were facilitated by the use of an Excel spreadsheet provided by Dr. Richard Sanders (NOCS). This spreadsheet has been modified/corrected to include pipettes" calibrated dispensing volumes (i.e., reagents and iodate standard additions have been calibrated). Figure 2 shows a time series of replicates.

Observations

The use of the 776 Dosimat as a dispensing unit for calibration allowed for precise calibrations with relative standard deviations ranging from 0.15 % - 0.32 %.

Replicate measurements of selected samples were carried out on nearly all bottles in order to test for reproducibility. The mean difference between replicates was 0.5 ± 0.5 µmol O_2 L^{-1}, results are shown in Figure 2.

It was noted that as observed in previous cruises, the first sample analysed tended to have a larger error than subsequent replicate bottles. Therefore a dummy sample was often used from the underway supply.

Table 1: JR271 CTDs from which Oxygen measurements were sampled from.

CTD No.	No. of Depths
04	5
06	5
10	6
17	6
19	6
21	6
22†	6
29	5
32	6
34	11
39	5
40	6
45	6
56	7
58	5
61†	5
62	6
63	6
66†	5

† Sampled from the titanium CTD

Table 2: JR271 O_2 calibrations; thiosulphate calibration number, date of calibration, mean blank titre volume (BLK), standard titre volume (STD), STD minus BLK, molarity of thiosulphate solution and the stations from which each calibration was used.

Calibration number	Date	BLK (mL)	STD (ml)	STD – BLK (ml)	Thiosulphate Molarity	Used from CTD No.
1	02/06/2012	0.0000	0.5084	0.5084	0.1967	
2	02/06/2012	0.0001	0.5112	0.5112	0.1957	4
3	10/06/2012	-0.0001	0.5099	0.5100	0.1961	19
4	17/06/2012	-0.0012	0.5143	0.5155	0.1940	34
5	26/06/2012	-0.0012	0.5098	0.5109	0.1958	56

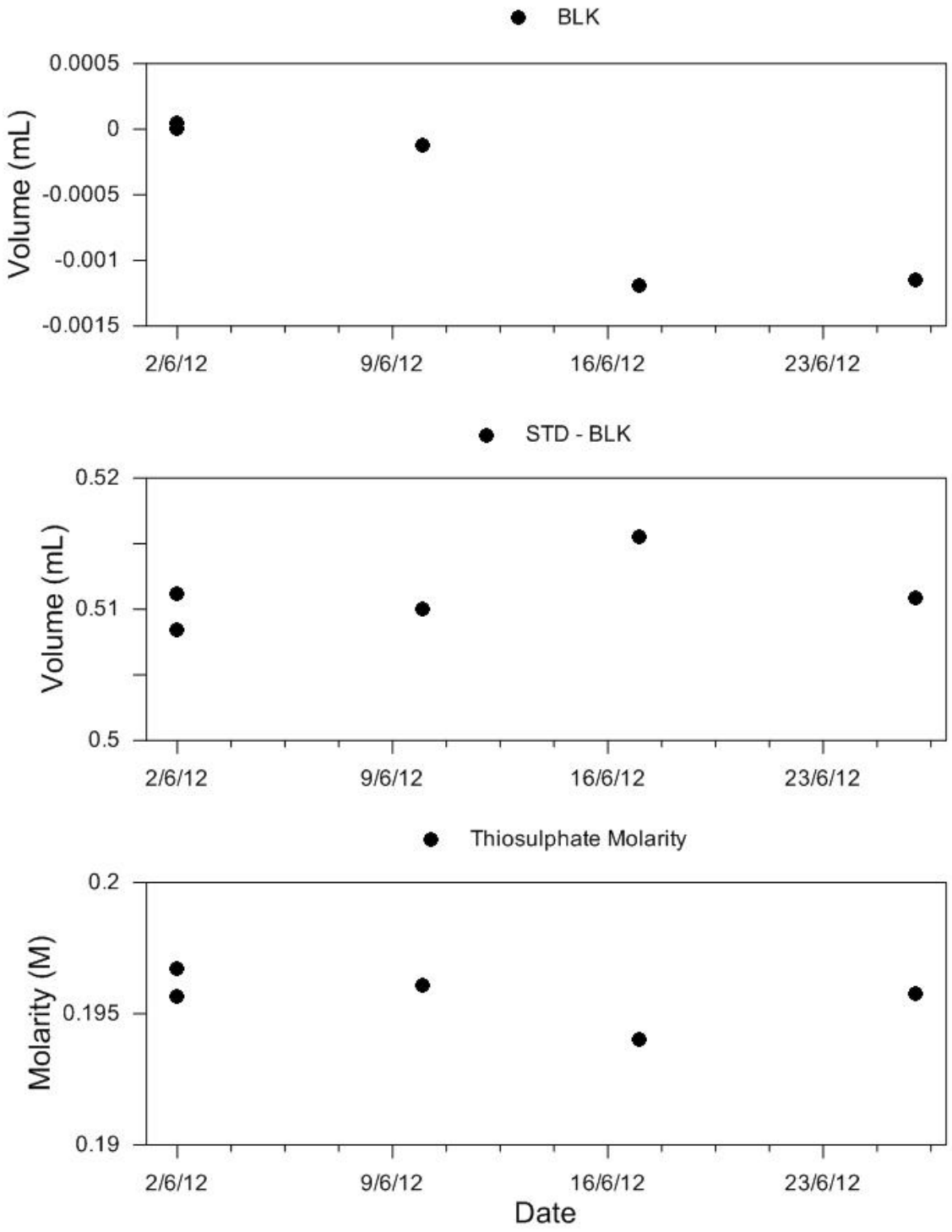

Figure 1: Calibrations for dissolved oxygen analysis. Blank volume titre, standard minus blank and thiosulphate molarity. Values plotted here are shown in Table 2.

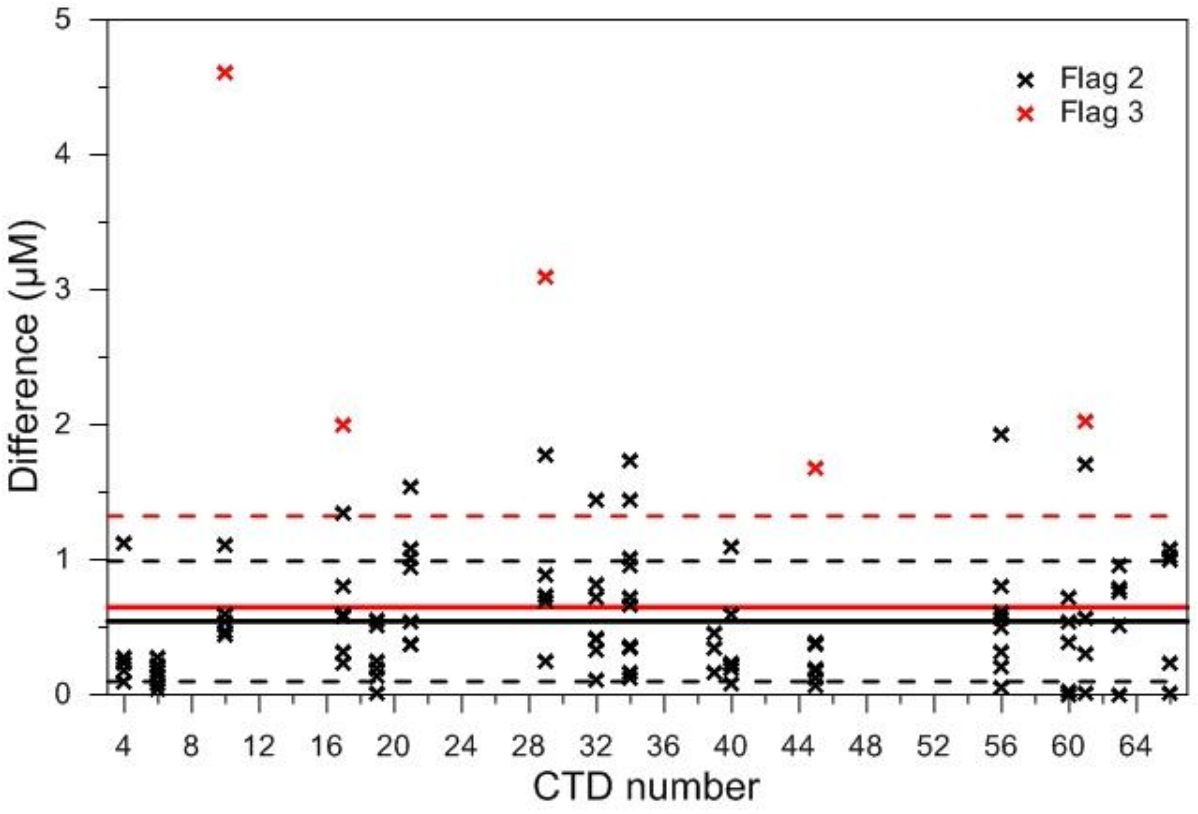

Figure 2: The absolute replicate difference for oxygen bottles in each CTD cast. The mean (0.5 µmol L^{-1}) and standard deviation are specified with solid and dashed lines respectively. Black symbols indicate values flagged as good (Flag 2) and red symbols are those values flagged as dubious (Flag 3).

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SCIENTIFIC REPORT 9: Dissolved oxygen and respiration within bioassays

Mark Moore

Background

Dissolved oxygen (O_2) is produced by photosynthesis and consumed by respiration and photochemical reactions in the surface waters. Equilibrium between dissolved O_2 in seawater and O_2 in the atmosphere is maintained through air-sea gas exchange. The aim of this work was to quantify O_2 and respiration in bioassay bottles to ascertain with an artificial increase of pCO_2 impacts on natural microbial community respiration.

Methods

Dissolved O_2 was determined by automated Winkler titration with photometric end-point detection (Carritt & Carpenter, 1966). The concentration of thiosulphate was calibrated every 3 days. Respiration experiments were carried out according to Robinson et al. (2002). In brief, seawater samples were collected from 12 bottles (triplicates of 4 conditions) after 48h or 96h incubation out of each bioassay. The bottles analysed and the time points are listed in Table 1.

Two 125 ml glass O_2 bottles were filled from each incubation bottle. One was placed in the dark in the container for 6-8 hours under controlled temperature and the other was fixed immediately (T0). Community respiration (CR) was calculated as O_2 consumption in the Dark samples (Dark – T0). Preliminary analysis indicates no clear differences in respiration rates between treatments

Table 1: Samples collected for respiration measurement

Date	Bioassay number	Condition	Bottle nb.
10-Jun-12	E02	A	4–6
		550	22-24
		750	40-42
		1000	58-60
15-Jun-12	E03	A	4–6
		550	22-24
		750	40-42
		1000	58-60
22-Jun-12	E04	A	13-15
		550	33-35
		750	49-51
		1000	67-69
28-Jun-12	E05	A	13-15
		550	33-35
		750	49-51
		1000	67-69

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References

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SCIENTIFIC REPORT 10: Assessing the effects of ocean acidification on dimethyl sulfide (DMS), dimethyl sulfoniopropionate (DMSP) and associated processes in Arctic waters.

Frances Hopkins and John Stephens

Introduction

Oceanic emission of the trace gas dimethyl sulfide (DMS) is the major source of reduced sulfur into the marine boundary layer, influencing atmospheric chemistry (von Glasow et al. 2004) and contributing to the radiative properties of oceanic clouds (Ayers et al 1991, Charlson et al. 1987, Korhonen et al 2008). DMS is an enzymatic breakdown product of dimethylsulfoniopropionate (DMSP) synthesised by phytoplankton. Both DMS and DMSP also contribute significant proportions of the carbon and sulphur flux through microbial foodwebs (Simo et al. 2004) and may play important roles as infochemicals, influencing predator prey interactions (Wolfe et al. 1997). In consequence alterations in atmospheric *p*CO2 concentrations that lead to increased sea surface temperature, changes in upper-ocean stratification and decreasing ocean pH are likely to influence the extent of DMS and DMSP production, with potential impacts on climate, ocean biogeochemistry and microbial food web structure and function.

A number of previous studies have recorded responses in net DMS and DMSP production in relation to varied pCO2, including high-latitude mesocosm experiments (Archer et al, in prep, Hopkins et al, 2010, Wingenter et al. 2007) and ship-board incubation experiments (Lee et al. 2009). However, there remains limited understanding of the mechanisms behind the observed pH-related changes in DMS and DMSP concentrations. Our overarching objective was to improve our understanding of the processes that may alter net DMS production and hence, its emission to the atmosphere, in the face of changing ocean pH.

Objectives and Aims

1. To determine the spatial variability in water column DMS and DMSP concentrations in relation to varied pCO_2, pH and microbial community composition.

2. To quantify DMSP production rates in relation to varied *pCO2* exposure in bioassay experiments and relate this to phytoplankton community composition.

3. To quantify the biological loss rates of DMS in relation to varied *p*CO2 exposure in bioassay experiments and thereby determine the rates of gross production of DMS.

Methods

DMS and DMSP concentrations: CTD profiles

Seawater samples for DMS and DMSP were directly taken from Niskin bottles, and collected in 250 ml amber glass-stoppered bottles. The bottle was rinsed three times before being filled gently from the bottom through the Tygon tubing, and then allowed to over-flow 2 – 3 times. Once full, the glass stopper was securely placed on the bottle, ensuring the presence of no headspace. Samples were kept in a coolbox and analysed within 2 hours. For analysis, 20ml of seawater was gently drawn from the amber bottle into a glass syringe through ¼" nylon tubing. The samples were gently filtered through a stainless steel Millipore filtration unit containing 25mm GF/F filter, directly into a 10ml glass syringe. The addition of air/bubbles was kept to a minimum at all times. 5ml of filtered seawater was injected into a glass purge tower. The sample was purged with He gas for 5 minutes at 60 ml/min, and the sample stream was dried by passing through a stainless steel counterflow nafion drier, at a flow rate of ~180 ml/min. The sample was trapped in a 1/16" PTFE loop held in liquid nitrogen. Once purging was complete, the sample loop was rapidly submerged in boiling water, injecting the sample into a Varian 3800 GC with pulsed flame photometric detector (PFPD). The oven was held at 60°C until DMS eluted at ~3.3 minutes, and for the remainder of the 5 minute runtime run the oven ramped to 250°C.DMS calibrations were performed using alkaline cold-hydrolysis (10M NaOH) of DMSP diluted 3 times in MilliQ, to give working standards in the range

0.03 – 3.3 ng S ml^{-1}. Four to five point calibrations were performed every 2 – 4 days throughout the cruise.

Samples for total DMSP were taken from the same amber bottles used for DMS analysis. Once the DMS sample had been removed, the bottle was gently rotated 3 times, and 7ml of seawater was removed using a pipette, and transferred into an 8ml glass vial. Samples were immeditaely hydrolysed with 1ml 10M NaOH, and analysed after 4 – 6 hours. Where sample storage was required, samples were fixed by addition of 35µl of 50% H_2SO_4, and hydrolysed 4 – 6 hours before analysis. Table 1 lists the CTD casts and depths from which samples for DMS and DMSPt were taken.

Table 1: CTD sample log: DMS and DMSP (total)

CTD Cast #	***Date***	***Nominal depths:***									***No. samples***
CTD004	3/6/2012	Surface	5m	10m	15m	20m	30m	40m			7
CTD006	4/6/2012	5m	8m	12m	20m	30m	40m	60m	100m		8
CTD010	6/6/2012	5m	20m	30m	35m	50m	100m				6
CTD012	7/6/2012	5m	10m	20m	30m	40m	65m	100m			7
CTD017	8/6/2012	5m	10m	20m	30m	40m	80m	100m			7
CTD019	10/6/2012	5m	10m	15m	20m	25m	30m	50m	100m		8
CTD020	11/6/2012	5m	10m	15m	20m	25m	40m	60m	100m		8
CTD021	12/6/2012	5m	10m	15m	20m	30m	50m	100m			7
CTD027	13/6/2012	5m	10m	15m	20m	25m	40m	80m			7
CTD029	14/6/2012	5m	10m	15m	20m	40m	65m				6
CTD031	15/6/2012	5m	10m	20m	30m	50m	80m				6
CTD032	16/6/2012	5m	10m	25m	50m	60m	85m				6
CTD033	17/6/2012	5m	10m	15m	25m	35m	50m	130m			7
CTD039	18/6/2012	5m	12m	20m	25m	60m					5
CTD040	19/6/2012	5m	10m	16m	25m	60m					5
CTD041	19/6/2012	5m	18m	20m	25m	30m	50m				6
CTD042	20/6/2012	5m	10m	15m	20m	25m	50m				6
CTD044	21/6/2012	5m	10m	20m	30m	35m	50m				6
CTD045	22/6/2012	5m	15m	20m	37m	60m	90m				6
CTD046	22/6/2012	5m	10m	20m	45m	55m	70m				6
CTD047	23/6/2012	5m	10m	20m	25m	30m	40m	60m	80m	125m	9
CTD048	23/6/2012	5m	10m	20m	30m	40m	60m	100m			7
CTD052	24/6/2012	5m	10m	18m	25m	40m	50m	100m			7
CTD054	25/6/2012	5m	10m	13m	20m	25m	60m				6
CTD055	25/6/2012	5m	10m	15m	20m	25m	50m				6
CTD056	26/6/2012	5m	10m	20m	30m	50m					5
CTD057	26/6/2012	5m	10m	15m	20m	35m	70m				6
CTD058	27/6/2012	5m	10m	15m	20m	35m	47m				6
CTD059	27/6/2012	5m	10m	15m	20m	28m	35m	70m			7
CTD060	28/6/2012	5m	10m	25m	35m	50m					5
CTD063	29/6/2012	5m	10m	20m	30m	45m	75m				6
CTD065	29/6/2012	5m	10m	15m	25m	35m	50m				6
CTD067	30/6/2012	5m	10m	15m	20m	30m	50m				6
CTD068	1/7/2012	5m	10m	15m	25m	35m	40m	75m			7

Experimental incubations

DMS and DMSP standing stocks

Samples for standing stocks of DMS and DMSP (total and particulate) were taken from bioassay bottles at T0, T48 and T96 of each bioassay experiment (see Table 2 below for specific bioassay bottle numbers). For T0, samples were taken directly from the Niskin bottles on the CTD cast used to collect the bioassay water. Samples were collected as described in Section 1 above. At T48 and T96, samples were siphoned directly from the bioassay incubation bottles using 6mm silicone tubing into 100ml clear glass-stoppered bottles. The bottles were first rinsed then, allowed to fill to the top, ensuring the presence of no bubbles or headspace. Samples for DMS and total DMSP (DMSPt) were analysed as described above for CTD samples. For particulate DMSP (DMSPp), a 7ml sub-sample was gravity filtered through 25mm GF/F, and the filter was placed in an 8ml glass vial containing 7ml of MilliQ and 1ml of 10M NaOH. DMS samples were analysed within 2 hours of collection, and DMSPt and DMSPp samples were analysed within 12 hours.

DMSP synthesis rates

Specific synthesis rates of DMSP were determined using a stable isotope-based approach, involving tracing the incorporation of ^{13}C into DMSP by proton transfer reaction-mass spectrometry (PTR-MS) (Stefels et al 2010). DMSP production was determined in sub-incubations of the main bioassay experiments at T0, T48 and T96 hours, as detailed in the Table 2 below. Three 500 ml polycarbonate bottles were filled directly from each bioassay bottle, and spiked with tracer concentrations of ^{13}C-H_2CO_3. Samples were taken at T0, then at two further time points over a 9 – 10 hour period. 250ml was gravity filtered through 47mm GF/F, the filter gently folded and placed in a 20ml serum vial with 10ml of Milli-Q and one NaOH pellet, and the vial was crimp-sealed. Samples were stored at -20°C until analysis by PTR-MS at PML.

DMS loss and production rates

DMS loss rates were determined by the addition of tracer-level^{13}C-DMS to dark sub-incubations of seawater. Incubations were performed at T0, T48 and T96 of the five bioassay experiments for the ambient and 750 µatm CO_2 treatments (E01 – E05), during which concentrations of both ^{13}C-DMS and DMS were monitored to determine rates of consumption, net production and gross production of DMS. 500ml of seawater was siphoned from the bioassay bottle into a 1L Tedlar bag. Once filling was complete, all bubbles/headspace were removed from the bag. Each Tedlar bag was spiked with the working solution of ^{13}C-DMS to give concentrations of 0.1 – 0.3 nM. After spiking, the Tedlar bags were left for one hour to allow complete homogenisation of the tracer. The Tedlar bags were incubated in the dark, in the bioassay incubation container. 20ml samples were withdrawn using a glass syringe at T0, and at 3 further time-points over a 12 hour period. The samples were gently filtered through a stainless steel Millipore filtration unit containing 25mm GF/F filter, directly into a 10ml glass syringe. The addition of air/bubbles was kept to a minimum at all times. 8ml of filtered seawater was injected into a glass purge tower. The sample was purged with He gas for 8 minutes at 90 ml/min, and the sample stream was dried by passing through a PTFE counterflow nafion drier, at a flow rate of ~180 ml/min. The sample was trapped in a 1/16" PTFE loop held in liquid nitrogen. Once purging was complete, the sample loop was rapidly submerged in boiling water, injecting the sample into an Agilent 5973N gas chromatograph with mass spectral detector, using a 60m DB-VRX capillary column. The oven was held at 60°C for 8 minutes, and for the remainder of the 10 minute runtime run the oven ramped to 220°C. DMS and ^{13}C-DMS eluted at ~5.3 minutes. In order to monitor system sensitivity and drift, 100 µl of a 5 ppmv deuterated DMS (d6) gas standard was injected upstream of each sample. DMS-d6 eluted at ~5.2 minutes. Table 2 lists the bioassay experiments, CO_2 treatments and bioassay bottle numbers from which dark ^{13}C-DMS-loss and DMS gross production rates were determined.

Table 2: CO_2 treatments and bioassay bottle numbers from which DMS and DMSP parameters were determined. Applies to all bioassay experiments, E01 – E05, T48 and T96.

	Ambient ***Bottle #***			***550 µatm*** ***Bottle #***			***750 µatm*** ***Bottle #***			***1000 µatm*** ***Bottle #***		
T48	*1*	*2*	*3*	*19*	*20*	*21*	*37*	*38*	*39*	*55*	*56*	*57*
T96	*10*	*11*	*12*	*28*	*29*	*30*	*46*	*47*	*48*	*64*	*65*	*66*
Standing stocks DMS & DMSP (total)	√	√	√	√	√	√	√	√	√	√	√	√
DMSP synthesis	√	√	√	√	√	√	√	√	√	√	√	√
DMS consumption and production	√	√	√				√	√	√			

Preliminary results

CTD profiles

DMS and DMSPt concentrations were obtained for the CTD casts listed in Table 1. Surface DMS ranged from 0.72 nM (CTD033) – 16.26 nM (CTD029). The highest observed DMS and DMSPt concentrations of 23.43 nM and 357.70 nM, respectively, were observed at the flouresence maximum from CTD029. Surface DMSPt ranged from 11.08 nM (CTD032) – 287.04 nM (CTD029). In general, elevated DMS and DMSPt were associated with the presence of blooms of *Phaeocystis*, a species known to be a prolific producer of DMSP.

Experimental Incubations

Standing stocks of DMS and DMSP

DMS and DMSP (total and particulate) concentrtations (nM) were quantified for all bioassay experiments at T0, T48 and T96. The results for bioassay E02 are shown in Figure 1 below. For all experiments, no clear effect of pCO_2 treatment on DMS and DMSP was found. The full dataset data will undergo further quality control and statistical analysis upon return to PML.

DMSP synthesis rates

Incubations for calulation of DMSP synthesis rates were made at T0. T48 and T96 of each bioassay experiment. The samples will be analysed upon return to PML, so no data is available at this stage.

DMS consumption and production rates

Rates of DMS consumption, and gross DMS production (nM d^{-1}) have been made for all bioassay experiments at T0, T48 and T96. The data will undergo quality control and finalisation upon return to PML.

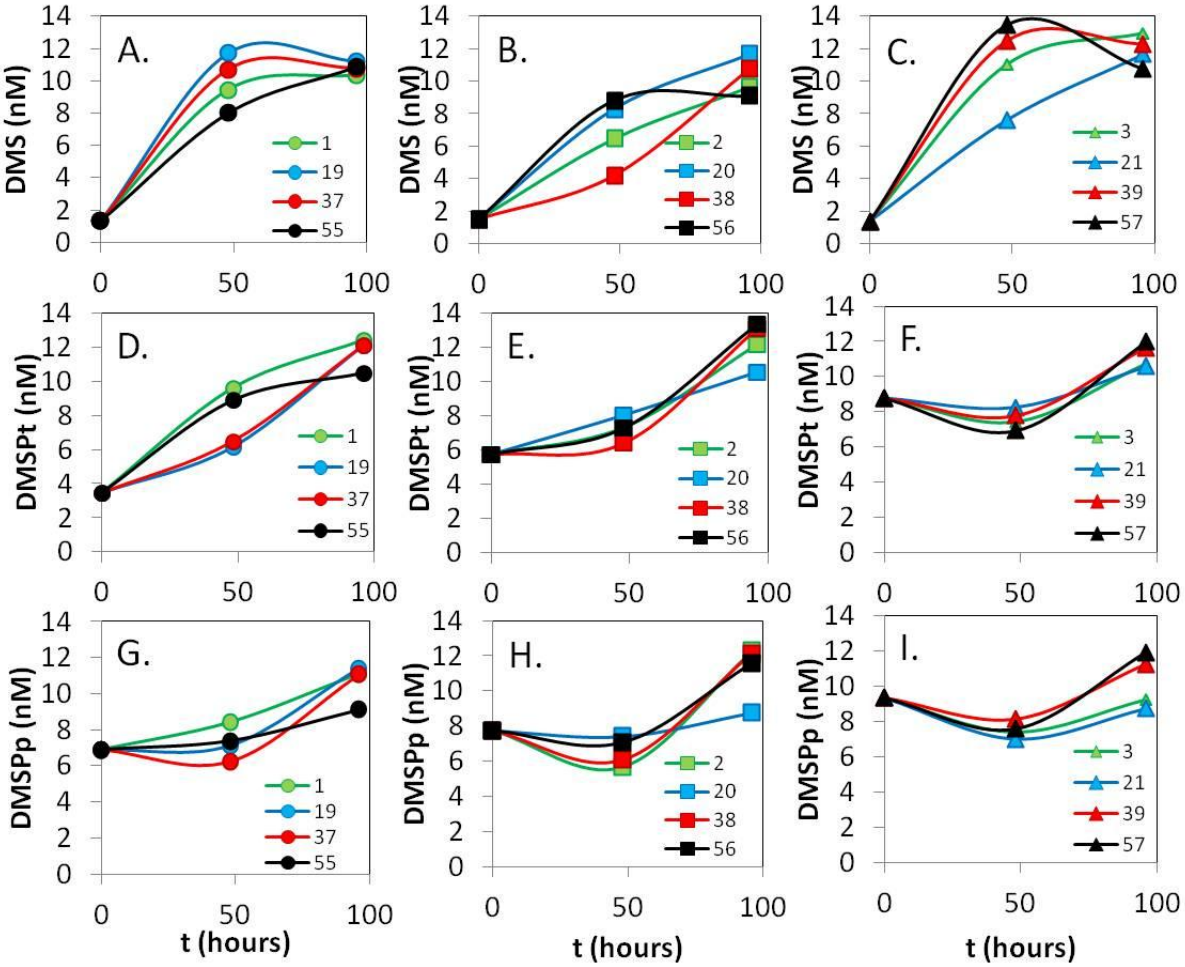

Figure 1. Preliminary standing stocks (nM) of DMS (A-C), DMSP (total) (D-F) and DMSP (particulate) (G –I) from bioassay E02. Green = ambient, blue = 550 µatm, red = 750 µatm, black = 1000 µatm. Legends show bioassay bottle number.

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SCIENTIFIC REPORT 11: Nitrous oxide and methane.

Ian Brown

Introduction

Nitrous oxide and methane are biogenically produced trace gases whose atmospheric concentrations are increasing at a rate in the order of 0.7 ppbv y^{-1}. Both gases are radiatively active, contributing approximately 6% and 15% of "greenhouse effect" respectively, whilst N_2O contributes to stratospheric ozone depletion and CH_4 limits tropospheric oxidation capacity.

The oceans are generally considered to be close to equilibrium relative to the atmosphere for both gases, however oceanic source/sink distributions are largely influenced by oxygen and nutrient status and regulatory processes are complicated and are currently not well understood. Little is known about the effects of ocean acidification on the production of N2O.

Aim

To examine spatial variability in methane production and Nitrous oxide along the cruise tract and in the bioassay CO2 manipulations

Methods

Samples were collected from the surface bioassay manipulations and a single sample run at time points 48hr and 96hr. A further deep manipulation was carried out with water collected from depth and run in triplicate. Samples were also collected from CTD stations identified below. Samples were collected in 1 litre borosilicate bottle. A headspace was generated with compressed air and equilibrated for 15 minutes with the same air. Analysis was performed onboard using FID-gas chromatography and ECD-gas chromatography for CH_4 and N_2O respectively. Atmospheric concentrations were determined by the same method using a tedlar gag filled with a hand pump from the bow when on station. Samples from the bioassays were sampled in the same way. Table 1 lists the CTD casts and depths from which samples for N2O and CH4 were taken. Table 2 lists the bioassay treatments and bottle numbers sampled.

Table 1. CTD sample log: N2O and CH4

CTD cast #	***Date***	***Depth (m)***	***Parameters***
04	3 June 2012	1,10,15,25,40,60	N2O, CH4
06	4 June 2012	5,8,12,20,40,60,100	N2O, CH4
10	7 June 2012	5,20,35,50,100,150	N2O, CH4
17	8 June 2012	5,20,30,40,60,80	N2O, CH4
20	11 June 2012	5,10,15,20,25,40,60	N2O, CH4
27	13 June 2012	5,10,15,25,40,80	N2O, CH4
29	14 June 2012	5,10,15,20,40,65	N2O, CH4
32	16 June 2012	5,10,25,50,60,85	N2O, CH4
39	18 June 2012	5,12,20,25,60,175	N2O, CH4
40	19 June 2012	5,10,16,25,60,150	N2O, CH4
47	23 June 2012	10,20,29,40	N2O, CH4
52	24 June 2012	5,10,18,25,40,50,100	N2O, CH4
54	25 June 2012	5,10,13,20,25,60	N2O, CH4
58	27 June 2012	5,10,20,25,35,47,125	N2O, CH4
63	29 June 2012	5,10,20,30,45,75,125,350	N2O, CH4
65	30 June 2012	5,10,15,25,25,35,50,150	N2O, CH4
68	31 June 2012	5,10,25,35,75,150	N2O, CH4

Table 2. CO_2 treatments and bioassay bottle numbers from which deep N2O and CH4 were determined. Applies to all bioassay experiments D01 – E05

	Ambient ***Bottle #***	***550 µatm*** ***Bottle #***	***750 µatm*** ***Bottle #***	***1000 µatm*** ***Bottle #***
T48	2	5	8	11
T96	3	6	9	12
N2O – CH4	√	√	√	√

Table 3. CO_2 treatments and bioassay bottle numbers from which surface N2O and CH4 were determined. Applies to all bioassay experiments E01 – E05

	Ambient ***Bottle #***			***550 µatm*** ***Bottle #***			***750 µatm*** ***Bottle #***			***1000 µatm*** ***Bottle #***		
T48	*4*	*5*	*6*	*22*	*23*	*24*	*40*	*41*	*42*	*58*	*59*	*60*
T96	*13*	*14*	*15*	*31*	*32*	*33*	*49*	*50*	*51*	*67*	*68*	*69*
N2O – CH4	√			√			√			√		

SCIENTIFIC REPORT 12: N-cycling in an acidified ocean.

Darren Clark

Introduction

Nitrogen is a major element for phytoplankton growth. However, the concentration and composition of the dissolved inorganic nitrogen pool in seawater is highly variable in the world's ocean and frequently limits both the rate and extent of autotrophic primary production. Conversely, heterotrophic nutrient regeneration has an important role to play in elemental cycles, increasing the efficiency with which potentially limiting nutrients such as nitrogen are utilised by the autotrophic community. The aim of this study was to investigate the assimilation and regeneration of dissolved inorganic nitrogen, both within the present-day ocean and under simulated OA conditions of the future ocean under projected global warming scenarios.

Aims

To estimate the rate of NH_4^+ regeneration and NH_4^+ oxidation under simulated OA conditions using seawater collected near surface (approx. 5 m) and at depth (approx. 60 m). These rates will be complimented with measurements of nitrous oxide concentration and an investigation of nitrifying community composition using molecular biology techniques.

Using seawater collected at discrete stations during CTD casts, undertake simultaneous estimations of N-assimilation rate (as NO_3^-, NO_2^- and NH_4^+) and N-regeneration rate (as NH_4^+ regeneration, NH_4^+ oxidation and NO_2^- oxidation). Process studies will be complimented with measurements of nitrous oxide concentration and an investigation of nitrifying community composition using molecular biology techniques.

Methods

OA arrays. Seawater samples collected from OA CTD's (To) or bottle treatments (T48, T96) were used to derive NH_4^+ regeneration and NH_4^+ oxidation rates using isotope dilution methods described in Clark et al. 2006, 2007. Briefly, $^{15}NH_4^+$ (99at%) or $^{15}NO_2^-$ was added to triplicate 1L bottles at an estimated 10% ambient [NH_4^+] or [NO_2^-] respectively . Samples were mixed and used to fill triplicate 500 ml incubation bottles which were placed in the temperature controlled container for 24 hours. The remaining volume was used to derive pre-incubation DIN concentration and isotopic enrichment. Following incubations, samples were filtered and used for the determination of post-incubation DIN concentration and isotopic enrichment. Additional volumes of un-amended water from OA treatments were filtered with sterivex cartridges and frozen at -80°C.

Seawater collected from approx. 5m during CTD casts were used to derive N-assimilation and N-regeneration rates using methods described previously (Clark et al. 2011). N-assimilation rates were estimated from the ^{15}N enrichment of particulate organic nitrogen during incubations of seawater amended with $^{15}NH_4^+$, $^{15}NO_2^-$, or $^{15}NO_3^-$. Isotope dilution approaches described for OA studies were used to derive N-regeneration rates.

Results.

From the point at which samples are received at PML, analysis will take approximately 3 months to complete with data being made available in the following month.

Table of sample stations

OA arrays 1-5.

Time point	Treatment	Depth	Parameter
To	Ambient	'Surface'	NH_4^+ regeneration
			NH_4^+ oxidation
			Nitrifier composition (molec. biol)
'Deep' (60m)		NH_4^+ regeneration	
			NH_4^+ oxidation
			Nitrifier composition (molec. biol)
T48/T96	550/750/1000	surface/deep	As above

CTD casts.

Date	CTD cast	Bottle/depth/Volume	Parameter
4/6/12	6	21/8m/ 15L	$[NH_4^+]$
			$[NO_2^-]$
			$[NO_3^-]$
			[PON]
			NH_4^+ assimilation
			NO_2^- assimilation
			NO_3^- assimilation
			NH_4^+ regeneration
			NH_4^+ oxidation
			NO_2^- oxidation
			(N_2O concentration)
	Nitrifier composition (molec. biol)		
6/6/12	10	24/5m/15L	As above
11/6/12	20	24/5m/15L	As above
14/6/12	29	24/5m/15L	As above
16/6/12	32	24/5m/15L	As above
23/6/12	47	24/5m/15L	As above
24/6/12	52	24/5m/15L	As above
25/6/12	54	24/5m/15L	As above
27/6/12	58	24/5m/15L	As above
29/6/12	63	24/5m/15L	As above
30/6/12	65	24/5m/15L	As above

References

Clark, D.R., Miller, P.I., Woodward, E.M.S., Rees, A.P. (2011). Inorganic nitrogen assimilation and regeneration in the coastal upwelling region of the Iberian Peninsula. *Limnology and Oceanography*. 53:1689-1702.

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Clark, D.R., T.W. Fileman, I. JOINT. (2006). Determination of ammonium regeneration rates in the oligotrophic ocean by gas chromatography/mass spectrometry. *Marine Chemistry*. 98: 121–130, doi:10.1016/j.marchem.2005.08.006

SCIENTIFIC REPORT 13: Dissolved inorganic and organic nutrient concentrations.

Mario Esposito

Objective

My objective on JR271 Arctic cruise was to measure the concentrations of inorganic nutrients on seawater samples collected along the track and from on board experiments using segmented flow analysis. Samples were also collected for analysis of dissolved organic nutrients (DON, DOP and DOC).

Sampling

Samples for the analysis of inorganic nutrients (NO_3^- + NO_2^- , PO_4^{3-} and $Si(OH)_4$) were collected directly from Niskin bottles into 30 ml coulter counter vials after samples for oxygen, dissolved inorganic carbon and alkalinity were drawn. Sampling vials were rinsed at least 3 times by half filling with the seawater being sampled and shaking vigorously before sample collection. A silicon tube from the sampling tap of the Niskin bottle was used to carefully fill the vials. Tested nutrient-free vinyl gloves were warn during sampling to avoid potential contamination. Samples were collected from all the stations at all depths. During the transit, every two hours additional surface samples from the non-toxic supply were collected and analysed. Further samples from incubation experiments were analysed too. A full list of nutrient samples collected and analysed is shown in Table 1.

Analysis

Samples were analysed immediately after collection to avoid any possibility of biological growth or decay in the samples. In few occasions, samples were stored in the fridge and analysed within maximum 12 hours. Inorganic nutrients were measured using the Skalar San^{plus} segmented-flow autoanalyser. The system is set up for analysis and data logging with the Flow Access software package version 1.2.5. The general analytical method is based on colorimetric chemical reactions of nutrient with specific metals. The intensity of the colour of the solution is proportional to the concentration of the reacted nutrient. The concentration is determined by measuring the absorbance of light using a photometer. The methods used are that of Kirkwood (1984) for the determination of nitrate/nitrite, that of Murphy and Riley (1962) for phosphate and that of Koroleff (1971) modified by Grasshoff (1983) and reported in Kirkwood (1984) for the determination of silicate. The analyses were calibrated with a set of 4 working standards with nitrate, silicate and phosphate concentrations appropriate to the samples being analysed as shown in Table 2.

Stock solutions (5 mM) were used to prepare new working standards every three to four days. Stock standards were prepared with Milli-Q water, while working standards were prepared in a saline matrix - 40 g NaCl per 1L of Milli-Q water - also referred to as artificial seawater. Most CTD casts were analysed in single runs together with underway and/or samples from bioassays. Every run included of a set of standards, wash and drift cups, certified low nutrient sea water in order to test for contamination of the matrix and samples, and OSIL certified standards to monitor the performance of the analyser. A new cadmium column was placed at the beginning of the cruise and the autoanalyser pump tubing was changed every 7-10 days.

Problems encountered and troubleshooting

On day 15 of the cruise the Skalar “SA 8503 Interface” stopped working. Initially a replacement of the fuse solved the problem. Two days later the fuse blew again without any evident sign of where or what the fault was. Fortunately a spare interface was packed for this cruise. The part was therefore replaced. Once connected, at the beginning the phosphate and the silicate line were not recognised but a small change in the software settings solved the problem.

On day 20 the nitrate signal exhibited a very noisy baseline with extremely high peaks. The cause was thought to be due to the presence of small cadmium granules in the cell. While cleaning, the

cell input line cracked therefore the replacement with a new one was necessary. Once changed, a few hours were needed for the baseline to stabilise and be ready for a new run.

Quality Assessment

The consistency of the analysis was monitored by recording the baseline (digital units, DU) and calibration coefficients of the three nutrient channels measured over time. Mean values and standard deviations of baselines and correlation coefficients are presented in Table 3. The variations observed throughout the cruise were within the analytical error of the method. The consistency of the analyses was also tested by measuring on every run OSIL certified standards. A total of 74 aliquots of this standards were measured and the mean values were 9.97 ± 0.16, 1.00 ± 0.02 and 9.98 ± 0.05 µM for nitrate, phosphate and silicate respectively. The standard deviation of the mean nutrient concentrations of these standards represents variations of less than 2.0 %. In order to check the performance and reproducibility of the results, one of the sample was measured in triplicate in each run and the values averaged to give a mean value and a standard deviation error. The average standard deviations for all the runs were 0.04, 0.01 and 0.007 µM for NO_3^{2-}, PO_4^{3-} and $Si(OH)_4$, respectively. The precision of the method was further tested analysing the variations of the complete set of the measured standards. The results of the more than 300 measurements carried out per calibration standard are showed in Table 4.

Organic Nutrients

Sampling and storing: A total of 376 samples for analysis of dissolved organic nutrients (DON, DOP and DOC) were collected directly from the CTD Niskin bottles into 60 ml Sterilin white plastic cups. The containers were rinsed at least 3 times with the sampled water before collection. The pots were appropriately labelled and placed in a freezer until analysis back in NOCS (National Oceanographic). Samples were collected from all the stations surveyed at the same depths as the inorganic nutrients.

Table 1. List of all inorganic nutrients sampled on JR271 cruise. In brackets it is shown the number of samples for CTD casts, GoFlo and bioassays. UW=Underway samples.

ID	Date	Time	ID	Date	Time	ID	Date	Time
UW01	03/06/12	12:00	UW54	08/06/12	20:05	UW107	13/06/12	20:04
UW02	03/06/12	14:00	UW55	08/06/12	22:00	UW108	13/06/12	22:00
UW03	03/06/12	16:05	UW56	09/06/12	00:00	UW109	14/06/12	00:00
UW04	03/06/12	18:00	UW57	09/06/12	02:05	UW110	14/06/12	00:30
UW05	03/06/12	20:05	UW58	09/06/12	11:00	UW111	14/06/12	01:00
UW06	03/06/12	22:05	UW59	09/06/12	13:20	UW112	14/06/12	01:30
UW07	03/06/12	00:07	UW60	09/06/12	16:00	UW113	14/06/12	02:00
UW08	04/06/12	02:01	UW61	09/06/12	18:00	UW114	14/06/12	02:37
UW09	04/06/12	04:00	UW62	09/06/12	20:05	UW115	14/06/12	04:00
UW10	04/06/12	08:55	UW63	09/06/12	22:00	UW116	14/06/12	06:00
UW11	04/06/12	10:20	UW64	10/06/12	02:30	UW117	14/06/12	10:07
UW12	04/06/12	12:08	UW65	10/06/12	04:28	UW118	14/06/12	14:10
UW13	04/06/12	14:00	UW66	10/06/12	06:00	UW119	14/06/12	16:10
UW14	04/06/12	16:00	UW67	10/06/12	08:00	UW120	18/06/12	16:10
UW15	04/06/12	18:05	UW68	10/06/12	10:00	UW121	19/06/12	10:00
UW16	04/06/12	20:01	UW69	10/06/12	12:02	UW122	19/06/12	12:00
UW17	04/06/12	22:00	UW70	10/06/12	14:19	UW123	19/06/12	14:06
UW18	05/06/12	01:02	UW71	10/06/12	16:00	UW124	19/06/12	16:03
UW19	05/06/12	04:01	UW72	10/06/12	18:07	UW125	19/06/12	18:00
UW20	05/06/12	06:04	UW73	10/06/12	20:00	UW126	19/06/12	20:14
UW21	05/06/12	12:10	UW74	10/06/12	22:00	UW127	19/06/12	22:00
UW22	05/06/12	14:04	UW75	11/06/12	00:00	UW128	20/06/12	01:10
UW23	05/06/12	16:04	UW76	11/06/12	02:00	UW129	20/06/12	04:05
UW24	05/06/12	18:01	UW77	11/06/12	04:45	UW130	20/06/12	06:00
UW25	05/06/12	20:00	UW78	11/06/12	06:04	UW131	20/06/12	08:04
UW26	05/06/12	22:00	UW79	11/06/12	08:00	UW132	20/06/12	10:00
UW27	06/06/12	01:00	UW80	11/06/12	10:03	UW133	20/06/12	12:00
UW28	06/06/12	04:06	UW81	11/06/12	12:00	UW134	20/06/12	14:00
UW29	06/06/12	08:01	UW82	11/06/12	14:24	UW135	21/06/12	10:00
UW30	06/06/12	10:30	UW83	11/06/12	16:20	UW136	21/06/12	14:00
UW31	06/06/12	12:06	UW84	11/06/12	18:11	UW137	21/06/12	16:00
UW32	06/06/12	14:01	UW85	11/06/12	20:15	UW138	21/06/12	18:00
UW33	06/06/12	15:55	UW86	11/06/12	22:14	UW139	21/06/12	20:02
UW34	06/06/12	19:05	UW87	12/06/12	01:20	UW140	21/06/12	22:00
UW35	06/06/12	21:05	UW88	12/06/12	04:19	UW141	22/06/12	01:08
UW36	06/06/12	23:00	UW89	12/06/12	06:01	UW142	22/06/12	04:15
UW37	07/06/12	01:20	UW90	12/06/12	08:00	UW143	22/06/12	06:00
UW38	07/06/12	04:05	UW91	12/06/12	10:00	UW144	22/06/12	11:00
UW39	07/06/12	06:00	UW92	12/06/12	12:08	UW145	22/06/12	13:30
UW40	07/06/12	09:06	UW93	12/06/12	14:08	UW146	22/06/12	16:00
UW41	07/06/12	12:10	UW94	12/06/12	16:04	UW147	22/06/12	18:10
UW42	07/06/12	14:10	UW95	12/06/12	18:03	UW148	22/06/12	20:00
UW43	07/06/12	16:10	UW96	12/06/12	20:12	UW149	22/06/12	22:04
UW44	07/06/12	18:00	UW97	12/06/12	22:02	UW150	23/06/12	01:00
UW45	07/06/12	20:00	UW98	13/06/12	01:02	UW151	23/06/12	04:10
UW46	07/06/12	22:00	UW99	13/06/12	04:16	UW152	23/06/12	08:00
UW47	08/06/12	01:05	UW100	13/06/12	06:00	UW153	23/06/12	10:00
UW48	08/06/12	06:00	UW101	13/06/12	08:50	UW154	23/06/12	12:00
UW49	08/06/12	10:00	UW102	13/06/12	11:09	UW155	23/06/12	14:06
UW50	08/06/12	12:00	UW103	13/06/12	13:00	UW156	23/06/12	16:00
UW51	08/06/12	14:00	UW104	13/06/12	15:06	UW157	23/06/12	17:50
UW52	08/06/12	16:15	UW105	13/06/12	17:09	UW158	23/06/12	20:00
UW53	08/06/12	18:10	UW106	13/06/12	18:31	UW159	23/06/12	22:00

Table 1. (continued).

ID	Date	Time
UW160	24/06/12	00:10
UW161	24/06/12	10:00
UW162	24/06/12	12:00
UW163	24/06/12	14:05
UW164	24/06/12	16:00
UW165	24/06/12	18:00
UW166	24/06/12	20:00
UW167	24/06/12	22:00
UW168	24/06/12	23:55
UW169	25/06/12	02:50
UW170	25/06/12	06:00
UW171	25/06/12	12:00
UW172	25/06/12	14:10
UW173	25/06/12	16:05
UW174	25/06/12	20:00
UW175	25/06/12	22:00
UW176	26/06/12	00:12
UW177	26/06/12	02:00
UW178	26/06/12	04:10
UW179	26/06/12	08:05
UW180	26/06/12	12:00
UW181	26/06/12	13:58
UW182	26/06/12	16:00
UW183	26/06/12	18:00
UW184	26/06/12	20:00
UW185	26/06/12	22:00
UW186	27/06/12	00:02
UW187	27/06/12	02:20
UW188	27/06/12	04:10
UW189	27/06/12	08:00
UW190	27/06/12	12:00
UW191	27/06/12	14:00
UW192	27/06/12	16:05
UW193	27/06/12	18:00
UW194	27/06/12	20:00
UW195	27/06/12	22:00
UW196	28/06/12	00:00
UW197	28/06/12	01:55
UW198	28/06/12	04:00
UW199	28/06/12	08:00
UW200	28/06/12	12:01
UW201	28/06/12	14:00
UW202	28/06/12	16:00
UW203	28/06/12	17:57
UW204	28/06/12	20:00
UW205	28/06/12	22:20
UW206	29/06/12	00:00
UW207	29/06/12	02:00
UW208	29/06/12	04:00
UW209	29/06/12	08:00
UW210	29/06/12	12:00
UW211	29/06/12	14:00
UW212	29/06/12	16:15

ID	Date	Time
UW213	29/06/12	18:00
UW214	29/06/12	20:00
UW215	29/06/12	22:00
UW216	30/06/12	01:30
UW217	30/06/12	08:30
UW218	30/06/12	12:00
UW219	30/06/12	14:00
UW220	30/06/12	16:00
UW221	30/06/12	18:20
UW222	30/06/12	20:10
UW223	30/06/12	22:00
UW224	30/06/12	00:02
UW225	01/07/12	02:05
UW226	01/07/12	04:10
UW227	01/07/12	08:00
UW228	01/07/12	12:00
UW229	01/07/12	14:00
UW230	01/07/12	16:00

Station	Date	CTD
1	03/6/12	004 (19)
1	03/6/12	005 (10)
2	04/6/12	006 (21)
2	04/6/12	007 (8)
3	05/6/12	008 (9)
3	05/6/12	009 (12)
4	06/6/12	010 (8)
4	06/6/12	011 (12)
5	07/6/12	012 (10)
5	07/6/12	013 (19)
6	08/6/12	017 (9)
6	08/6/12	018 (12)
7	10/6/12	019 (9)
8	11/6/12	020 (19)
9	12/6/12	021 (9)
9	12/6/12	022 (21)
10	13/6/12	027 (9)
10	13/6/12	028 (12)
11	14/6/12	029 (8)
12	15/6/12	030 (9)
13	15/6/12	031 (9)
14	16/6/12	032 (9)
15	17/6/12	033 (9)
16	17/6/12	034 (20)
18	18/6/12	039 (7)
19	19/6/12	040 (8)
20	19/6/12	041 (9)
21	20/6/12	042 (9)
25	21/6/12	044 (9)
26	22/6/12	045 (9)
27	22/6/12	046 (8)
28	23/6/12	047 (9)

Station	Date	CTD
29	23/6/12	048 (8)
30	24/6/12	052 (9)
31	24/6/12	053 (9)
32	25/6/12	054 (8)
33	25/6/12	055 (9)
34	26/6/12	056 (9)
35	26/6/12	057 (9)
36	27/6/12	058 (10)
37	27/6/12	059 (10)
38	28/6/12	060 (10)
38	28/6/12	061 (24)
39	29/6/12	062 (10)
40	29/6/12	063 (9)
41	29/6/12	064 (10)
42	30/6/12	065 (10)
42	30/6/12	066 (14)
43	30/6/12	067 (10)
44	01/7/12	068 (10)
44	01/7/12	069 (11)
45	01/7/12	070 (14)

Station	Date	GoFlo
11	14/6/12	001 (8)
12	15/6/12	002 (7)
14	16/6/12	003 (7)
15	17/6/12	004 (6)
18	18/6/12	005 (8)
19	19/6/12	006 (9)
21	20/6/12	007 (9)
26	22/6/12	008 (8)
28	23/6/12	009 (6)
30	24/6/12	010 (9)
32	25/6/12	011 (8)
34	26/6/12	012 (9)
36	27/6/12	013 (9)
40	29/6/12	014 (8)

Bioassay	Date
E01 Initial (3)	03/6/12
E01 48hrs (36)	05/6/12
E01 96hrs (48)	07/6/12
E02 Initial (4)	08/6/12
E02 48hrs (39)	10/6/12
E02 96hrs (42)	12/6/12
E03 Initial (4)	13/6/12
E03 48hrs (42)	15/6/12
E03 96hrs (42)	17/6/12
E04 Initial (4)	18/6/12
E04 48hrs (36)	20/6/12
E04 96hrs (42)	22/6/12
E05 Initial (4)	24/6/12
E05 48hrs (42)	26/6/12
E05 96hrs (42)	28/6/12

Table 2. Set of calibration standards used for nutrient analysis on JR271. Concentrations are in µM.

	NO_3^-	PO_4^{3-}	$Si(OH)_4$
Std 1	19.63	2.03	19.69
Std 2	9.83	1.52	9.85
Std 3	4.92	1.02	4.94
Std 4	1.00	0.51	1.00

Table 3. Nutrient analysis: statistics of analytical parameters. Baseline values are in digital units (DU).

	Mean Baseline (DU)	**Baseline Std. Dev %**	**Mean Correlation Coefficient (r^2)**
NO_3^-	1908619	0.5	0.99997
PO_4^{3-}	932442	0.7	0.99992
$Si(OH)_4$	131524	2.5	0.99999

Table 4. Mean values and standard deviations of all standard measured. Concentrations are in µM.

	NO_3^-	PO_4^{3-}	$Si(OH)_4$
Std 1	19.65 ± 0.15	2.03 ± 0.01	19.70 ± 0.05
Std 2	9.87 ± 0.09	1.52 ± 0.01	9.85 ± 0.05
Std 3	4.96 ± 0.05	1.02 ± 0.01	4.92 ± 0.03
Std 4	0.98 ± 0.04	0.51 ± 0.005	1.02± 0.03

SCIENTIFIC REPORT 14: Ammonium measurements in water column and zooplankton experiments.

Eric Achterberg

Introduction

My contribution towards the research activities on the cruise consisted of undertaking ship-board measurements of ammonium in water column samples at all stations and in zooplankton experiments.

Materials and methods

Samples for water column measurements of ammonium were taken from the 20 L OTE bottles deployed on the stainless steel CTD rosette frame. Samples were taken on a daily basis, and all CTD stations sampled with the stainless frame were covered. Samples for ammonium were collected in polypropylene vials and reagent added, with subsequent fluorimetric analysis 24 h later. The method by Kerouel, Aminot (1997) was followed, allowing nanomolar ammonium concentrations to be determined. Typically 8-10 depths were covered for a CTD cast.

Ammonium measurements were also undertaken in the zooplankton respiration and zooplankton pCO_2 perturbation experiments. For this purpose, ca. 20-30 ml of sample was poured from the incubation bottles into a polypropylene vial and reagent was added. The same protocol as for the water column samples was followed.

Results

Ammonium measurements at sea were successful. The concentrations were typically lower in the surface mixed layer (typically 10-400 nM) with enhanced concentrations (typically between 400-900 nM, but as high as 2 to 3 µM) at depth below the mixed layer as a result of bacterially mediated organic matter remineralisation. At the deeper stations, the ammonium concentrations decreased to < 10 nM at depths below 150-200 m.

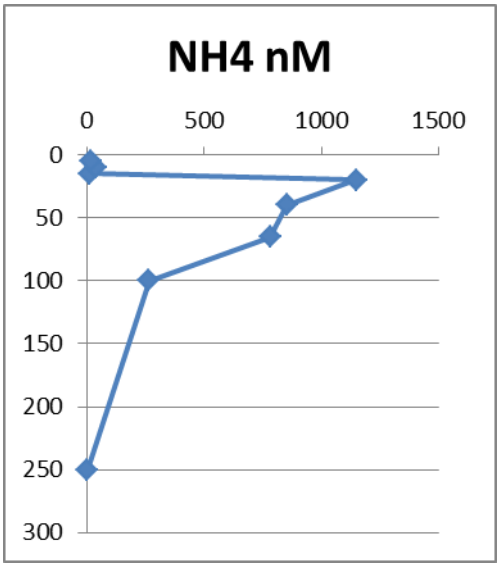

Figure 1 shows an example of a depth profile for station 11, with depth in meters on y axis and ammonium concentrations in nM on x axis.

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SCIENTIFIC REPORT 15: Distribution of dissolved and total dissolvable trace metals in Arctic Waters

Gianna Battaglia and Eric Achterberg

Introduction

Iron (Fe) and other trace metals (zinc, cadmium, etc.) have been shown to be (co)limiting nutrients for phytoplankton growth in the surface oceans (Boyd, et al., 2000; Coale et al., 2004; Croot et al., 2005). Yet, little is known about the processes by which these elements are supplied to surface waters (Aeolian dust, resuspension of continental shelf sediments) and which mechanisms govern scavenging/uptake, solubility, mineralization, or remineralization in the water column. Data are particularly scarce for Arctic Waters. Determining the dissolved and particulate trace metal (Fe, Mn, Co, Cd, Zn, Cu, Pb, Ba) distributions within the scope of this work will therefore help fill this gap and allow inferring and quantifying the processes which are controlling primary productivity, biogeochemical processes and supply and removal of trace metals in Arctic Waters.

Methods

Sampling

The water column was sampled using a titanium frame CTD with trace metal clean 10 L OTE (Ocean Test Equipment) sampling bottles (see Table 1) on 12 out of 26 occasions. On the other 14 occasions, the water column profiles were collected using 10 L OTE bottles on a plastic coated wire (see Table 1). The sample bottles were always transferred to a clean container on the aft deck for water sampling. Seawater was gravity filtered (using 0.2 μm Acropack filter cartridges) for dissolved trace metal and collected in Nalgene LDPE bottles (125ml or 250ml). In addition, sampled were collected (unfiltered) for total dissolvable trace metals.

In addition, surface water samples (filtered and unfiltered) were collected from the NMF towed fish deployed from a winch on the working deck, some 3-4 m from the side of the ship and at a depth of about 2-3 m. From the fish, samples were pumped to the trace metal clean sampling container via a totally enclosed system with suction provided by Teflon pump. Samples were collected every two to four hours while the ship was in transit. At selected stations, 1000 ml of filtered water was sampled from the towfish and frozen (not acidified) immediately for Fe and Cu ligand titrations back home at NOCS.

All samples were acidified after collection using ultra-clean HCl acid (145 μl for 125 ml of sample, 290 μl for 250 ml of samples, 1160 μl for 1000 ml of sample).

Samples for phosphate, nitrate, and salinity measurements were taken at all stations.

Analysis

Selected filtered water samples from the CTDs were analysed on board for dissolved Fe via flow injection analysis techniques using luminol-Fe(III) chemiluminescence (FIA-CL) (Obata and al., 1996). Also, for each bioassay breakdown, 6 random samples were analysed for Fe contamination in the bioassay setup.

Replicate water samples from the CTDs will be analysed for a range of trace metals, e.g. Fe, Mn, Co, Cd, Zn, Cu, Pb, Ba by isotope dilution inductively coupled plasma mass spectrometry (ID-ICP-MS) back at NOCS. Also at NOCS the Fe and Cu ligand titrations will be done electrochemically via competitive ligand exchange cathodic stripping voltammetry (CLE-CSV) (Croot and Johansson, 2000).

Unfiltered samples will be stored for >6 months before analysis.

Table 1: Sampling Scheme for dissolved and particulate trace metal analysis

Station	Date	Lat	Long	Cast	Depth (m)
1	03/06/2012	56.26665 N	2.63323 E	CTD 005	60 50 40 30 25 20 15 10 5 1
2	04/06/2012	58.73967 N	0.86148 W	CTD 007	100 80 60 40 30 25 20 15
3	05/06/2012	60.13425 N	6.71212 W	CTD 009	1100 900 700 500 400 300 200 150 100 80 40 20
4	06/06/2012	59.97105 N	11.97509 W	CTD 011	1200 1000 800 600 500 400 275 150 100 50 30 20

Table 1: (Continued)

5	07/06/2012	60.00145 N	18.67024 W	CTD 012	275 200 150 100 65 40 30 20 10 5
5	07/06/2012	60.00143 N	18.67029 W	CTD 013	2500 2000 1600 1200 1000 800 600 500 400 275 200 150 100 65 40 30 20 10 5
6	08/06/2012	60.59420 N	18.85652 W	CTD 018	1000 800 600 400 300 200 150 100 60 40 30 20

Table 1: (Continued)

9	12/06/2012	74.11646 N	4.69305 W	CTD 022	3462 3250 3000 2750 2500 2000 1750 1250 1000 750 500 250 150 100 80 60 50 40 30 20 10
10	13/06/2012	76.17525 N	2.54957 W	CTD 028	1000 800 600 400 200 150 100 80 60 40 20 10
11	14/06/2012	78.71806 N	0.00010 W	GF1	400 300 200 150 100 60 40 20

Table 1: (Continued)

12	15/06/2012	78.23377 N	5.56322 W	GF2	320 280 230 180 100 40 15
14	16/06/2012	78.20889 N	5.99663 W	GF3	330 230 130 80 60 40 25
15	17/06/2012	77.80667 N	4.93323 W	GF4	200 100 80 50 35 25
18	18/06/2012	78.26295 N	4.34280 W	GF5	500 400 300 200 150 100 40 25
19	19/06/2012	77.85295 N	1.26999 W	GF6	500 400 300 200 150 100 60 40 25
21	20/06/2012	78.99276 N	7.97375 E	GF7	500 460 300 200 150 100 60 40 20

Table1: (Continued)

26	22/06/2012	76.26200 N	12.54163 E	GF8	500 400 300 200 120 60 40 25
28	23/06/2012	76.15638 N	2607028 E	GF 9	110 90 70 50 30 15
30	24/06/2012	72.88871 N	26.00531 E	GF 10	350 300 250 200 150 100 60 40 25
32	25/06/2012	71.75197 N	17.90070 E	GF 11	260 200 150 100 80 50 40 20
34	26/06/2012	71.74751 N	8.44273 E	GF 12	500 400 300 200 150 100 60 40 20

Table 1: (Continued)

36	27/06/2012	71.74529 N	1.26729 W	GF 13	500 400 300 200 150 100 60 40 20
38	28/06/2012	71.75038 N	10.57339 W	CTD 061	2180 2330 2300 1900 1700 1500 1300 1100 900 700 600 500 400 300 200 150 100 80 60 50 40 30 20 10
40	29/06/2012	68.69511 N	10.57605 W	GF 14	400 300 200 150 100 60 40 20

Table 1: (Continued)

42	30/06/2012	67.83043 N	16.42179 W	CTD 066	1026 900 800 700 500 400 300 200 150 100 80 60 40 20
44	01/07/2012	67.27095 N	24.05761 W	CTD 069	660 600 500 400 300 200 150 80 60 40 20

Preliminary Results

Three example profiles measured on board are presented in

Figure **2**. At station 4 and at station 26, dissolved Fe concentrations show a general increase with depth (from 0.5 nM in the surface to around 1 nM in deeper waters (note the different scales on the y-axis)). Station 21 shows increased surface water concentrations (at around 1 nM) and decreases with depth (to about 0.5 nM).

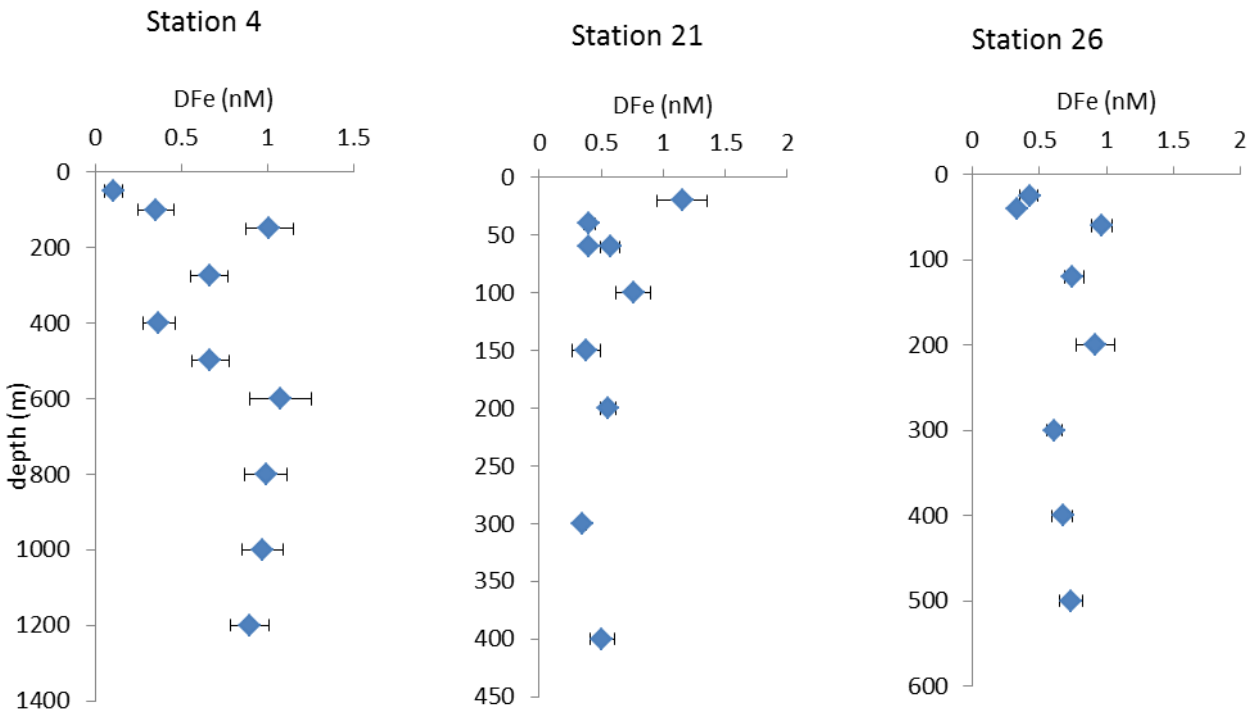

Figure 2: Exemplary dissolved Fe profiles for three different stations (note different y-axis scale).

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SCIENTIFIC REPORT 16 Dissolved Organic Carbon (DOC) and Transparent Exopolymer Particles (TEP)

Tingting Shi

Introduction

Oceanic dissolved organic carbon (DOC) is one of the major carbon reservoirs on the Earth. DOC serves as substrate to vast heterotrophic microbial populations and the export of DOC throughout the ocean water column plays an important role in the biological pump (Hansell, Carlson, Repeta, & Schlitzer, 2009). Besides DOC mixed downward from the surface ocean, passively sinking particulate carbon is another main component of the biological pump (Hansell et al., 2009). The sinking of the particulate carbon can be accelerated by the existence of the transparent exopolymer particles (TEP) (Passow 2002). TEP are polymeric gel particles that form from dissolved or colloidal extracellular acid polysaccharides by abiotic processes in the seawater (Engel 2002; Engel & Passow 2001). Since TEP are rich in carbon relative to the Redfield ratio (C:N:P 106:16:1), the production of TEP may be the result of a cellular carbon overflow, and the sedimentation of TEP may be a selective export of carbon from the surface ocean to the deep water (Passow 2002).

Ocean acidification, as a consequence of the accumulating atmospheric carbon dioxide (CO_2) permeating into the ocean (Raven et al., 2005), has become one of the global problems and received considerable worldwide attention. The effects of ocean acidification on marine organisms and biogeochemical cycles are less well understood. Therefore several large research programmes on ocean acidification have been launched or will start shortly (Tyrrell, 2011). DOC and TEP, as important components of oceanic carbon cycle, are well worth investigating.

Objectives

The objectives of the study on this cruise were 1) to investigate the vertical distributions of DOC and TEP in surface water in the studied Arctic area; 2) to work out the effects of pCO_2 perturbations on DOC and TEP production. This study was a continuation of the work on the UK shelf research cruise, as part of the UK Ocean Acidification project.

Methodology

DOC sampling and analysis
Seawater samples were taken from CTD casts and pCO_2 perturbation bioassay experiments. Sampling details are shown in the tables at the end of this report. Water taken from shallower than 300 m from CTD bottles was filtered using pre-combusted (450 °C, > 5 h) GF/F filters to remove the particulate carbon and most organisms in the seawater. And all samples from bioassay experiments were filtered. Samples were collected into pre-combusted glass vials and acidified to pH < 2 with 40 µL 50% HCl immediately after collection. The vials were then closed with acid-cleaned PTFE lined polypropylene caps and stored in fridge (4 °C) for post-cruise analysis on return to the UK.

DOC samples will be analysed using the high temperature combustion technique. The principle of this technique is to combust the dissolved organic carbon compounds in the samples into CO_2 and measure the amount of generated CO_2. Filtered and acidified seawater samples are to be sparged with oxygen to remove dissolved inorganic carbon from the water and then injected into a combustion column. The non-purgeable organic carbon in the sample is combusted at 680 °C and converted to CO_2, which can be detected by a non-dispersive infrared detector (NDIR). A Shimadzu TOC-TDN instrument (TOC V_{CPN}) will be used for DOC analysis.

TEP sampling and analysis
Seawater was taken from CTD casts, bioassay experiments and Marine Snow Catchers. Sampling details are shown in the tables at the end of this report. TEP were collected by filtering the seawater through 0.45 µm pore-size polycarbonate filters (25 mm in diameter) at constant 200 mBar vacuum. Three replicates were filtered for each seawater sample. The particles retained on the filters were stained with 500 µL of 0.02% aqueous Alcian Blue in 0.06% acetic acid (pH = 2.5).

The dye was pre-filtered with 0.2 µm pore-size polycarbonate filters before use. After being stained, filters were rinsed once with Milli-Q water and put into 15 mL polypropylene centrifuge tubes. Filters were then stored in freezer at - 20 °C for post-cruise analysis on return to the UK.

TEP will be analysed using a colorimetric technique. The particles can be detected by staining with Alcian Blue, a cationic copper phthalocyanine dye that combines with carboxyl (-COO-) and half-ester sulphate (-OSO3-) reactive groups of acidic polysaccharides (Passow & Alldredge 1995). The amount of Alcian Blue adsorbed onto the filter is directly related to the weight of the polysaccharide retained on the filter (Passow & Alldredge 1995). The filters will be soaked in 6 mL of 80% sulphuric acid for 2 h to dissolve the adsorbed Alcian Blue. The absorbance of the solution at 787 nm (absorption maximum) will be measured using Hitachi U-1800 spectrophotometer.

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Sampling details

Table 1. Details of sampling from CTDs

Date	Station	CTD	Niskin	Depth (m)	DOC	TEP
03/06/2012	1	4	1	60	x	x
			5	40	x	
			7	30	x	
			9	25	x	
			11	20	x	
			13	15	x	
			19	10	x	x
			21	5	x	x
			23	1	x	x
04/06/2012	2	6	1	100	x	
			3	60	x	
			5	40	x	
			7	30	x	x
			9	25	x	
			11	20	x	
			13	20	x	
			17	12	x	x
			19	8	x	x
			23	5	x	x
05/06/2012	3	8	2	300	x	
			3	100	x	
			5	65	x	x
			8	40	x	
			9	30	x	
			11	20	x	x
			15	14	x	
			19	10	x	x
			23	5	x	x
06/06/2012	4	10	1	275	x	
			3	150	x	
			5	100	x	x
			7	50	x	
			11	35	x	x
			15	30	x	
			17	20	x	x
			21	5	x	x
07/06/2012	5	12	1	275	x	
			3	200	x	
			5	150	x	
			7	100	x	x
			9	65	x	
			11	40	x	
			13	30	x	x
			15	20	x	
			19	10	x	x
			21	5	x	x
08/06/2012	6	17	1	275	x	
			3	150	x	
			5	100	x	
			7	80	x	x
			9	60	x	
			11	40	x	
			13	30	x	x
			17	20	x	x
			21	5	x	x

Table 1. Details of sampling from CTDs (cont.)

Date	Station	CTD	Niskin	Depth (m)	DOC	TEP
10/06/2012	7	19	1	250	x	
			3	100	x	
			5	50	x	x
			8	30	x	
			9	25	x	
			11	20	x	
			15	15	x	x
			19	10	x	x
			23	5	x	x
11/06/2012	8	20	1	250	x	
			3	100	x	x
			5	60	x	
			7	40	x	x
			9	25	x	
			11	20	x	
			17	15	x	x
			19	10	x	x
			23	5	x	x
12/06/2012	9	21	1	250	x	
			4	150	x	
			5	100	x	
			7	50	x	x
			9	30	x	
			11	20	x	x
			15	15	x	
			19	10	x	x
			23	5	x	x
13/06/2012	10	27	1	250	x	
			3	150	x	
			5	80	x	x
			7	40	x	x
			11	25	x	
			13	20	x	x
			17	15	x	
			19	10	x	x
			23	5	x	x
14/06/2012	11	29	1	250	x	
			4	100	x	
			5	65	x	
			7	40	x	x
			13	20	x	x
			15	15	x	x
			19	10	x	x
			23	5	x	x
15/06/2012	12	30	1	340	x	
			3	280	x	
			5	200	x	
			7	100	x	x
			12	50	x	x
			13	35	x	
			16	20	x	x
			19	10	x	
			24	5	x	x
16/06/2012	14	32	1	330	x	
			4	220	x	
			5	100	x	x
			7	85	x	
			11	60	x	x
			13	50	x	x
			15	25	x	x
			21	10	x	
			23	5	x	x

Table 1. Details of sampling from CTDs (cont.)

Date	Station	CTD	Niskin	Depth (m)	DOC	TEP
17/06/2012	15	33	1	340	x	
			3	180	x	x
			5	130	x	
			7	50	x	x
			9	35	x	x
			13	25	x	x
			17	15	x	x
			21	10	x	
			23	5	x	x
17/06/2012	16	34	1	2877	x	
			2	2750	x	
			3	2500	x	
			5	2000	x	
			6	1900	x	
			7	1800	x	
			9	1600	x	
			10	1500	x	
			11	1400	x	
			12	1200	x	
			14	875	x	
			15	750	x	
			16	625	x	
			17	500	x	
			18	375	x	
			19	250	x	
			20	200	x	
			21	150	x	
			22	100	x	
			24	20	x	
18/06/2012	18	39	1	350	x	
			3	175	x	
			5	60	x	x
			9	25	x	x
			13	20	x	
			17	12	x	x
			21	5	x	x
19/06/2012	19	40	1	350	x	
			3	250	x	
			5	150	x	x
			7	60	x	x
			9	25	x	
			13	16	x	x
			17	10	x	
			21	5	x	x
19/06/2012	20	41	1	350	x	
			3	120	x	
			5	90	x	
			7	50	x	x
			9	30	x	
			11	25	x	x
			13	20	x	
			17	18	x	x
			21	5	x	x
20/06/2012	21	42	1	500	x	
			4	350	x	
			5	250	x	
			7	50	x	x
			9	25	x	
			13	20	x	x
			17	15	x	
			21	10	x	x
			23	5	x	x

Table 1. Details of sampling from CTDs (cont.)

Date	Station	CTD	Niskin	Depth (m)	DOC	TEP
21/06/2012	25	44	1	500	x	
			3	350	x	
			5	180	x	
			7	50	x	x
			9	35	x	x
			13	30	x	
			15	20	x	x
			19	10	x	
			23	5	x	x
22/06/2012	26	45	1	500	x	
			3	350	x	
			5	150	x	
			7	90	x	x
			9	60	x	
			11	37	x	x
			15	20	x	
			19	15	x	x
			23	5	x	x
22/06/2012	27	46	1	230	x	
			3	150	x	
			5	70	x	x
			7	55	x	
			9	45	x	x
			13	20	x	
			17	10	x	x
			21	5	x	x
23/06/2012	28	47	1	125	x	
			3	80	x	x
			5	60	x	
			8	40	x	
			9	30	x	x
			13	25	x	
			15	20	x	
			19	10	x	x
			23	5	x	x
23/06/2012	29	48	1	350	x	
			3	100	x	
			5	60	x	x
			7	40	x	
			9	30	x	x
			13	20	x	
			17	10	x	x
			21	5	x	x
24/06/2012	30	52	1	350	x	
			3	150	x	
			5	100	x	x
			7	50	x	
			9	40	x	x
			11	25	x	
			15	18	x	x
			19	10	x	
			23	5	x	x
24/06/2012	31	53	1	315	x	
			3	150	x	
			5	75	x	x
			7	50	x	
			9	25	x	
			11	20	x	x
			15	15	x	
			19	10	x	x
			23	5	x	x

Table 1. Details of sampling from CTDs (cont.)

Date	Station	CTD	Niskin	Depth (m)	DOC	TEP
25/06/2012	32	54	2	275	x	
			3	150	x	
			5	60	x	x
			7	25	x	
			9	20	x	x
			13	13	x	x
			19	10	x	
			21	5	x	x
25/06/2012	33	55	1	500	x	
			3	350	x	
			5	150	x	
			7	50	x	x
			9	25	x	
			13	20	x	x
			17	15	x	x
			19	10	x	
			23	5	x	x
26/06/2012	34	56	1	500	x	
			3	350	x	
			5	110	x	
			7	50	x	x
			9	30	x	
			15	20	x	x
			17	15	x	
			19	10	x	x
			23	5	x	x
26/06/2012	35	57	1	500	x	
			3	350	x	
			5	150	x	
			7	70	x	x
			9	35	x	x
			13	20	x	x
			17	15	x	
			19	10	x	x
			23	5	x	x
27/06/2012	36	58	1	500	x	
			4	350	x	
			5	225	x	
			7	125	x	x
			9	47	x	x
			11	35	x	x
			15	20	x	x
			17	15	x	
			19	10	x	x
			23	5	x	x
27/06/2012	37	59	1	500	x	
			3	300	x	
			5	100	x	
			7	70	x	x
			9	35	x	
			11	28	x	x
			15	20	x	
			19	10	x	x
			23	5	x	x
28/06/2012	38	60	1	500	x	
			3	300	x	
			5	120	x	
			7	75	x	x
			9	50	x	
			11	35	x	x
			15	25	x	
			17	15	x	
			19	10	x	x
			23	5	x	x

Table 1. Details of sampling from CTDs (cont.)

Date	Station	CTD	Niskin	Depth (m)	DOC	TEP
28/06/2012	39	62	1	500	x	
			3	350	x	
			5	150	x	
			7	80	x	x
			9	50	x	x
			13	40	x	
			15	30	x	x
			17	20	x	
			19	10	x	x
			23	5	x	x
29/06/2012	40	63	1	500	x	
			3	350	x	
			5	150	x	
			7	75	x	x
			9	45	x	
			11	30	x	x
			15	20	x	
			21	10	x	x
			23	5	x	x
29/06/2012	41	64	1	500	x	
			3	350	x	
			5	100	x	
			7	50	x	x
			9	40	x	x
			13	30	x	
			15	20	x	x
			21	10	x	x
			23	5	x	x
30/06/2012	42	65	1	500	x	
			4	300	x	
			5	150	x	
			7	50	x	x
			9	35	x	x
			13	25	x	
			15	20	x	x
			17	15	x	
			19	10	x	x
			23	5	x	x
30/06/2012	43	67	1	500	x	
			3	350	x	
			5	175	x	
			7	100	x	
			9	50	x	x
			11	30	x	
			13	20	x	x
			17	15	x	
			19	10	x	x
			24	5	x	x
01/07/2012	44	68	1	500	x	
			3	300	x	
			5	150	x	
			7	75	x	x
			9	40	x	
			11	35	x	x
			15	25	x	
			17	15	x	
			19	10	x	x
			23	5	x	x

Table 2. Details of sampling from the bioassay experiments

Experiment 1	Time point	Bottle no.	DOC	TEP	Experiment 2	Time point	Bottle no.	DOC	TEP
03/06/2012	T0	T01	x	x	08/06/2012	T0	T01	x	x
		T02	x	x			T02	x	x
		T03	x	x			T03	x	x
04/06/2012	T24	Z01	x	x	04/06/2012	T24	NA	NA	NA
		Z04	x	x	10/06/2012	T48	1	x	x
		Z06	x	x			2	x	x
		Z10	x	x			3	x	x
		Z14	x	x			19	x	x
05/06/2012	T48	1	x	x			20	x	x
		2	x	x			21	x	x
		3	x	x			37	x	x
		19	x	x			38	x	x
		20	x	x			39	x	x
		21	x	x			55	x	x
		37	x	x			56	x	x
		38	x	x			57	x	x
		39	x	x	12/06/2012	T96	10	x	x
		55	x	x			11	x	x
		56	x	x			12	x	x
		57	x	x			28	x	x
07/06/2012	T96	10	x	x			29	x	x
		11	x	x			30	x	x
		12	x	x			46	x	x
		28	x	x			47	x	x
		29	x	x			48	x	x
		30	x	x			64	x	x
		46	x	x			65	x	x
		47	x	x			66	x	x
		48	x	x					
		64	x	x					
		65	x	x					
		66	x	x					
		Z18	x	x					
		Z21	x	x					
		Z23	x	x					
		Z27	x	x					
		Z31	x	x					

Table 2. Details of sampling from the bioassay experiments

Experiment 3	Time point	Bottle no.	DOC	TEP	Experiment 4	Time point	Bottle no.	DOC	TEP
13/06/2012	T0	T01	x	x	18/06/2012	T0	T01	x	x
		T02	x	x			T02	x	x
		T03	x	x			T03	x	x
14/06/2012	T24	Z01	x	x	19/06/2012	T24	Z01	x	x
		Z04	x	x			Z04	x	x
		Z06	x	x			Z06	x	x
		Z10	x	x			Z10	x	x
15/06/2012	T48	1	x	x	20/06/2012	T48	1	x	x
		2	x	x			2	NA	NA
		3	x	x			3	x	x
		19	x	x			19	x	x
		20	x	x			20	x	x
		21	x	x			21	x	x
		37	x	x			37	x	x
		38	x	x			38	x	x
		39	x	x			39	x	x
		55	x	x			55	NA	NA
		56	x	x			56	x	x
		57	x	x			57	x	x
17/06/2012	T96	10	x	x	22/06/2012	T96	10	x	x
		11	x	x			11	x	x
		12	x	x			12	x	x
		28	x	x			28	x	x
		29	x	x			29	x	x
		30	x	x			30	x	x
		46	x	x			46	x	x
		47	x	x			47	x	x
		48	x	x			48	x	x
		64	x	x			64	x	x
		65	x	x			65	x	x
		66	x	x			66	x	x
		Z14	x	x			Z14	x	x
		Z17	x	x			Z19	x	x
		Z19	x	x			Z23	x	x
		Z23	x	x			Z32	x	x

Table 2. Details of sampling from the bioassay experiments

Experiment 5	Time point	Bottle no.	DOC	TEP
24/06/2012	T0	T01	x	x
		T02	x	x
		T03	x	x
25/06/2012	T24	Z01	x	x
		Z04	x	x
		Z06	x	x
		Z10	x	x
26/06/2012	T48	1	x	x
		2	x	x
		3	x	x
		19	x	x
		20	x	x
		21	x	x
		37	x	x
		38	x	x
		39	x	x
		55	x	x
		56	x	x
		57	x	x
28/06/2012	T96	10	x	x
		11	x	x
		12	x	x
		28	x	x
		29	x	x
		30	x	x
		46	x	x
		47	x	x
		48	x	x
		64	x	x
		65	x	x
		66	x	x
		Z14	x	x
		Z17	x	x
		Z19	x	x
		Z23	x	x

Table 3. Details of sampling from Marine Snow Catcher

Date	MSC	ID	TEP
07/06/2012	2	MSC2 BASE	x
10/06/2012	3	MSC3 BASE NF	x
11/06/2012	4	MSC4 BASE Settled NF	x
14/06/2012	6	MSC6 TO	x
16/06/2012	7	MSC7 BASE Suspended NF	x
17/06/2012	8	MSC8 BASE Settled NF	x
18/06/2012	9	MSC9 BASE Settled NF	x
19/06/2012	10	MSC10 BASE Suspended NF	x
22/06/2012	11	MSC11 BASE Settled NF	x
24/06/2012	12	MSC12 BASE Settled NF	x
25/06/2012	13	MSC13 BASE Settled NF	x
26/06/2012	14	MSC14 BASE Settled NF	x
27/06/2012	15	MSC15 BASE Settled NF	x
29/06/2012	16	MSC16 BASE Suspended NF	x
		MSC16 BASE Settled NF	x
30/06/2012	17	MSC17 BASE Suspended NF	x
		MSC17 BASE Settled NF?	x

SCIENTIFIC REPORT 17: Particulate organic nutrient and chlorophyll a concentrations.

Sophie Richier, Mark Moore, Brandy Robinson and Laura Bretherton

Introduction

Aliquots of seawater were taken from the CTD and bioassay bottles for filtration and analyses of the following properties, which characterize biomass and/or physiology of the planktonic communities:

Total & size fractionated Chlorophyll a

Bioassay - Aliquots of 50 or 100 mL were filtered onto 25mm Glass Fiber (GF/F) filters and/or onto 10µm pore size polycarbonate filters (to yield a total and >10µm size fraction, respectively and therefore by difference a <10 µm size fraction). All filters were extracted in 90% acetone for 24 h, and chlorophyll a quantified with a Turner Designs Trilogy fluorometer according to Welschmeyer et al. . Final chlorophyll a concentrations were obtained via calibration against a solid standard as referenced against dilutions of a solution of pure chlorophyll a (Sigma, UK) in 90% acetone. Preliminary data analysis indicated few clear trends in overall chlorophyll biomass between treatments within bioassays (Figure 1). Time series responses were variable between bioassays presumably reflecting initial conditions, e.g. available macronutrients and/or community structure.

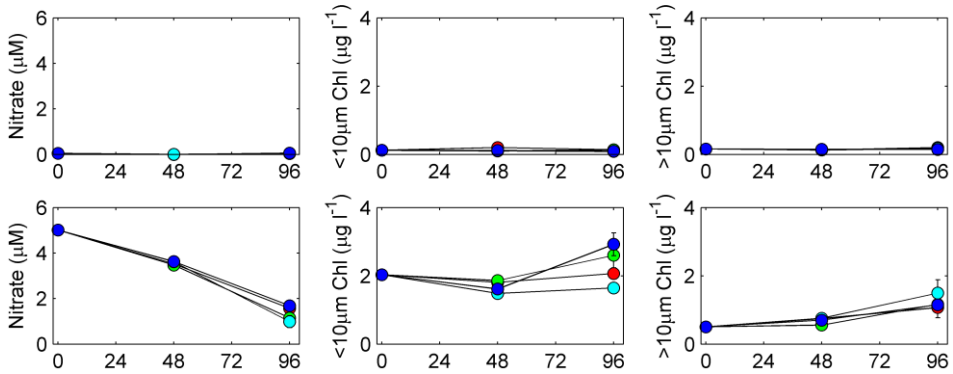

Figure 1: Preliminary data from E01 (top three panels) and E02 (bottom three panels). From left to right panels indicate measured DIN (labeled nitrate) concentrations, <10 µm chlorophyll concentrations and >10 µm chlorophyll concentrations for the 4 conditions: ambient (red), 550 µatm pCO_2 (green), 750 µatm pCO_2 (light blue) and 1000 µatm pCO_2 (dark blue).

CTD – Aliquots of 100 mL from 6 depths were filtered onto 25mm Glass Fibre (GF) filters. In addition 100 mL was filtered from one depth (corresponding to the one chosen for primary production measurement) on 10µm pore size polycarbonate filters. A total of 35 CTDs were sampled for chlorophyll analysis (Table 1). Combined with the underway chlorophyll data (see Scintific Report 20), these provided good spatial coverage of surface chlorophyll concentrations across the study region (see Figure 1 in Scientific Report 3).

Table 1: List of CTDs sampled for chlorophyll along with sampled Niskin bottles

CTD #	Niskins sampled for chlorophyll					
6	1	21	19	15	9	7
8	23	20	16	14	10	6
10	23	18	16	14	10	6
12	24	22	16	13	12	10
17	22	18	14	12	9	8
19	20	16	13	10	8	6
20	23	16	12	10	8	4
21	24	21	18	12	10	8
27	24	20	14	11	8	6
29	24	22	16	14	8	6
30	24	22	18	14	12	8
31	24	20	16	9	8	6
32	24	22	16	14	11	8
33	22	18	16	10	8	6
39	24	20	16	12	8	
40	24	20	16	12	8	6
42	24	20	18	16	10	8
45	24	22	18	14	10	8
47	24	22	14	12	8	6
48	24	20	16	12	8	6
52	24	20	18	12	10	8
53	24	20	18	14	10	8
54	24	20	14	9	8	5
55	24	20	16	12	10	8
56	24	20	18	14	10	8
57	24	20	18	16	10	8
58	24	20	18	16	10	8
59	24	18	16	14	10	8
60	20	18	16	12	10	8
62	20	18	16	14	12	8
63	24	22	16	12	10	8
64	21	18	16	14	12	8
65	24	22	18	16	14	6
67	24	20	17	16	12	10
68	22	18	16	14	10	8

Particulate organic carbon/nitrogen/phosphorous (POC/N/P)

Bioassay - Aliquots of 750 mL seawater from 12 bioassay bottles were filtered on 25 mm GFF filters and oven dried (60ºC) for 8-12 hours; filters for POC/PON were pre-combusted at 400°C whilst those for POP were also acid soaked (and repeat milliQ rinsed). Samples were dry stored for later POC/N/P quantification at University of Southampton. The date and volume filtered for POC/PON/POP from each bioassay are listed in Table 2.

CTD–Aliquots of 1 L from 1, 2 or 3 depths were filtered on 25 mm GFF filters. The filters were stored in the same way described above. The CTD, date and volume filtered for POC/PON/POP from each CTD are listed in Table 3.

Table 2: Date and volume filtered for POC/PON/POP from each bioassay.

Date	Sample name	Bottle nb	Volume filtered POC/PON (ml)	Volume filtered POP (ml)
05.06.2012	E01 T1	all	750	750 (8-730; 9-710)
07.06.2012	E01 T2	all	750	750
08.06.2012	E02 I1	7	970	950
	E02 I2	20	940	1000
	E02 I3	7	960	810
10.06.2012	E02 T1	all	750	750
12.06.2012	E02 T2	all	750	750
13.06.2012	E03 I1	13	750	750
	E03 I2	19	500	750
	E03 I3	22	750	750
15.06.2012	E03 T1	all	750	750 (62-725)
17.06.2012	E03 T2	all	750	750 (53-710)
18.06.2012	E04 I1	23	750	750
	E04 I2	22	750	750
	E04 I3	24	750	750
20.06.2012	E04 T1	all	750	750
22.06.2012	E04 T2	all	750	750
24.06.2012	E05 I1	24	750	750
	E05 I2	24	750	750
	E05 I3	24	750	750
26.06.2012	E05 T1	all	750	750
28.06.2012	E05 T2	all	750	750

Table 3: Date and volume filtered for POC/PON/POP from CTD casts (continued on next page)

Date	CTD nb.	Niskin bottle	Depth	Volume filtered POC/PON (ml)	Volume filtered POP (ml)
04.06.2012	6	20	5	1000	1000
05.06.2012	8	6	65	1000	1000
	8	3	100	1000	1000
	8	20	10	1000	1000
06.06.2012	10	18	20	530	620
	10	23	5	580	615
07.06.2012	12	5	150	600?	600
	12	13	30	600?	600
	12	22	10	600?	600
08.06.2012	17	1	60	700	950
	17	2	20	400	700
	17	3	5	1000	850
10.06.2012	19	20	10	380	390
	19	10	25	300	280
	19	6	50	430	400
11.06.2012	20	23	5	500	500
	20	16	15	500	500
	20	8	40	500	500
12.06.2012	21	24	5	1000	1000
	21	18	15	1000	1000
	21	8	50	1000	1000
13.06.2012	27	24	5	1000	1000
	27	14	20	1000	1000
	27	8	40	1000	1000
14.06.2012	29	22	10	300	300
	29	14	20	380	340
	29	4	100	750	750
15.06.2012	30	24	5	1000	1000
	30	18	20	1000	1000
	30	12	50	1000	1000
	31	20	10	1000	1000
	31	14	40	1000	1000
16.06.2012	32	22	10	1000	1000
	32	11	60	1000	1000
	32	24	5	1000	650
17.06.2012	33	18	15	1000	1000
	33	10	35	1000	1000
	33	6	130	1000	1000
18.06.2012	39	24	5	1000	1000
	39	12	25	1000	1000
	39	8	60	1000	1000

Table 3: Date and volume filtered for POC/PON/POP from CTD casts (continued)

Date	CTD nb.	Niskin bottle	Depth	Volume filtered POC/PON (ml)	Volume filtered (ml)
19/6/2012	40	24	5	380	360
	40	12	25	750	750
	40	5	150	1000	1000
20/6/2012	42	24	5	900	820
	42	18	10	1000	1000
	42	8	50	1000	1000
22/6/2012	45	18	20	1000	1000
	45	10	60	1000	1000
	45	8	90	1000	1000
	46	14	20	230	430
23/6/2012	47	24	5	1000	1000
	47	14	25	1000	1000
	47	6	60	1000	1000
	48	16	20	1000	1000
	48	8	40	1000	1000
24/6/2012	53	20	10	1000	1000
25/6/2012	54	24	5	1000	1000
	54	14	13	1000	1000
	54	4	150	1000	1000
	55	16	15	900	1000
26/6/2012	56	18	15	1000	1000
	56	10	30	1000	1000
	56	6	110	1000	1000
	57	18	15	1000	1000
27/6/2012	58	24	15	1000	1000
	58	16	20	1000	1000
	58	8	125	1000	1000
	59	18	15	1000	1000
28/6/2012	60	20	10	1000	1000
	60	16	25	1000	1000
	60	6	120	1000	1000
	62	12	50	400	400
29/6/2012	63	24	5	1000	1000
	63	12	30	1000	1000
	63	6	150	1000	1000
	64	12	40	900	1000
30/06/2012	65	22	10	1000	1000
		16	20	1000	1000
		6	150	1000	1000
01/07/2012		18	15	1000	1000
		14	33	700	720
		6	150	1000	1000

SCIENTIFIC REPORT 18: Primary production (total and >10 µm), Calcite production and phytoplankton community composition

Chris Daniels and Alex Poulton

Introduction

Coccolithophores are the most abundant calcifying phytoplankton in the ocean, constituting up to 20% of phytoplankton biomass (Poulton et al. 2007; Poulton et al. 2010) and responsible for around half of oceanic carbonate production (Broecker and Clark 2009). Through the production and export of their calcium carbonate extracellular plates (coccoliths), coccolithophores are a significant component of the global carbon cycle. The response of calcifying plankton to ocean acidification could have considerable ramifications; their response is currently unclear with conflicting responses from culture studies (Iglesias-Rodriguez et al. 2008; Langer et al. 2009). The goal of this work is to assess the dynamics of the coccolithophore community both in terms of its rates of calcification and primary production and its contribution to the total phytoplankton community. Furthermore cellular rates of calcification will be derived from the community structure and compared with environmental conditions.

Sampling

(1) Predawn CTD casts – Measurements were made on water samples collected from middle of the mixed layer (~55% of surface irradiance) during 24 early morning (0600-0800) CTD casts. Water samples were incubated in an on-deck incubator on the aft deck, with surface light level replicated using misty blue light filters and in situ temperatures were replicated by continuously flushing the incubators with sea-surface water.

(2) OA Bioassays – Measurements were made for the Tzero, T48 and T96 time points for all five (JR271 E01-E05) of the bioassays. All samples were incubated in the OA container on the aft deck.

Methodology

(1) Primary Production (total) and Calcite Production – Daily (dawn-to-dawn, 24-hrs) rates of primary production (PP) and calcite production (CP) were determined at 24 CTD stations following the methodology of Balch et al. (2000). Water samples (70-ml, 3 light, 1 formalin-killed) were collected from surface waters, spiked with 30-40 µCi of 14C-labelled sodium bicarbonate and incubated on deck. Incubations were terminated by filtration through 25-mm 0.4-µm Nucleopore polycarbonate filters, with extensive rinsing with fresh filtered seawater to remove any labelled ^{14}C-DIC. Filters were then placed in glass vials with gas-tight septum and a bucket containing a Whatman GFA filter soaked with 200-µl phenylethylamine (PEA) attached to the lid. Phosphoric acid (1-ml, 1%) was injected through the septum into the bottom of the vial to convert any labelled ^{14}C-PIC to ^{14}C-CO_2 which was then caught in the PEA soaked filter. After 20-24 hrs, GFA filters were removed and placed in fresh vials and 8-10-ml of Ultima-Gold liquid scintillation cocktail was added to both vials: one containing the polycarbonate filter (non-acid labile production, organic or primary production) and one containing the GFA filter (acid-labile production, inorganic production or calcite production). Activity in both filters was then determined on a Tri-Carb 2100 low level liquid scintillation counter and counts converted to uptake rates using standard methodology.

(2) >10 µm Primary production - Daily rates of size-fractionated primary production (>10 µm) were also measured from the 24 production CTD casts. Triplicate water samples were collected from each light depth (70-ml), spiked with 6-7 µCi ^{14}C-labelled sodium bicarbonate and incubated on deck. Incubations were terminated after 24 hours with filtering through 25-mm 10-µm Nucleopore polycarbonate filters, with extensive rinsing with fresh filtered seawater to remove any labelled ^{14}C-DIC. Ultima-Gold liquid scintillation cocktail (8-10-ml) was then added and activity on the filters was determined on a Tri-Carb 2100 low level liquid scintillation counter and counts converted to uptake rates using standard methodology.

(3) Dissolved production (DOC) – Production of DOC was measured following Lopez-Sandoval et al. (2011) from three of the bioassays (EB02, 03, 04) at both time points and from the daily measurements of primary production. 2.5 ml aliquots were removed from the sample bottles at the end of the incubation period, gently filtered through 0.2 µm syringe tip filters into 20-ml glass scintillation vials and the processed as in the Micro-Diffusion Technique (see (1)) with the addition of 50 µl of 50% Hydrochloric acid.

(4) Light microscopy – Water samples were preserved with 2-3% acidic Lugol's solution from 1-2 depths (mixed layer, chlorophyll maximum where present) from 24 CTD casts and from each treatment bottle from the 5 bioassay experiments. In the case of CTD sampling, 100-ml samples were collected and preserved, while 250-ml samples were collected from the bioassays. Phytoplankton community composition will be assessed using light microscopy (following Poulton et al. 2007) for diatoms, dinoflagellates, and planktonic ciliates.

Table 1. List of CTDs sampled for Primary Production (total and >10 □m, PP),Calcite Production (CP) and production of Dissolved Organic Carbon (pDOC).

Date	CTD number	Depth (m)	PP/CP, >10 µm	pDOC		Date	CTD number	Depth (m)	PP/CP, >10 µm	pDOC
04 June	C006	8	Y	N		17 June	C033	15	Y	Y
05 June	C008	10	Y	N		19 June	C040	18	Y	Y
06 June	C010	20	Y	N		20 June	C042	15	Y	Y
07 June	C012	10	Y	N		22 June	C045	20	Y	Y
08 June	C017	20	Y	N		23 June	C047	25	Y	Y
10 June	C019	25	Y	Y		24 June	C052	18	Y	Y
11 June	C020	15	Y	Y		25 June	C054	13	Y	Y
12 June	C021	15	Y	Y		26 June	C056	15	Y	Y
13 June	C027	20	Y	Y		27 June	C058	20	Y	Y
14 June	C029	10	Y	Y		28 June	C060	25	Y	Y
15 June	C030	20	Y	Y		29 June	C063	20	Y	Y
16 June	C032	10	Y	Y		30 June	C065	20	Y	Y

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SCIENTIFIC REPORT 19: Fluorescence and phytoplankton photophysiology

Laura Bretherton and Mark Moore

Background

Ocean acidification is a result of an increase in the rate at which CO_2 dissolves into seawater (Raven *et al.* 2005). Many marine biological processes utilise DIC, with photosynthesis by marine phytoplankton being of particular importance. In the modern ocean, CO_2 is not at high enough concentrations to saturate the primary carboxylating enzyme used in the carbon fixation process, RubisCO (Riebesell 2004), so ocean acidification has the potential to stimulate primary production in marine environments. This has not always shown to be the case, though, as some taxa have evolved means of concentrating carbon (Giordano *et al.* 2005) to ensure maximal rates of photosynthesis (Rost *et al.* 2003). These differences in response to increased carbon availability could mean that ocean acidification will cause community shifts, further complicated by the fact that different pre-adapted communities of phytoplankton will exist along natural environmental gradients and possibly each respond differently to CO_2.

Chlorophyll fluorescence offers a non-invasive method of assessing photosynthesis and carbon assimilation *in vivo* (Baker 2008), and can be used to monitor several photophysiological parameters. It is therefore a useful tool for measuring any changes in photosynthesis, or potential stress signals, in response to ocean acidification.

Aims and Objectives

The aims of this work were to find out:

how various photophysiological parameters of phytoplankton change depending on local environmental factors, and;
if the physiologies of natural phytoplankton assemblages are affected by manipulation of the carbonate system.

These aims were achieved by taking samples from CTD casts at different stations along the cruise track, as well as from five bioassay experiments, and analysing them using a Fast-Rate Repetition Fluorometer (FRRF).

Approach and Methodology

General FRRF Protocol: All samples were incubated in the dark for 15-20 minutes in a water bath kept at the *in situ* temperature. After incubation, a 3mL sub-sample was placed in the fluorometer and between 5 and 7 single turnover acquisitions were made to obtain general photophysiological parameters. In addition, a rapid light curve (RLC) was often also carried out to further assess photophysiology. PAR values used in the RLC were between 0-1400 µmol photons m^{-2} s^{-1} for high-light samples and 0-600 µmol photons m^{-2} s^{-1} for low light samples. In order to run blanks, 10mL of each sample was filtered using 0.2µm syringe filter, and gently gravity filtered to minimise the amount of cells lysing and contaminating the filtrate with chlorophyll.

Photophysiology of Natural Phytoplankton Communities: 50mL samples were taken from CTD casts and collected in black plastic bottles. The sample depth varied, depending on the depth profile of the station. One sample was usually taken from the chlorophyll maximum depth, and another near-surface depth was used as a high-light sample if the chlorophyll maximum was deeper than 20m. At stations where the water was well mixed, one sample was taken between 10 and 20m.

Photophysiology of Phytoplankton in Manipulated Seawater: A 50mL sample was collected from each bioassay bottle (12 in total) in black plastic bottles and stored at the same temperature as the bioassay incubation container. In addition to the single turnover acquisitions, RLCs were run on one replicate per CO_2 treatment, using the “high-light” PAR range.

Sampling Log

Table 1 – Stations and depths sampled for FRRF measurements over the course of cruise JR271.

Date	Station	CTD No.	Niskins	Depth
06/06/2012	4	10	12	35m
			22	5m
10/06/2012	7	19	8	30m
			24	5m
13/06/2012	10	27	8	40m
			20	10m
14/06/2012	11	29	14	20m
			24	5m
15/06/2012	12	30	14	35m
			22	10m
16/06/2012	14	32	10	60m
			16	25m
17/06/2012	15	33	6	130m
			10	35m
			18	15m
19/06/2012	19	40	8	60m
			14	16m
	20	41	10	30m
			18	18m
20/06/2012	21	42	16	20m
			24	5m
21/06/2012	25	44	10	35m
			20	10m
22/06/2012	26	45	12	37m
			22	15m
	27	46	10	45m
			18	10m
23/06/2012	28	47	10	30m
			20	10m
24/06/2012	31	53	16	15m
25/06/2012	33	55	16	15m
26/06/2012	34	56	14	20m
28/06/2012	38	60	12	35m
			22	10m
	39	62	10	50m
			20	10m
29/06/2012	40	64	10	40m
30/06/2012	41	65	10	35m
	43	67	14	20m
01/07/2012	44	68	12	35m

Table 2 – Bottles sampled for FRRF measurements from every bioassay experiment.

Bioassay T1	**Bioassay T2**	**Target pCO_2**
7	16	Ambient
8	17	Ambient
9	18	Ambient
25	34	550
26	35	550
27	36	550
43	52	750
44	53	750
45	54	750
61	70	1000
62	71	1000
63	72	1000
-	83	Ambient
-	84	Ambient
-	85	Ambient
-	86	750
-	87	750
-	88	750

Preliminary Results

Data from the first bioassay is presented here, showing how the F_v/F_m values (an indicator of photosynthetic efficiency) change between the four CO_2 treatments over time (Fig. 1).

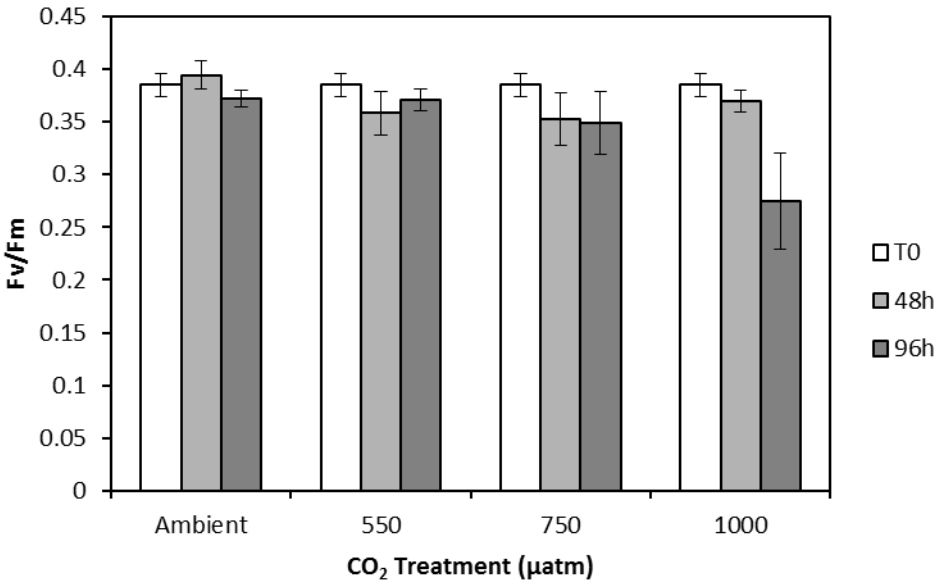

Figure 1. The changes in F_v/F_m values over time from Bioassay 1 (northern North Sea) at different pCO_2 levels. Error bars are +/- 1 S.E., *n*=3.

All data will be analysed fully after the cruise. The RLC data will be analysed by fitting the Jassby and Platt (1976) model to the curves to obtain more information on the photophysiology.

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SCIENTIFIC REPORT 20: Surface water filtration for heme analysis

Brandy Robinson and Mark Moore

Background

Atmospheric CO_2 concentrations have been rapidly increasing since the industrial revolution (due to deforestation and burning of fossil fuels) at a rate of 10 to 100 times higher than any other point in the previous 420,000 years (Falkowski P. 2007). Phytoplankton, which intake CO_2 from the atmosphere, use photosynthesis to convert the carbon into organic compounds; this process is known as primary production (Ho T. 2003; Sigman D. 2003; Longhurst A. 1989). Hemoproteins function in multiple reactions of phytoplankton during primary production; oxygen reduction (cytochrome c oxidase), hydrogen peroxide utilization (catalases and peroxidases) and electron transfer (cytochromes b and c) (Dupont et al. 2004). Heme b, the prevalent heme used in photosynthesis, can be detected and measured using high performance liquid chromatography (HPLC) attached with diode array spectrophotometry (Gledhill M. 2007). Recent studies have suggested that marine phytoplankton might cycle hemes through protein pools in order to boost primary production when iron concentrations are low (Saito et al. 2010; Gledhill M. 2007). In addition chlorophyll fluorescence is an effective and minimally obtrusive method for monitoring photosynthesis and other photophysiological factors, it is therefore useful in combination with heme measurements to establish phytoplankton reaction to iron stressed and/or iron rich waters.

Aims and Objectives

To see if there is a diurnal change of hemoprotein content within marine phytoplankton.
To monitor the diurnal change of chlorophyll fluorescence levels.

These aims were achieved by sampling at two hour intervals over a 12 hour period each day possible from the surface waters along the cruise route.

Approach and Methodology

General Sampling Protocol: Samples were taken directly from the non-toxic supply of water and were filtered immediately to reduce contamination and prevent growth or decay of sample organisms. Sample water (500ml to 1500mL)for heme analysis was filtered onto GFF 25mm filters and then placed in fissure tubes and stored in a -80 C freezer for analysis in the lab back in Southampton. Samples were taken every two hours, beginning at 12:00 (GMT) until 0:00. In addition to heme samples, chlorophyll fluorescence samples (100ml to 200ml) were filtered on GFF 25mm filters; these were placed in clear culture counter vials with 8ml of 10% acetone and then stored in the fridge for 24 hours. After 24 hours the chlorophyll fluorescence was measured using a turner flourometer, vials were then rinsed three times and stored back in the fridge.

Preliminary Results

Heme data will be analysed after the cruise and will be combined with chlorophyll data to establish diurnal changes. Figure 1 below shows the change in chlorophyll fluorescence over a 12 hour period taken at three time points along the trip; 11th of June occurred while we were in arctic ice waters.

Heme data will be analysed back in the lab using a High Performance Liquid Chromatographer and Mass Spectrometer, cruise data will also be combined with *in vivo* experiments on *Emiliania Huxleyi* to look at the diurnal cycling of hemoproteins within marine phytoplankton in relation to iron depravation.

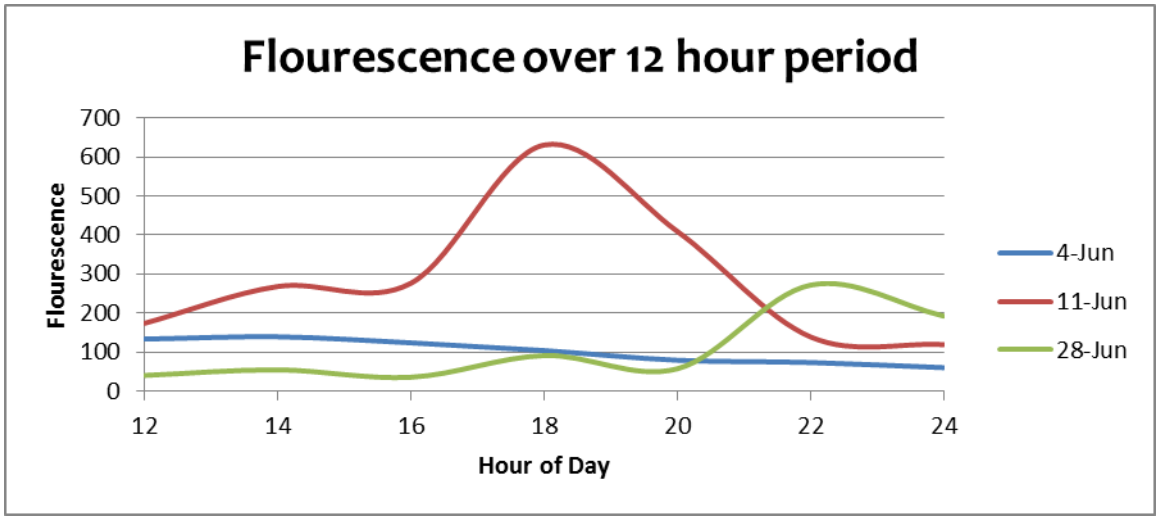

Figure 1. Fluorescence levels over time taken from three time points selected to represent general fluorescence levels during the cruise. Fluorescence levels were changed to equilibrate difference in sample volume measured.

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SCIENTIFIC REPORT 21: RNA sample collection

Sophie Richier

Background

As the research community explores the impact of ocean acidification (OA) on marine ecosystems (Royal Society, 2005), a key link to forecasting the effects of this altered seawater chemistry is understanding the response at the organismal level. A potential productive path for the OA research community is to leverage molecular tools (e.g transcriptomics) to understand the cellular mechanisms that might be driving phytoplankton adaptation to changes in future ocean carbonate chemistry. The measurements of all mRNAs in the natural microbial community have emerged in ocean sciences to assess the physiological response of organisms to abiotic environmental conditions. These techniques have the potential to highlight pathways that are changing in response to elevated pCO_2 (Zehr et al., 2008).

Methodology - Sampling for RNA

4L of seawater was subsampled from bioassay bottles subjected to increase in pCO_2 (1000 or 750 ppm) for 48h or 96h (Table 1). The water was filtered on sterivex columns (0.2 µm) for a limited time of 20 to 25 min using a peristaltic pump. The columns once sealed with parafilm were snap frozen in liquid nitrogen and stored at -80 ^{o}C. Only 2L was filtered on each column to avoid long filtration time and RNA degradation.

Table 1: List of incubation bottles and volume subsampled

Date	Bioassay	Time point	Condition	Bottle nb.	Volume filtered (L)
7-Jun-2012	E01	2	A	73	2.5
	E01	2	A	74	2.5
	E01	2	750	75	2.5
	E01	2	750	76	2.5
	E01	2	1000	77	2.5
	E01	2	1000	78	2.5
10-Jun-2012	E02	1	A	73	4 (2x2L)
	E02	1	A	74	4 (2x2L)
	E02	1	A	75	4 (2x2L)
	E02	1	1000	76	4 (2x2L)
	E02	1	1000	77	4 (2x2L)
	E02	1	1000	78	4 (2x2L)
15-Jun-2012	E03	1	A	73	4 (2x2L)
	E03	1	A	74	4 (2x2L)
	E03	1	A	75	4 (2x2L)
	E03	1	750	76	4 (2x2L)
	E03	1	750	77	4 (2x2L)
	E03	1	750	78	4 (2x2L)
20-Jun-2012	E04	1	A	73	4 (2x2L)
	E04	1	A	74	4 (2x2L)
	E04	1	A	75	4 (2x2L)
	E04	1	750	76	4 (2x2L)
	E04	1	750	77	4 (2x2L)
	E04	1	750	78	4 (2x2L)
26-Jun-2012	E05	1	A	73	4 (2x2L)
	E05	1	A	74	4 (2x2L)
	E05	1	A	75	4 (2x2L)
	E05	1	750	76	4 (2x2L)
	E05	1	750	77	4 (2x2L)
	E05	1	750	78	4 (2x2L)

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SCIENTIFIC REPORT 22: Collection of DNA elutions, filters in RNA later and cultures.

Cecilia Balestreri

Introduction

Ocean acidification due to the increasing atmospheric carbon dioxide concentration has been recognised to have an impact on the marine phytoplankton communities and to affect fundamental processes as photosynthesis and biocalcification (Riebesell, 2004). Genetic studies on Emiliania huxleyi populations revealed an extent genetic variability within this taxon (Medlin et al., 1996). Controversial responses of E. huxleyi to the changing climate (see Riebesell, 2004; Iglesias-Rodriguez et al., 2008, and commentary by Riebesell et al., 2008) have to be further investigated to understand the true response of this globally important species to a rapidly changing environment.

Cruise objective

Collect samples from CTD stations and Bioassay Experiments. These will be analysed and used to assess genetic variability within extant phytoplankton populations, with particular interest in Emiliania huxleyi adaptive potential. Our hypothesis is that the strains best suited to the future climatic scenarios will be selected for.

Sampling

Water has been collected into Nalgene bottles (previously washed with acid solution, HCl 2%, and rinsed three times with MilliQ water).

(1) CTD casts – Water samples (2L) were collected from one light depth during 26 CTD casts (Table 1).

(2) Bioassay experiments – Water was collected from three CTDs (biological replicates) for every experiment and treated with 3 different CO_2 concentrations:
- not treated water: about 380 ppm of CO_2 (control samples)
- 550 ppm of CO_2
- 750 ppm of CO_2
- 1000 ppm of CO_2

All the bioassay experiment were run in a clean container on the outside back deck. 800 ml of water was collected (three bottle for each treatment) from the T0, T48 and T96 time points for all five of the bioassay experiments (Table 2).

Methodology

(1) Filtration
Water from each bottle was split into six samples.
- Some aliquots were filtered using a vacuum pump and a filter rig (previously washed with acid solution, HCl 2%, and rinsed three times with MilliQ water).
- One aliquot was filtered using 0.45 µm polycarbonate filters. The filter was collected in cryovial tube and 1.5 ml of 'RNA later' was added.
- Three aliquots were filtered using 0.45 µm polycarbonate filters. Each filter was rinsed into a petri dish with 2 ml of PBS buffer solution and the final solution was collected into an eppendorf tube.
- 2 ml of water were collected in an eppendorf tube (and 20 µl of Gluteraldehyde 50% was added) for the Flow Cytometer virus population screening. They will be analysed post-cruise.
- 20 ml of water were poured into culture vessel and filled with 30 ml of f/2 media (previously prepared). The vessels collection was incubate at 8°C.
- Some of the cultures were subcultured after three weeks on board. Post cruise these cultures will be used for cell isolation and physiological and molecular analysis.

- 50 ml of filtrate water were collected in 50 ml falcon tubes and they will be analysed post-cruise for virus molecular analysis.

(2) DNA extraction and RNA collection –

The filters in RNA later were cooled overnight at 4°C and subsequently put in the freezer at -20°C. They will be analysed post-cruise.

The solution from the previously collected eppendorf tubes was used for DNA extraction. A 'QIAGEN DNeasy kit' for DNA extraction was used (kit protocol). The final DNA elutions were collected into eppendorf tubes and were frozen at -20°C. They will be analysed post-cruise.

Table 1. List of CTDs sampled

CAST NUMBER	POSITION	NISKIN NUMBER	DEPTH
6	58 73.96 N, 0 86.15 W	20	8 m
8	60 13.42 N, 6 71.20 W	20	10 m
10	59 97.10 N, 11 97.50 W	18	20 m
12	60 00.14 N, 18 67.02 W	22	10 m
17	60 59.42 N, 18 85.64 W	22	5 m
19	65 97.94 N, 10 71.82 W	22	10 m
27	76 17.52 N, 2 54.94 W	10	40 m
29	78 71.80 N, 0 00.01 W	14	20 m
31	78 30.72 N, 6 08.10 W	24	5 m
40	77 84.64 N, 1 29.58 W	14	16 m
41	78 42.17 N, 2 76.57 E	18	18 m
42	78 59.29 N, 7 58.79 E	16	20 m
44	77 55.74 N, 9 08.18 E	10	35 m
45	76 15.71 N, 12 32.48 E	12	37 m
47	76 09.38 N, 26 04.20 E	10	30 m
48	74 05.39 N, 25 59.94 E	14	20 m
55	71 45.60 N, 13 23.61 E	16	15 m
56	71 44.85 N, 8 26.56 E	14	20 m
57	71 45.12 N, 3 52.20 E	14	20 m
58	71 44.72 N, 1 16.03 W	12	35 m
59	71 45.10 N, 5 51.84 W	14	28 m
62	70 30.49 N, 10 06.01 W	10	50 m
64	67 50.06 N, 12 10.45 W	10	40 m
65	67 49.83 N, 16 25.30 W	10	35 m
67	67 49.89 N, 20 03.86 W	14	20 m
68	67 15.82 N, 24 02.41 W	12	35 m

Table 2. Bioassay experiments list

CAST NUMBER	POSITION	BOTTLE NUMBER-AMBIENT CONC.	BOTTLE NUMBER-550 ppm CO_2	BOTTLE NUMBER-750 ppm CO_2	BOTTLE NUMBER-1000 ppm CO_2
1-2-3	56 26.65 N, 2 63.32 E	T0: 1, 2, 3 T48: 7, 8, 9 T96: 16, 17, 18	T48: 25, 26, 27 T96: 34, 35, 36	T48: 43, 44, 45 T96: 52, 53, 54	T48: 61, 62, 63 T96: 70, 71, 72
14-15-16	60 59.42 N, 18 85.64 W	T0: 1, 2, 3 T48: 7, 8, 9 T96: 16, 17, 18	T48: 25, 26, 27 T96: 34, 35, 36	T48: 43, 44, 45 T96: 52, 53, 54	T48: 61, 62, 63 T96: 70, 71, 72
24-25-26	76 17.52 N, 2 54.94 W	T0: 1, 2, 3 T48: 7, 8, 9 T96: 16, 17, 18	T48: 25, 26, 27 T96: 34, 35, 36	T48: 43, 44, 45 T96: 52, 53, 54	T48: 61, 62, 63 T96: 70, 71, 72
36-37-38	78 32.25 N, 4 16.80 W	T0: 1, 2, 3 T48: 7, 8, 9 T96: 16, 17, 18	T48: 25, 26, 27 T96: 34, 35, 36	T48: 43, 44, 45 T96: 52, 53, 54	T48: 61, 62, 63 T96: 70, 71, 72
49-50-51	72 53.49 N, 26 00.09 E	T0: 1, 2, 3 T48: 7, 8, 9 T96: 16, 17, 18	T48: 25, 26, 27 T96: 34, 35, 36	T48: 43, 44, 45 T96: 52, 53, 54	T48: 61, 62, 63 T96: 70, 71, 72

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SCIENTIFIC REPORT 23: Coccolithophore assemblage composition and morphology

Jeremy Young

Introduction

Coccolithophores are the most abundant and widespread marine pelagic calcifiers and a significant component of the marine phytoplankton. Consequently they have attracted much attention in ocean acidification research but with highly variable results being reported. The objective of the current research is to test if consistent responses of coccolithophores to carbonate chemistry conditions can be detected by compiling extensive datasets of coccolith composition and morphology data from environmental and bioassay samples.

Sampling

(1) Bioassays – Samples were collected from the T0, T48 and T96 time points for all five of the bioassays. From each bioassay three replicate samples were taken from each of the four CO_2 conditions, i.e. 12 samples per time point and 27 samples total per bioassay. In total 135 bioassay samples were taken.

(2) CTD casts – Samples were collected from all regular CTD casts (additional casts were made for trace element chemistry and were not sampled), usually from 6 water depths. The number of water depths and the depths selected varied depending on the nature of the water profile but typically samples were taken from each of the surface mixed layer, thermocline and sub-thermocline water. In total 232 samples were taken.

(3) *Underway samples* – Throughout the cruise, except while within the ice, samples were collected as part of the underway sampling collection set organized with Mario Esposito and Matthew Humphreys. Typically samples were collected at two hourly intervals from the non-toxic seawater supply system, with slightly longer sampling interval at times during the evening. Comparative data available for this sample set will include carbonate chemistry (MH), nutrient analysis (ME) and from the shipboard sensors temperature, salinity, fluorescence, length transmittance and weather data. In total 230 samples were taken. In addition high resolution sampling of the non-toxic seawater was carried out on two occasions. During both these intervals 12 additional samples were collected at 10 minute intervals, in order to investigate fine-scale sampling reproducibility and patchiness.

(4) *Culture isolation samples* – water samples for culture isolation were collected during the last week of the cruise. These were collected from the CTD cast bottles with suitable samples being selected following a light microscope reconnaissance of the assemblage composition. In total six samples were taken in triplicate.

(5) *PIC and BSI samples.* In parallel samples were taken for Particulate Inorganic Carbon (PIC) and Biogenic Silica (BSi). Samples were taken from each of the bioassays and from a single water depth from each standard CTD casts and the bioassay samples. Samples were collected by vacuum filtration onto 25mm polycarbonate filter membranes of between 150 and 500ml sea water. The membranes were then transferred into plastic tubes and oven dried.

Methodology

(1) Coccolithophore assemblage samples – for each of the CTD, underway and bioassay samples 100 to 250ml of water was filtered, onto 25mm diameter 0.8µm mesh filter membranes, by vacuum filtration, without prefiltration. Samples were rinsed with ammonia-buffered milli-Q water immediately after filtration. Two filters were taken per sample, one on polycarbonate filters (Whatman nuclepore) for scanning electron microscopy and a second on cellulose nitrate filters (Whatman ref 7188-002) for light microscopy. The filters were then transferred to plastic petrislides, secured with a small piece of sticky tape and oven dried at 40°C for 2 to 4 hours. For the CTD cast and bioassay samples, the water was filtered immediately after collection. For the underway samples water was stored after collection and processed in batches once or twice a day.

Light microscopy preparations were made later the same day from the cellulose nitrate filters. For this a portion of filter was mounted on a glass microscope slide using a low viscosity UV-setting adhesive (Norland Optical Adhesive 74). For the CTD cast and bioassay samples, the water was filtered immediately after collection. For the underway samples water was stored after collection and processed in batches once or twice a day.

(2) *Culture isolation samples* – for these samples 1litre of sea-water from selected CTD depths was prefiltered through a 60µm nylon mesh, in order to remove zooplankton and large dinoflagellates. The phytoplankton were then concentrated using vacuum filtration onto a 5µm pore size, 25mm filter disk. Filtration was stopped when about 45ml of water remained unfiltered and this water was then pipetted into a 50ml plastic tube. The filter membrane was removed while still wet and immediately placed into the plastic tube. The standard routine was to collect three replicate samples per selected water depth, in addition a further filter was prepared using exactly the same membrane type and water volume and stored for microscopy. After collection the concentrated water samples were stored in an incubator. Post-cruise one set of the replicate samples was taken to MBA Plymouth by Cecilia Balestreri, and the other two were sent to NOC Southampton and the Roscoff Marine Laboratory for culture isolation. The reference filter will be incorporated in the main filter collection of JRY.

(3) Assemblage counts. The coccolithophore assemblage was analysed by light microscopy using a Leitz Ortholux polarizing microscope at x1000 magnification. Counts were made of coccolithophores present per filter area and converted to specimens per litre. Approximately 2/3 of the underway samples and 1/3 of the CTD samples were analysed during the cruise.

(4) Planned post-cruise work. (a) Directly post-cruise LM counts will be completed for all samples collected. (b) In parallel SEM imaging of selected samples will be undertaken using the automated SEM of NOC Southampton (organised with Toby Tyrrell and Richard Pearce). The sampling for this will include one replicate from each bioassay, except for Bioassay 2 (South of Iceland) for which all three replicates will be examined. These SEM image sets will be used for morphometric analysis of *Emiliania huxleyi* and loose coccolith counts. They will also be used, by Alex Poulton, to assist phytoplankton counts and can be made be available to other project members. (c) High resolution SEM microscopy of selected filters will be carried out for taxonomic research, and potentially for study of Pappospheraceae (very lightly calcified cold-water coccolithophores). (d) LM-based image analysis will be used to carry out morphometrics, including mass estimation, of an extended set of samples.

Preliminary Results

Enough light microscopy has been carried out on-ship to give an overview of the coccolithophore assemblages encountered. In the initial part of the cruise, in the North Sea, assemblages were highly variable in numbers (20,000 to 600,000 cells / litre) but almost exclusively dominated by *Emiliania huxleyi*. This is typical of temperate shelf assemblages in the Atlantic. The first bioassay was taken in the North Sea, from water with low *E. huxleyi* concentrations (ca 20,000/litre). The population did not appear to increase significantly but detailed counts have not been made yet.

In the North Atlantic coccolithophore abundance and diversity increased as we entered the broad area of blooms south of Iceland. Abundances here were 100,000 to 1,300,000 cells per litre with a mixed assemblage of *E. huxleyi, Syracosphaera spp., Coccolithus pelagicus* HET[*], *Calciopappus caudatus,* and *Acanthoica quattrospina*. *C. pelagicus* HET occasionally dominated these assemblages with a peak abundance of 980,000 cells/litre. This is one of the highest abundances of the species ever recorded. This type of mixed bloom is not well-documented in the literature but similar assemblages have been collected by Alex Poulton and co-workers in the Ellett Line surveys and we will now have an excellent dataset. The second bioassay was taken in these waters, despite the problems caused by a significant storm. The mixed assemblage means that it will be possible to assess the effect of elevated CO2 conditions on a range of different species.

[*] *Coccolithus pelagicus* has calcifying two life-cycle stages, the diploid heterococcolith stage and haploid holococcolith bearing, these are conventionally indicated as HET and HOL

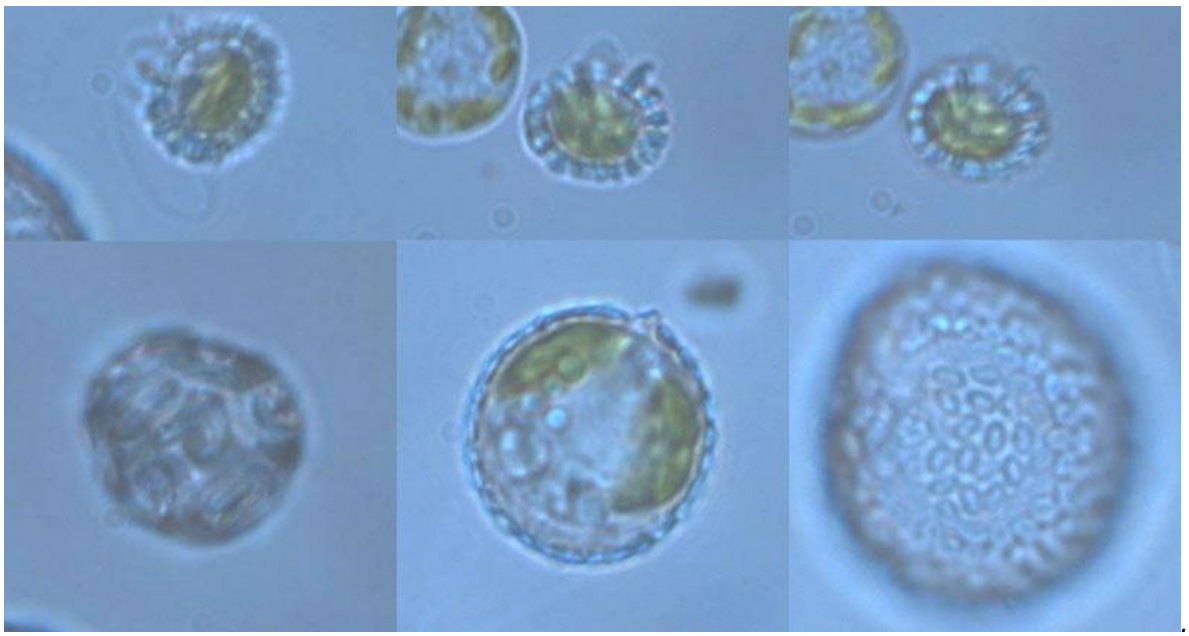
After crossing the Arctic Front, East of Iceland, the abundance of coccolithophores dropped and the dominant taxon, at least in the underway samples, was the holococcolith stage of *Coccolithus pelagicus*. North of Jan Mayen most samples were nearly barren of coccolithophores, including those in the 3rd bioassay. No coccolithophores were seen in the samples from within the ice-margin, including those of the 4th bioassay. On the transect to Svalbard low abundance assemblages of *C pelagicus* HOL and *E. huxleyi* were seen.

Within the Barents Sea and Eastern Norwegian Sea coccolithophore abundances fluctuated with some barren samples but others with several hundred thousand cells/litre. Assemblages were mixed with *E. huxleyi, C. pelagicus, Algirosphaera robusta* and *Calciopappus* all being common. CTD68 yielded particularly abundant assemblages, ca. 1,000,000 cells/litre, which is exceptional for a mixed assemblages, the peak abundances of *A. robusta* (392,000 cells/litre), *C. caudatus* (160,000 cells/litre) and *C. pelagicus* HOL (250,000 cells/litre) were the highest observed on the cruise and exceed any published records for these taxa. The fifth and final bioassay was taken from these waters. In the inoculum *C. pelagicus* was only present at extremely low abundances (<100/litre), it did however increase somewhat in abundance through the experiment so this may yield useful data.

Counts have not been made of samples from the final phase of the cruise, crossing the Norwegian Sea, from qualitative observations however the assemblages were generally low abundance and dominated by *C. pelagicus* and *E. huxleyi*.

Prognosis

The cruise recovered an extensive suite of samples with very variable abundance of coccolithophores, including many samples in which they were virtually absent and others with bloom-type abundances. They also were significantly variable in composition. This variability is obviously in large part a reflection of variations in temperature, light, nutrient content and grazing pressure, but the cruise track did also cross strong gradients in carbonate chemistry and the sample set should be suitable for determining whether carbonate chemistry is a significant influence on coccolithophores.



Algirosphaera (top), *Coccolithus pelagicus* HET (left bottom) and *C. pelagicus* HOL (centre and right bottom)

SCIENTIFIC REPORT 24: Effects of ocean acidification on microbial dynamics in the Arctic

Polly Hill, Elaine Mitchell, Ben Russell, Mike Zubkov and Ray Leakey

Introduction

The aim of this study was assess the effects of ocean acidification on microbial group-specific metabolic activities and predation. Also, to link community composition and function by phylogenetic affiliation of these groups using molecular methods.

Objectives

To estimate concentrations of dominant bacterioplankton and smallest protists in the water column (Elaine Mitchell and Mike Zubkov)

To estimate bacterioplankton production in the water column (Ben Russell & Polly Hill)

To assess the effects of acidification on bacterioplankton production within the collaborative bioassays (Ben Russell)

To estimate the effect of acidification on the rate of leucine turnover and respiration (Polly Hill)

To assess the impact of acidification on rates of bacterivory and herbivory (Polly Hill and Mike Zubkov)

To assess the impact of acidification on carbon-fixation by dominant picoplanktonic groups (Polly Hill and Mike Zubkov)

To collect concentrated seawater samples for molecular identification of the dominant microbial groups (Polly Hill and Mike Zubkov).

To assess microplankton composition using a size-fractionating micronet (Mike Zubkov and Ray Leakey).

Methods

Sampling

For the majority of work, seawater samples were collected from one depth within the upper mixed layer (10-20 m) from the morning CTD casts. Seawater was decanted into a 6 L acid-cleaned polycarbonate carboy using acid-soaked silicone tubing. Incubations were initiated within 40 min of sampling. For bacterial production measurements, seawater samples were collected from 6 depths. For microbial enumeration seawater samples were collected from 9-10 depths. Seawater was decanted into 50 mL acid-cleaned falcon tubes, and radioactively labelled leucine uptake was initiated within 10 minutes of sampling.

For the flow cytometry standard environmental observation CTD casts, seawater samples were collected from 8-10 depths. Seawater was decanted into 50ml acid cleaned falcon tubes which were taken directly to the cold room where 1.6ml was removed from each falcon tube and placed into a 2ml polypropylene screw cap vials containing PFA. For the bioassay samples the 2ml polypropylene screw cap vials containing PFA were prepared the night before and 1.6ml of sample was added to each tube on the sampling day by a member of the bioassay team and kept in the fridge.

Table 1: Microbial samples taken on JR271

Event No.	Date	Station	Latitude	Longitude	Activity	Comments	Measurements
001	3/6/12	Station 1 (E05)	56.26658 N	2.63326 E	CTD 001	Titanium CTD for Bioassay	BP, AFC
002	3/6/12	Station 1 (E05)	56.26664 N	2.63323 E	CTD 002	Titanium CTD for Bioassay	BP, AFC
003	3/6/12	Station 1 (E05)	56.26665 N	2.63325 E	CTD003	Titanium CTD for Bioassay	BP, AFC
007	3/6/12	Station 1 (E05)	56.26663 N	2.63321 E	CTD 004	Standard CTD for Observations	BP, AFC
013	4/6/12	Station 2	58.73969 N	0.86150 W	CTD 006	Standard CTD for Observations	BP, AFC
020	5/6/12	Station 3	60.13424 N	6.71209 W	CTD 008	Standard CTD for Observations	BP, AFC
021	5/6/12	Station 3	60.13425 N	6.71212 W	CTD 009	Titanium CTD for Trace Metals	BP
028	6/6/12	Station 4	59.97104 N	11.97509 W	CTD 010	Standard CTD for Observations	BP, OALB, AFC
030	6/6/12	Station 4	59.97106 N	11.97510 W	MICRO 001	Micronet deployment	CC
036	7/6/12	Station 5	60.00145 N	18.67024 W	CTD 012	Standard CTD for Observations	BP, OALB, AFC
038	7/6/12	Station 5	60.00143 N	18.67024 W	MICRO 002	Micronet deployment	CC
042	8/6/12	Station 6	60.59420 N	18.85649 W	CTD 014	Titanium CTD for Bioassay	BP, AFC
043	8/6/12	Station 6	60.59423 N	18.85646 W	CTD 015	Titanium CTD for Bioassay	BP, AFC
044	8/6/12	Station 6	60.59423 N	18.85649 W	CTD016	Titanium CTD for Bioassay	BP, AFC
045	8/6/12	Station 6	60.59421 N	18.85649 W	CTD 017	Standard CTD for Observations	BP, OALB, CC, FISH, AFC
049	10/6/12	Station 7	65.97938 N	10.71825 W	Micro 003	Micronet deployment	CC
052	10/6/12	Station 7	65.97940 N	10.71821 W	CTD 019	Standard CTD for Observations	BP, OALB, CC, FISH, AFC
057	11/6/12	Station 8	69.89571 N	7.57706 W	Micro 004	Micronet deployment	CC
060	11/6/12	Station 8	69.89566 N	7.57712 W	CTD 020	Standard CTD for Observations	BP, OALB, CC, FISH, OALR, AFC
064	12/6/12	Station 9	74.11643 N	4.69304 W	Micro 005	Micronet deployment	CC
067	12/6/12	Station 9	74.11645 N	4.69305 W	CTD 021	Standard CTD for Observations	BP, OALB, CC, FISH, OALR, OAB, OACF, AFC
074	13/6/12	Station 10	76.17525 N	2.54948 W	CTD 024	Titanium CTD for Bioassay	BP, AFC
075	13/6/12	Station 10	76.17525 N	2.54948 W	CTD 025	Titanium CTD for Bioassay	BP, AFC
076	13/6/12	Station 10	76.17525 N	2.54948 W	CTD026	Titanium CTD for Bioassay	BP, AFC
077	13/6/12	Station 10	76.17525 N	2.54945 W	Micro 006	Micronet deployment	CC
081	13/6/12	Station 10	76.17526 N	2.54949 W	CTD 027	Standard CTD for Observations	BP, OALB, CC, FISH, OALR, OACF, AFC
086	14/6/12	Station 11	78.71804 N	0.00395 W	Micro 007	Micronet deployment	CC
089	14/6/12	Station 11	78.71806 N	0.00014 W	CTD 029	Standard CTD for Observations	BP, OALB, CC, FISH, OALR, OAB, OACF, AFC
094	15/6/12	Station 12	78.24771 N	5.54734 W	Micro 008	Micronet deployment	CC
095	15/6/12	Station 12	78.24527 N	5.54986 W	CTD 030	Standard CTD for Observations	BP, OALB, CC, FISH, OALR, OAB, OACF, AFC
100	15/6/12	Station 13	78.30724 N	6.08104 W	CTD 031	Standard CTD for Observations	AFC

Table 1: Microbial samples taken on JR271 (Cont.)

Event No.	Date	Station	Latitude	Longitude	Activity	Comments	Measurements
103	16/6/12	Station 14	78.21106 N	6.00780 W	Micro 009	Micronet deployment	CC
105	16/6/12	Station 14	78.21313 N	5.99826 W	CTD 032	Standard CTD for Observations	BP, OALB, CC, FISH, OALR, OAB, OACF, AFC
110	17/6/12	Station 15	77.82989 N	5.02745 W	Micro 010	Micronet deployment	CC
113	17/6/12	Station 15	77.81768 N	4.97765 W	CTD 033	Standard CTD for Observations	BP, OALB, CC, FISH, OALR, OAB, OACF, AFC
119	18/6/12	Station 18	78.32865 N	4.19148 W	Micro 011	Micronet deployment	CC
120	18/6/12	Station 18	78.32816 N	4.19178 W	CTD 037	Titanium CTD for Bioassay	BP, AFC
121	18/6/12	Station 18	78.29534 N	4.25183 W	CTD 038	Titanium CTD for Bioassay	BP, AFC
126	18/6/12	Station 18	78.16310 N	4.18220 W	CTD 039	Standard CTD for Observations	BP, AFC
132	19/6/12	Station 19	77.84312 N	1.31191 W	Micro 012	Micronet deployment	CC
134	19/6/12	Station 19	77.84645 N	1.29586 W	CTD 040	Standard CTD for Observations	BP, CC, FISH, OAB, OACF, AFC
141	19/6/12	Station 20	78.42179 N	2.76572 E	CTD 041	Standard CTD for Observations	AFC
144	20/6/12	Station 21	78.98343 N	7.97982 E	Micro 013	Micronet deployment	CC
147	20/6/12	Station 21	78.98713 N	7.97973 E	CTD 042	Standard CTD for Observations	BP, CC, FISH, OAB, OACF, AFC
163	21/6/12	Station 25	77.92907 N	9.13648 E	CTD 044	Standard CTD for Observations	AFC
167	22/6/12	Station 26	76.26194 N	12.54175 E	Micro 014	Micronet deployment	CC
169	22/6/12	Station 26	76.26193 N	12.54164 E	CTD 045	Standard CTD for Observations	BP, CC, FISH, B/H, AFC
175	22/6/12	Station 27	76.21164 N	18.38416 E	CTD 046	Standard CTD for Observations	AFC
180	23/6/12	Station 28	76.15804 N	26.06571 E	Micro 015	Micronet deployment	CC
181	23/6/12	Station 28	76.15739 N	26.06745 E	CTD 047	Standard CTD for Observations	BP, CC, FISH, B/H, AFC
186	23/6/12	Station 29	74.08998 N	25.99927 E	CTD 048	Standard CTD for Observations	AFC
188	24/6/12	Station 30	72.89160 N	26.00171 E	CTD 049	Titanium CTD for Bioassay	BP, AFC
189	24/6/12	Station 30	72.89161 N	26.00165 E	CTD 050	Titanium CTD for Bioassay	BP, AFC
190	24/6/12	Station 30	72.89160 N	26.00166 E	CTD 051	Titanium CTD for Bioassay	BP, AFC
194	24/6/12	Station 30	72.88873 N	26.00524 E	CTD 052	Standard CTD for Observations	BP, CC, FISH, B/H, AFC
196	24/6/12	Station 30	72.88871 N	26.00529 E	Micro 016	Micronet deployment	CC
200	24/6/12	Station 31	71.74803 N	22.97222 E	CTD 053	Standard CTD for Observations	AFC
205	25/6/12	Station 32	71.75197 N	17.90075 E	CTD 054	Standard CTD for Observations	BP, CC, FISH, B/H, AFC
207	25/6/12	Station 32	71.75195 N	17.90080 E	Micro 017	Micronet deployment	CC
212	25/6/12	Station 33	71.76071 N	13.39492 E	CTD 055	Standard CTD for Observations	AFC
217	26/6/12	Station 34	71.74751 N	8.44282 E	CTD 056	Standard CTD for Observations	BP, CC, FISH, B/H, AFC
219	26/6/12	Station 34	71.74754 N	8.44272 E	Micro 018	Micronet deployment	CC

Table 1: Microbial samples taken on JR271 (Cont.)

Event No.	Date	Station	Latitude	Longitude	Activity	Comments	Measurements
224	26/6/12	Station 35	71.75192 N	3.87166 E	CTD 057	Standard CTD for Observations	AFC
229	27/6/12	Station 36	71.74527 N	1.26724 W	CTD 058	Standard CTD for Observations	BP, CC, FISH, B/H, AFC
231	27/6/12	Station 36	71.74528 N	1.26724 W	Micro 019	Micronet deployment	CC
236	27/6/12	Station 37	71.75171 N	5.86381 W	CTD 059	Standard CTD for Observations	AFC
241	28/6/12	Station 38	71.74836 N	10.59721 W	CTD 060	Standard CTD for Observations	BP, CC, FISH, B/H, AFC
242	28/6/12	Station 38	71.75021 N	10.57546 W	Micro 020	Micronet deployment	CC
248	28/6/12	Station 39	70.50828 N	10.09996 W	CTD 062	Standard CTD for Observations	AFC
253	29/6/12	Station 40	68.69505 N	10.57600 W	CTD 063	Standard CTD for Observations	BP, CC, FISH, B/H, AFC
i255	29/6/12	Station 40	68.69508 N	10.57599 W	Micro 021	Micronet deployment	CC
260	29/6/12	Station 41	67.83434 N	12.17422 W	CTD 064	Standard CTD for Observations	AFC
265	30/6/12	Station 42	67.83043 N	16.42183 W	CTD 065	Standard CTD for Observations	BP, CC, FISH, OAB, OACF, AFC
266	30/6/12	Station 42	67.83043 N	16.42178 W	Micro 022	Micronet deployment	CC
272	30/6/12	Station 43	67.83153 N	20.06415 W	CTD 067	Standard CTD for Observations	AFC
278	1/7/12	Station 44	67.26934 N	24.05413 W	Micro 023	Micronet deployment	CC

Key:

BP Bacterial production
CC Cell concentration
FISH Samples collected for fluorescence *in situ* hybridisation (FISH) analysis
OALB Ocean acidification leucine bioassay
OALR Ocean acidification leucine respiration
OAB Ocean acidification bacterivory
OACF Ocean acidification carbon-fixation
B/H Bacterivory/herbivory transect
AFC Flow cytometry samples for microbial abundance

Measurement of ^{14}C-leucine and ^{3}H-Leucine uptake rates

Bacterial production was estimated in samples from 6 depths from each morning CTD, using both ^{3}H-leucine and ^{14}C-leucine, added at a concentration of 0.2 nM and 20nM, respectively. In addition, 0.4 nM ^{3}H-leucine uptake rates were measured in control and acidified (1000 ppm) samples from the collaborative bioassays. 1.6 mL from each sample was added to 2 mL polypropylene screw cap vials containing either ^{3}H-leucine or ^{14}C-leucine. Samples were fixed at each time point (20, 40, 60 and 80 minutes) by the addition of 80μL 20% paraformalydehyde (1% v/w final concentration). Fixed cells were filtered onto 0.2 μm polycarbonate membrane filters soaked in non-labelled leucine solution to reduce adsorption of tracer. Filtered samples were washed twice with 4 mL deionised water. Radioactivity of samples was measured as counts per minute (CPM) by liquid scintillation counting.

2.2 Measurement of leucine concentration and turnover

Ambient concentrations and turnover rates of leucine (Leu) was estimated using a bioassay technique of radiotracer dilution (Wright & Hobbie, 1966) with untreated and acidified, live samples, as described previously (Mary et al., 2008; Zubkov et al., 2008; Hill et al., 2011). Additions of HCl and HCO_3^- were made to achieve 1000 ppm.

Briefly, L-[4,5-^{3}H]leucine (specific activity 5.18 TBq mmol^{-1}) was added in a concentration series of 0.1, 0.2, 0.4, 0.6, 0.8, 1.0 nM. Triplicate samples (1.6 mL) for each concentration were incubated in 2 mL polypropylene screw cap vials. One sample from each concentration was fixed at 10, 20 and 30 min by the addition of 20% paraformalydehyde (1% v/w final concentration). Due to the short incubation times, it was not possible to work in the dark; however, incubations were kept in dim indirect light at roughly ambient temperature. Fixed cells were filtered onto 0.2 μm polycarbonate membrane filters soaked in non-labelled leucine solution to reduce adsorption of tracer. Filtered samples were washed twice with 4 mL deionised water. Radioactivity of samples was measured as counts per minute (CPM) by liquid scintillation counting.

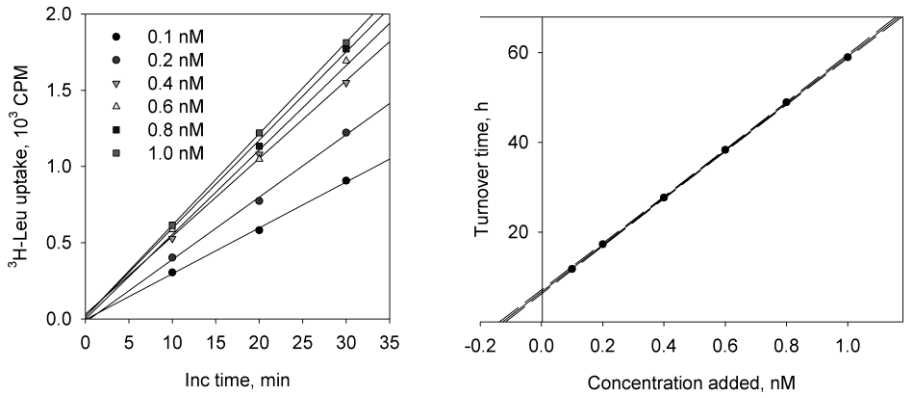


Figure 1: Example of data from a ^{3}H-leucine bioassay.

An example of the data achieved from a ^{3}H-Leu bioassay are given in Figure 1. ^{3}H-Leu uptake rates were calculated at each addition concentration as the slope of the linear regression of community assimilated radioactivity (CPM) against incubation time (Figure 1, left), from which turnover time could be calculated. The turnover time for each added concentration was then plotted against its concentration (Figure 1, right). Ambient Leu uptake rate, *V*, was estimated from the slope of the linear regression, assuming constant rate of removal and regeneration (Wright & Hobbie, 1966). Leu turnover time (*t*) at ambient concentration was estimated as the *y* intercept of this regression. From these estimates, ambient concentration (*S*) was estimated from the equation

$$S + K_t = V \times t$$

where K_t is a measure of the affinity of the uptake system for a substrate (with a range of zero to one), with a low K_t indicating high affinity (Wright & Hobbie, 1966). Here we assume that ambient

bacterioplankton are efficient in Leu uptake at ambient concentration and thus have a negligible K_t compared to Leu concentration; however, we accept that this provides an upper estimate of ambient concentration and, consequently, *V*.

2.3 Measurement of ^{14}C-Leucine uptake & respiration

Respiration and uptake rates of ^{14}C-Leu were measured in 120 mL glass serum bottles, which were sealed using crimped Teflon lids. The acid cleaned bottles were rinsed three times and filled with control or acidified seawater and ^{14}C-Leu added at 0.4 nM final concentration. At each incubation time point (e.g. 1, 2, 3, 4 h), 30 mL samples were removed from the bottle using a syringe and needle through the lid, and fixed with PFA (1% final concentration). The remaining sample was killed by the addition of 1.5 mL of 10% HCl, which also acidified the samples to <pH2, thereby driving any $^{14}CO_2$ out of solution. Biomass samples were filtered onto 0.2 µm polycarbonate membrane filters. Respiration samples were bubbled for 2 h with CO_2-free air and evolved CO_2 trapped in Carbo-sorb. Radioactivity of samples was measured as disintegrations per minute (DPM) by liquid scintillation counting.

2.4 Effect of acidification on rates of bacterivory

300 mL samples (control and 1000ppm) were incubated in acid cleaned Schott bottles with 0.25 nM ^{35}S-methionine and 0.5 nM ^{3}H-leucine. Bottles were placed in a water bath at ambient light and temperature. After 1.5 h, the tracers were chased with 250 nM methionine and 500 nM leucine to drastically reduce specific activity of the tracer. After another 1.5 h, 130 mL was fixed with PFA (1% final concentration) and 120 mL of the remaining sample transferred to a 130 mL Schott bottle to avoid large head spaces. After a total incubation period of 8 h, the remaining sample was fixed with PFA. Each sample was concentrated into 2 x 1.8 mL using a syringe pump and 0.8 µm pore size polycarbonate filters in Swinnex units. Samples were frozen for flow cytometric sorting back at NOCS.

2.5 Effect of acidification on rates of carbon fixation of dominant microbial groups

65 mL samples (control and 1000ppm) were incubated in acid cleaned Schott bottles with 150 µL Sodium ^{14}C-bicarbonate. Bottles were placed in a water bath at ambient light and temperature. After a total incubation period of 8 h, samples were fixed with PFA. Each sample was concentrated into 2 x 1.8 mL using a syringe pump and 0.8 µm pore size polycarbonate filters in Swinnex units. Samples were frozen for flow cytometric sorting back at NOCS. For the herbivory measurements, 130 mL untreated samples were incubated in Schott bottles at ambient light and temperature for the initial 12 h, after which 60 mL was removed and fixed with PFA, and the remaining sample placed in the dark. After another 12 h, the remaining sample was fixed with PFA. Samples were concentrated as described above, and dominant groups of phototrophic and heterotrophic protists were flow sorted after SYBR Green I staining of cells.

2.6 Collection of samples for FISH and other molecular analyses

From each sample, 5 x 1.6 mL aliquots were fixed with PFA (1% final concentration) and frozen for FISH analysis at NOCS. Additional replicated 60 mL samples were concentrated into 2 x 1.8 mL samples as described for samples above, to sort less abundant groups for FISH analysis at NOCS.

Micronet hauls were done from 100 m to surface. Samples of 100-180 um and 40-100 um fractions were collected and analysed live using a FlowCam microscope. Additional replicated 60 mL samples of the finer fraction were concentrated into 2 x 1.8 mL samples to sort less abundant groups for molecular identification at NOCS.

2.7 Flow cytometry analysis of bacterial & protist abundance:

Standard environmental observation CTD samples, bioassay samples and other related samples were analysed by flow cytometry aboard the ship. For each sample 1.6ml of seawater was removed and placed into 2ml polypropylene screw cap vials containing 80µl PFA (1% final concentration). The vials were then placed in a fridge and left for no longer than 12 hours before being analysed on a BD FACSort flow cytometer to enumerate bacterial and protist abundance. Samples were stained with SYBR green II nucleic acid dye for a minimum of 30 minutes, before being run through the flow cytometer. Samples were run on a low flow rate for 1 minute to

determine bacterial numbers and on a high flow rate for 3 minutes to determine phototrophic and heterotrophic protist groupings and numbers. For each sample a known volume of bead solution was added as an internal standard. The bead solution consists of Fluoresbrite multicolour beads both 0.5µm and 1.0µm sizes dispersed in 400ml of sterile Milli Q water. The bead concentration was calculated before use using the FACS calibur flow cytometer and a syringe pump. The beads allow us to accurately determine the flow rate and therefore the cell abundance.

For the main bioassay samples only 1ml of sample was run through the flow cytometer with the remaining 600µl frozen in the -80°C for return to NOCS to be run post cruise if required.

Table 2: Additional Flow cytometry samples

Date	Sample	Number of samples	Lead
04/06/12	Bioassay 1 Zooplankton T24	17	Geraint
05/06/12	Bioassay 1 T48	36	Mark
07/06/12	Bioassay 1 T96	36	Mark
07/06/12	Bioassay 1 T96	6	Laura
07/06/12	Bioassay 1 T96	6	Sophie
10/06/12	Bioassay 2 T48	36	Mark
10/06/12	Bioassay 2 T48	6	Sophie
12/06/12	Bioassay 2 T96	36	Mark
12/06/12	Bioassay 2 T96	6	Laura
12/06/12	BP	2	Polly
13/06/12	BP	2	Polly
14/06/12	BP	2	Polly
14/06/12	Bioassay 3 Zooplankton T24	13	Geraint
15/06/12	Bioassay 3 T48	36	Mark
15/06/12	Bioassay 3 T48	6	Sophie
15/06/12	BP	2	Polly
16/06/12	BP	2	Polly
17/06/12	BP	2	Polly
17/06/12	Bioassay 3 T96	36	Mark
17/06/12	Bioassay 3 T96	6	Laura
19/06/12	Bioassay 4 Zooplankton T24	13	Geraint
19/06/12	E04 PC02 experiment T1	6	Sophie
20/06/12	Bioassay 4 T48	36	Mark
20/06/12	Bioassay 4 T48	6	Sophie
20/06/12	E04 PC02 experiment T2	6	Sophie
21/06/12	E04 PC02 experiment T3	6	Sophie
22/06/12	E04 PC02 experiment T4	5	Sophie
22/06/12	Bioassay 4 T96	36	Mark
22/06/12	Bioassay 4 T96	6	Laura
22/06/12	BP	2	Polly
23/06/12	E04 PC02 experiment T5	5	Sophie
25/06/12	Bioassay 5 Zooplankton T24	13	Geraint
25/06/12	E05 PC02 experiment T1	6	Sophie
26/06/12	E05 PC02 experiment T2	6	Sophie
26/06/12	Bioassay 5 T48	36	Mark
26/06/12	Bioassay 5 T48	6	Sophie
27/06/12	E05 PC02 experiment T3	6	Sophie
28/06/12	Bioassay 5 T96	36	Mark
28/06/12	Bioassay 5 T96	6	Laura
28/06/12	E05 PC02 experiment T4	6	Sophie
29/06/12	E05 PC02 experiment T5	6	Sophie
30/06/12	E05 PC02 experiment T6	6	Sophie
30/06/12	BP	2	Polly

Preliminary observations

Initial scintillation counts were carried out on board the ship (Packard Tri-Carb 3100). The ambient bioavailable leucine concentrations ranged between 0.1-0.7 nM and the estimated turnover time for leucine varied between 1-53 hours. Following the acidification of samples, bioavailable leucine

concentration generally increased, suggesting an immediate effect on cell integrity. Acidification had no apparent effect on the rate of leucine uptake or respiration. Acidification in the collaborative 96 h bioassays gave inconsistent results.

After the cruise, the collected tracer samples of flow sorted cells will be analysed in detail on low background counters due to the sensitivity limitations of the scintillation counters on board. The detailed data set will allow estimation of rates of metabolic activity of bacterioplankton and phytoplankton, as well as production and mortality. Moreover, completion of molecular analysis will enable us to link prokaryotic and eukaryotic community composition and function.

Post cruise the flow cytometry dot plots will be gated and analysed in detail to determine bacteria and protist groupings and abundance.

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SCIENTIFIC REPORT 25: Zooplankton

Geraint Tarling and Vicky Peck

Introduction

Zooplankton work is incorporated in a number of workpackages within the surface consortium OA programme, namely WP2 and WP7 - bioassay experiments encompassing foodweb effects; WP4 – plankton community structure and WP6 – biocalcification. In so doing, it encompasses both experimental and observational work. The starting point for most zooplankton activities was the sampling of a motion compensated Bongo net (100 and 200 um mesh, Plate 1), deployed between 0 and 200 m depth (water-depth permitting). The net was deployed each morning (from 05:15), three times in succession, with one set of samples being immediately preserved (ethanol and formalin) and the two other sets used for hand picking copepods, pteropods and foraminifera for bioassays, rate measurements, body condition analyses, shell chemistry and size-normalised weights. An evening Bongo deployment was also carried out towards the latter half of the cruise. The subsequent sections describe how the various treatments of these samples contributed to respective workpackages. Note that WP4 also describes the deployment of the Continuous Plankton Recorder, which was the other means by which mesozooplankton was collected. Foramanifera were also monitored through intermittent collections made on 125 um mesh attached to the underway uncontaminated seawater supply.

Plate 1: Deployment of the motion-compensated Bongo net

WP2 and WP 7: BIOASSAY EXPERIMENTS

Objectives

To perform bioassay experiments designed to evaluate the response to artificial carbonate system manipulation of multiple organisms and processes. In particular with regards zooplankton, incubations are to be carried out to study foodweb effects at different pCO2 levels using modified natural sea-water. DIC, TA, DOC and TEP measurements will be made on aliquots taken at the start and end of incubations. Bacterio-plankton and protist counts will be carried out through flow cytometry on freshly fixed samples. Microplankton enumeration and identification will be performed on Lugols-preserved samples and/or FlowCam microscopy. Measurements of nutrient and ammonia levels will also be made.

Methods

1L Duran bottles were filled with untreated natural seawater modified with varying aliquots of 0.96 M HCl and 1.03 M $NaHCO_3$ (see Annex 1: Acid/Base additions for zooplankton bioassays) to achieve pCO2 levels 550, 750 and 1000 uatm. All treatments were carried out in triplicate (i.e. 3 individual 1 L Duran bottles per pCO2 level), including triplicate ambient conditions. There were two separate sets of bottles, one for a 24 h incubation, the other for a 96 h incubation.

Hand-picked copepods were introduced to the bottles, with the species of copepod and the number of specimens per bottle varying between bioassays depending on the prevailing natural copepod community. Some bottles were left without copepods to act as controls. The bottles were topped up to the rim and the lids sealed with parafilm before being placed on plankton wheels within a controlled temperature container maintained at ambient surface water temperature. Diffused light fields were maintained next to the wheels to simulate the light regime at 5 m depth.

Inspections of the copepods were made before stopping an incubation (Plate 2) and the number of dead specimens noted. The bottles were then sampled for microplankton composition and abundance, TA and DIC, TEP and DOC, bacterial abundance, bacterial production, nutrient levels (silicate, nitrate, phosphate), ammonia and oxygen concentrations (Annex 2: Zooplankton bioassay). It was not possible to make all measurements on all bottles because of the volumes required for each analytical method. However, each measurement was made on at least one seeded and one control bottle at each pCO2 level. Bacterial abundance, bacterial production and microplankton samples were only made on the 24 h incubation, to avoid exponential growth and overgrazing effects respectively. Subsequent to sampling, the copepods were extracted and all live specimens snap frozen in liquid nitrogen for future analysis of gut fluorescence and enzyme activity.

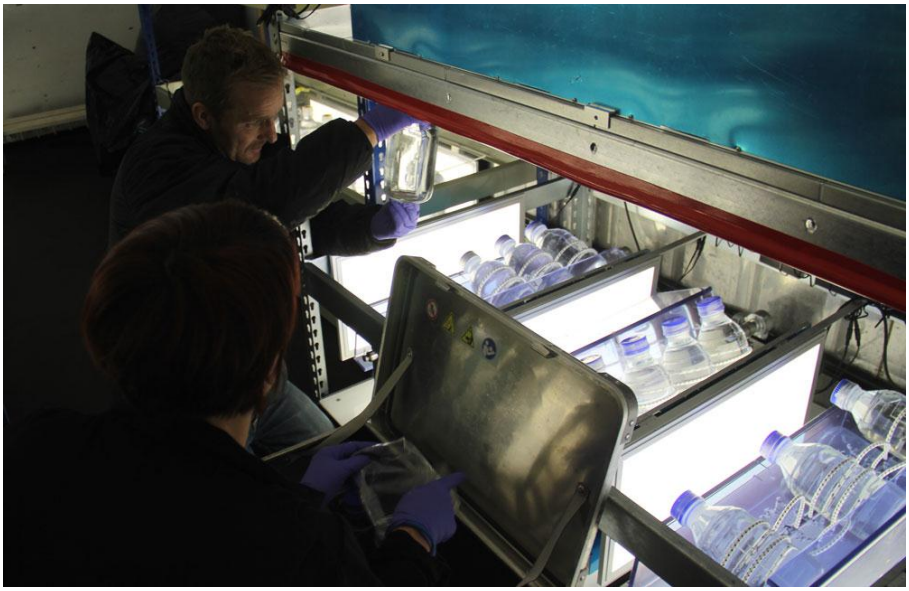

Plate 2: Inspection of incubation bottles during takedown of a zooplankton bioassay

Implementation

Bioassay 1: Set up on 3/6 24 h at 56.267°N 2.633°E (North Sea)

Copepod species/stage: *Calanus finmarchicus* CV – 5 per bottle.

pCO2 conditions: ambient, 550, 750 and 1000 uatm

Comments: Picking the specimens out was difficult due to a number of factors (small size of specimens and difficulties in extracting them cleanly), and the condition of the animals introduced to the bioassay bottles was not good. There were a number of mortalities across all bottles. NB. Oxygen and bacterial production was not measured in this bioassay. Also, difficult to deal with

such a large number of bottles, so decided to not include 550 uatm treatment in future bioassays. Some specimens lost through extraction tube – remedied in all subsequent incubations through placing a 125um mesh over the submerged end of the tube.

Bioassay 2: Planned for 8th June but high winds and swell prevented the Bongo from being deployed and the zooplankton setup from being carried out

Bioassay 3: Set up on 13/6 at 76.175°N 2.550°W (Open sea conditions, north of Arctic Front)

Copepod species/stage: *Calanus hyperboreus* female – 5 per bottle

pCO2 conditions: ambient, 750, 1000 uatm

Comments: These specimens were around 2-3 times the size of C finmarchicus and much easier to handle. All measurements made apart from bacterial production. Mortality in specimens was very low (<=1) across all bottles. Note that the mesh over the end of the extraction tube meant that samples for microplankton had to be extracted first using a Gilson pipette to avoid bias.

Bioassay 4: Set up on 18/6 at 78.289°N 4.266°W (Ice conditions)

Copepod species/stage: *Calanus hyperboreus* female – 5 per bottle

pCO2 conditions: ambient, 750 and 1000 uatm

Comments: Easy to handle with low (<=1) mortality across all treatments. Bacterial production was also measured on 24 h incubated bottles (samples taken from 1 seeded and 1 non-seeded bottle per pCO2 level).

Bioassay 5: Set up on 24/6 at 72.892°N 26.002°W (Barents Sea)

Copepod species/stage: *Calanus glacialis* CV – 10 per bottle

pCO2 conditions: ambient, 750 and 1000 uatm

Comments*: C. glacialis* was highly abundant at this station and was caught in the CTD water used for the bioassays. Therefore, in addition to the 10 introduced specimens, there were further specimens within the incubation. Mortality low (<=1 per bottle).

Additional incubations for respiration and excretion rates

Incubations of copepods in ~300 ml BOD bottles were carried out to determine respiration and ammonia excretion rates of both copepods and pteropods. Bottles were filled with 0.22 um filtered water and modified with varying aliquots of 0.96 M HCl and 1.03 M $NaHCO_3$ (see Annex Acid_Base additions for zooplankton bioassays) to achieve pCO2 levels (550), 750 and 1000 uatm. The species/stage of incubated copepods varied in line with those in the parallel bioassay experiments. Either 5 or 10 copepod were placed in each bottle and incubated for 48 h. Between 1 and 3 further bottles were not seeded with copepods at each pCO2 level to act as controls. A further non-seeded bottle at each manipulated pCO2 level was also setup for TA and DIC analysis to verify the pCO2 level achieved by the acid/base manipulation.

At the end of the incubation, bottles were inspected for mortalities before adding Winkler chemicals I and II and the temperature and time noted. A Winkler titration was subsequently carried out after a further 24 h at room temperature.

A total of 7 x 48 h incubations of *C hyperboreus* females and 3 x 48 h incubations of *C glacialis* CV were carried out mainly at pCO2 levels of ambient, 750 and 1000 uatm (Table 3). Note: samples for ammonia were not taken from the first C hyperboreus experiment.

WP 4: PLANKTON COMMUNITY STRUCTURE

Objectives

The rate at which a biologically-mediated process proceeds, when expressed as a rate per unit volume of seawater, is the product of the abundance per unit volume of the relevant organism(s)

and the per-organism physiological rates. The identification and enumeration of plankton communities is therefore a necessary parameter to place measurement of processes within a biogeochemical context. Collection of specimens for this purpose was mainly achieved through the deployment of vertical net hauls (motion compensated Bongo net, 100um and 200um mesh) and the Continuous Plankton Recorder (CPR) tows (>10 nm long at 0- 10 m depth, 270 µm mesh).

Methods

The Bongo net was deployed between 0 and 200 m (water depth permitting) each day at approximately 05:00 (GMT). The deployments were made in immediate succession, Generally, the samples from the first deployment were preserved and the subsequent two were used to pick out live specimens for incubation, snap-freezing or for CHN analysis. Beyond 21st June, an additional evening deployment of the Bongo was made around 18:30 (GMT) – this was preserved although some pteropod and foraminifera specimens may have been removed from the 100um sample and note on the sample label. On 20th and 21st some focussed Bongo netting at three different locations in Ny Alesund Bay were carried out to capture pteropods. With respect to preservation, the 100 um samples was preserved in Ethanol and the 200 um in Steedman's (a formalin based) solution. Up to 14th June, 70% Ethanol was used after which 100% Ethanol was used.

The CPR was deployed continuously during transects between stations, with the exception of ice-covered regions during the period 15th-19th June. Ship's speed between stations was approximately 10 knots. Until 20th June, there was one station stop per day, meaning that the CPR was hauled out of the water just prior to the station (generally around 05:00) and serviced in readiness for redeployment once station activities had been completed (approximately 09:00 for short stations and 11:00 for long stations). After 21st June, there were two station stops per day, with the additional evening stop lasting around 90 minutes between 18:30 and 20:00. Although the CPR was hauled out of the water during the evening, it was not serviced as during the morning station.

Servicing the CPR involved extracting the internal mechanism, making a note of patch number, drawing a red line in marker pen at this point, winding on the gauze for ~2 patches, marking the new position with a green marker pen. Formalin was added to the spool well and the mechanism was reinserted(Plate 3). An inspection was made of the seaworthiness of the CPR body (front opening, propeller blades, fenders etc.) upon each retrieval.

Plate 3: Recovery of CPR and winding-on of the internal mechanism

Implementation

99 Bongo net deployments were made between 3rd June and 1st July 2012.Of these, 40 were preserved in Formalin/Ethanol (Table 1) and the remainder were used for picking live animals before being discarded.

Table 1: Bongo net deployments: 100 um sample preserved in Ethanol (70% up to 14/6;100% 15/6 onwards) and the 200um sample in Steedmans (formalin based) solution

Start Date/Time of deployment(s)	Latitude	Longitude	Water Depth (m)	Sea Surface Temp	Salinity	Max Depth
03/06/2012 06:39	56.26664	2.63319	74.5	10.65	35.1115	0- 50 m
04/06/2012 05:20	58.73979	-0.86149	118.29	10.15	35.327	0- 50 m
05/06/2012 05:15	60.13396	-6.70426	1176.38	10.47	35.4385	0-200 m
06/06/2012 05:14	59.97134	-11.9794	1227.05	10.43	35.3036	0-200 m
07/06/2012 05:14	60.00141	-18.6703	2615.07	9.99	35.1225	0-200 m
10/06/2012 05:17	65.97936	-10.7183	1214.96	4.37	34.8278	0-200 m
11/06/2012 05:08	69.89569	-7.57707	1132.86	3.83	35.0289	0-200 m
11/06/2012 05:36	69.89568	-7.57705	1132.61	3.88	35.0326	0-200 m
12/06/2012 05:13	74.11646	-4.69297	2736.41	0.78	34.8702	0-200 m
13/06/2012 06:04	76.17525	-2.5495	3758.66	1.51	34.9007	0-200 m
14/06/2012 05:13	78.71805	0.00409	2728.69	2.93	34.8404	0-200 m
15/06/2012 06:39	78.23941	-5.55754	354.05	-1.62	33.1991	0-200 m
16/06/2012 05:15	78.21593	-6.00595	344.83	1.03	29.9992	0-200 m
17/06/2012 05:15	77.83008	-5.02818	1091.33	In ice – no USS		0-200 m
18/06/2012 10:36	78.28862	-4.26552	1749.5	-1.6	32.4796	0-200 m
19/06/2012 05:38	77.84251	-1.31593	3052.02	In ice – no USS		0-200 m
19/06/2012 18:36	78.42182	2.76566	2329.54	3.94	35.0674	0-200 m
20/06/2012 05:08	78.98257	7.97998	1101	5.72	35.0274	0-200 m
20/06/2012 14:29	78.95553	11.92494	359.43	4.9	34.4033	0-250 m
21/06/2012 10:09	79.05749	11.14384	316.4	3.44	34.6199	0-200 m
21/06/2012 18:39	77.92909	9.13675	1155.96	5.69	35.096	0-200 m
22/06/2012 05:10	76.26196	12.54192	1713.65	5.63	35.1288	0-200 m
22/06/2012 18:34	76.21155	18.38216	247.28	4.27	35.0171	0-150 m
23/06/2012 05:09	76.15948	26.06155	131.73	0.8	34.3709	0-50 m
23/06/2012 18:30	74.09	25.99935	434.53	5.76	35.0663	0-200 m
24/06/2012 06:26	72.88977	26.00403	362.72	6.29	34.9799	0-200 m
24/06/2012 18:31	71.74803	22.97218	377.21	7.08	34.5198	0-200 m
25/06/2012 05:02	71.75197	17.90084	283.45	7.75	34.8922	0-200 m
25/06/2012 18:37	71.75783	13.39092	1859.24	8.2	34.963	0-200 m
26/06/2012 05:05	71.7475	8.44275	2735.63	6.66	35.1394	0-200 m
26/06/2012 18:31	71.75222	3.86253	3072.77	6.65	35.1572	0-200 m
27/06/2012 05:05	71.74527	-1.26728	1786.8	5.76	35.1215	0-200 m
27/06/2012 08:28	71.74528	-1.26726	1748.71	5.85	35.1228	0-200 m
28/06/2012 05:00	71.74838	-10.5971	2387.34	3.17	34.3511	0-200 m
28/06/2012 18:57	70.50824	-10.0999	1241.84	4.02	34.8726	0-200 m
29/06/2012 05:06	68.69505	-10.576	2193.79	4.05	34.791	0-200 m
30/06/2012 05:07	67.83043	-16.4218	1060.97	6.84	34.8979	0-200 m
30/06/2012 18:28	67.83151	-20.0642	855.27	7.79	34.7199	0-200 m
01/07/2012 05:26	67.26236	-24.0363	657.55	3.86	32.3846	0-200 m
01/07/2012 15:18	66.7929	-25.1405	822.45	3.89	32.4513	0-200 m

The CPR was deployed continuously between 3/6 and 14/6 and then between 19/6 and 2/7. A total of 8 different internal mechanisms were used, including the respooling of mechanisms 167/1 and 167/2 with new mesh for a second deployment. The CPR body was swapped from 167 to 157 on 19/6 to even out sampling wear. CPR 157 was used again on 29/6 since there was some difficulty in inserting mechanism 167/2 into the body of 157.

Across all deployments, a total of 753 patches were sampled, equating to 3765 nautical miles. However, it is to be noted that the estimate of 5 nm per patch appeared to underestimate over-ground GPS distance by around 20%.

Full details of the numbers of patches sampled each day and the wind-on increments are listed in Annex CPR1: Short leg CPR tow forms. Lats and longs at the start and end of each CPR deployment are given in Annex CPR2: CPR log sheets

Table 2: Deployment of CPR mechanisms during JR271

	Date	**Mechanism**	**CPR body**	**Total number of patches (bottom of tunnel)**
1	3/6/12 to 6/6/12	167/0	167	105.1
2	6/6/12 to 10/6/12	157/1	167	107.2
3	10/6/12 to 13/6/12	167/1	167	101.6
4	13/6/12 to 14/6/12	167/2	167	36.6
5	19/6/12 to 23/6/12	157/0	157	97.0
6	23/6/12 to 26/6/12	157/2	157	101.1
7	26/6/12 to 29/6/12	167/1 (2)	157	99.4
8	29/6/12 to 2/7/12	167/0 (2)	167	111 (wound off the reel in situ)
			Total	**753**
			Nautical miles	*3765*

WP 6: IMPACT OF OCEAN ACIDIFICATION ON BIOCALCIFICATION

Objectives

To carry out extensive observations on the effect of natural gradients in pH and ΩCaCO3 on calcifying organisms, in parallel with bioassay experiments to test the following hypotheses:

$H1_1$: Size-normalised weight of foraminiferal species will decrease in tandem with ΩCaCO3*.*

$H1_2$: Pteropod shells will show evidence of dissolution and/or inhibited calcification in lowest ΩCaCO3 *waters.*

Planktonic foraminifera and pteropods to be collected from the plankton net and underway sampling of the uncontaminated was supply. Cleaned specimens will be imaged in standard orientations, measured and weighed to produce size-weight spectra for each of the main species. In addition, live specimens of *L. helicina and L. retroversa* will be handpicked for bioassay experiments to be undertaken in parallel with the main bioassay experiments and at the same range of pCO2 conditions, but using separate vessels to provide suitable growth conditions for the organisms. Both field and bioassay pteropod specimens will be examined in detail by a combination of scanning electron microscopy (to identify external dissolution) and SEMled EMPA to examine shell composition.

Methods

Bongo netting: Both foramanifera and pteropod specimens were extracted from Bongo deployments (see above). All foram and a representative sample of pteropod specimens were rinsed in ammonia buffered Milli-Q before being placed on specimen slides to air dry. In some instances, a fraction of pteropods were also placed in Ethanol (initially 70% and then 100% after 14/6).

Underway sampling: the uncontaminated seawater supply was sampled with a 125 um gauze stretched over a 15 cm diameter funnel attached to the outlet hose. The flow rate was 10 L/min. Sampling was carried out between 05:00 and 07:30 each day to coincide with Bongo deployments. The gauzes were subsequently stretched on a frame, rinsed with Milli-Q water with a final rinse of ammonia buffered Milli-Q. The gauze was then blotted from underneath and air dried before they were examined to extract foraminifera and pteropods.

Plate 4: Sampling of underway water supply

Bioassays: Live pteropods for bioassays were obtained from the Bongo nets (see above). Once a representative sample of pteropods had been picked to provide a reference, half of the number of picked specimens were placed in a poisoned solution (generally mercuric chloride) to cause mortality, the remainder were kept alive. Two sets of pCO2 manipulated bottles were prepared, one for dead specimens only, the other only for live specimens. The manipulations were at least to create pCO2 levels of 750 and 1000 uatm as well as ambient. Where numbers were sufficient, a 550 uatm treatment was also prepared. Once the pteropods had been introduced, the bottles were sealed and incubated either for 4 d or 8 d. In instances where the bioassays took place at the same time as the copepod bioassays, the pteropods were placed in 1L Duran bottles, with live specimens being placed on a plankton wheel and dead specimens in a covered box (Allibert). In those instances, the water was not prefiltered. In all other instances, the pteropod were placed in either 310ml polycarbonate bottles or 290 ml glass BOD bottles containing 0.22um filtered seawater. Manipulations were made through addition of aliquots of 1M HCl and NaHCO3 determined through reference to the ambient TA and DIC conditions. At the termination of the incubation, any mortalities in the live specimen incubations was noted before specimens were decanted and pipetted out of the water. Light microscope pictures were taken before rinsing in buffered Milli-Q water and drying out in specimen slides. In some instances, a fraction were preserved in Ethanol.

Implementation:

In total, 7 pteropod bioassays were carried out, 4 on *Limacina retroversa* and 3 on *Limacina helicina*. Mortalities were low in each bioassay although there was evidence of the breakage of shells in a small number of specimens.

Table 3: Pteropod bioassays

Experiment	Date	Treatments	Av. Ind. per treatment	Incubation period	Mortality levels	Storage
EO1	7/6/12	Ambient, 550, 750, 1000 in 1 L Durans (live on plankton wheels; dead in Alibert box)	17 (*L retroversa*)	4 d	4 (Note: some exposed to 70% EtOH survived)	Part frozen part EtOH
EO4	18/6/12	Ambient, 750, 1000 in 1 L Durans (live in plankton wheel; dead in Alibert box)	6 (*L helicina*)	4 d	0 (Note: some exposed to HgCl survived)	Air-dried or EtOH
Ptero 1	21/6/12	Ambient, 550, 750 and 1000 in 310 ml plastic bottles, live and dead in Alibert	10 (*L helicina*)	8 d	0 although one with broken shell	Air dried
Ptero 2	23/6/12	Ambient, 550, 750 and 1000 in 290 ml BOD bottles, live and dead in Alibert	17 (*L helicina*)	8 d	1	Air dried
Ptero 3	26/6/12	Ambient, 550, 750 and 1000 in 290 ml BOD bottles, live and dead in Alibert	10 (*L retroversa*)	4 d	0	Air dried
Ptero 4	27/6/12	Ambient, 750 and 1000 in 290 ml BOD bottles, live and dead in Alibert	8 (*L retroversa*)	4 d	0 although one with broken shell	Air dried
Ptero 5	27/6/12	Ambient, 750 and 1000 in 290 ml BOD bottles, live and dead in Alibert	8 (*L retroversa*)	4 d	0 although one with broken shell	Air dried

Annex 1: Acid/Base additions for zooplankton bioassays and rate process measurements

Date	Incubation type	Bottle volume (ml)	TA	DIC	Salinity	Temperature of incubation	550 DIC added (ml)	550 HCl added (ml)	750 DIC added (ml)	750 HCl added (ml)	1000 DIC added (ml)	1000 HCl added (ml)
03/06/2012	Bioassay 1	This addition was carried out by directly by bioassay team										
05/06/2012	Respiration 48 h(pteropod)	290	2335.6	2110.78	35.92	?	0.027325	0.027325	0.040052	0.040052	0.050956	0.050956
07/06/2012	Respiration 48 h(pteropod)	290	2326.86	2096.2	35.16	7.3	0.033613	0.033613	0.046435	0.046435	0.057502	0.057502
10/06/2012	Respiration 48 h (C hyp fem 1)	290	2309.9	2046	34.81	5.2			0.060595	0.60595	0.071305	0.071305
11/06/2012	Respiration 48 h (C hyp fem 2)	290	2310.6	2124	35	4			0.03743	0.03743	0.047635	0.047635
12/06/2012	Respiration 48 h (C hyp fem 3)	290	2303.4	2150	34.87	4.1			0.27922	0.029085	0.038085	0.039671
13/06/2012	Bioassay 3	1000	2126.6	2308.1	34.9	3.163			0.12902	0.1344	0.16389	0.17072
13/06/2012	Respiration 48 h (C hyp fem 4)	290	2126.6	2308.1	34.9	3.163			0.037416	0.038975	0.047527	0.049508
16/06/2012	Respiration 48 h (C hyp fem 5)	290	2166.5	2061.6	32.29	-0.07			0.023968	0.024967	0.033211	0.034595
17/06/2012	Respiration 48 h (C hyp fem 6)	290	2242.6	2120.5	32.6	0.782			0.025642	0.027512	0.034894	0.037438
18/06/2012	Bioassay 4	1000	2234.1	2106.9	32.59	-1.6			0.1064	0.1142	0.1381	0.1482
20/06/2012	Respiration 48 h (C hyp fem 7)	290	2322.2	2031.3	35.03	4			0.065515	0.070293	0.075405	0.080967
20/06/2012	Pteropod 8 d incubation (Ptero1)	355	2314.1	2085.2	34.88	4.1	0.045161	0.048454	0.058958	0.063257	0.071089	0.076272
23/06/2012	Pteropod 8 d incubation (Ptero2)	290	2277.7	2081.4	34.37	3.9	0.029318	0.031455	0.0403	0.043238	0.049999	0.053645
24/06/2012	Bioassay 4	1000	2311.19	2107	34.98	6.53			0.12924	0.13867	0.16421	0.17618
25/06/2012	Respiration 48 h (C gla CV 1)	290	2315.8	2095.2	34.9	4.1			0.045781	0.049119	0.055699	0.05976
26/06/2012	Respiration 48 h (C gla CV 2)	290	2319.3	2120.4	35.14	3.9			0.039739	0.042637	0.049681	0.053304
26/06/2012	Pteropod 4 d incubation (Ptero3)	290	2319.3	2120.4	35.14	3.9	0.028435	0.030509	0.039739	0.042637	0.049681	0.053304
27/05/2012	Respiration 48 h (C gla CV 3)	290	2318.8	2108	35.14	4			0.042946	0.046078	0.052895	0.056752
27/05/2012	Pteropod 4 d incubation (larger specimens caught night before - Ptero4)	290	2318.8	2108	35.14	4			0.042946	0.046078	0.052895	0.056752
27/05/2012	Pteropod 4 d incubation (smaller specimens from present day catch - Ptero5)	290	2318.8	2108	35.14	4			0.042946	0.046078	0.052895	0.056752

Annex 2: Zooplankton bioassays

Zooplankton Bioassay EO1 (3-7/6/12)												
Bottle Number	Treatment	Zooplankton	Intact bottle estimates	Filtered down obs	Stop (hrs)	Bacteria and protists (ml)	TEP and DOC	TA and DIC	Microplankton (ml)	NO3, Si, PO4 (ml)	NH4 (ml)	Code
1	Ambient	5 C finmarchicus CV	Not done	3 live	24	2	750.00					ZJR271EO1Z01
2	Ambient	5 C finmarchicus CV	Not done	1 live, 2 dead	24	2		250.00	100.00	50.00	50.00	ZJR271EO1Z02
3	Ambient	5 C finmarchicus CV	Not done	5 live	24	2			100.00	50.00	50.00	ZJR271EO1Z03
4	Ambient	No copepods			24	2	750.00					ZJR271EO1Z04
5	Ambient	No copepods			24	2		250.00	100.00	50.00	50.00	ZJR271EO1Z05
6	550	5 C finmarchicus CV	Not done	some live (forgot to take note)	24	2	750.00					ZJR271EO1Z06
7	550	5 C finmarchicus CV	Not done	5 live - 3 in 1 vial, 1 in another, 1 lost	24	2		250.00	100.00	50.00	50.00	ZJR271EO1Z07
8	550	5 C finmarchicus CV	Not done	3 live, 2 dead (note gelatinus material covering live copepods	24	2			100.00	50.00	50.00	ZJR271EO1Z08
9	550	No copepods			24	2		250.00	100.00	50.00	50.00	ZJR271EO1Z09
10	750	5 C finmarchicus CV	Not done	1 live, 2 dead	24	2	750.00					ZJR271EO1Z10
11	750	5 C finmarchicus CV	Not done	4 live	24	2		250.00	100.00	50.00	50.00	ZJR271EO1Z11
12	750	5 C finmarchicus CV	Not done	2 live	24	2			100.00	50.00	50.00	ZJR271EO1Z12
13	750	No copepods			24	2		250.00	100.00	50.00	50.00	ZJR271EO1Z13
14	1000	5 C finmarchicus CV	Not done	1 live, 2 dead	24	2	750.00					ZJR271EO1Z14
15	1000	5 C finmarchicus CV	Not done	4 live, 1 dead	24	2		250.00	100.00	50.00	50.00	ZJR271EO1Z15
16	1000	5 C finmarchicus CV	Not done	3 live, 1 dead	24	2			100.00	50.00	50.00	ZJR271EO1Z16
17	1000	No copepods			24	2		250.00	100.00	50.00	50.00	ZJR271EO1Z17
18	Ambient	5 C finmarchicus CV	2 alive, 1 dead	2 alive, 1 dead	96		750.00					ZJR271EO1Z18
19	Ambient	5 C finmarchicus CV	2 alive, 1 dead	3 alive, 2 dead	96			250.00		50.00	50.00	ZJR271EO1Z19
20	Ambient	5 C finmarchicus CV	4 alive, 1 dead	4 alive, 2 dead	96					50.00	50.00	ZJR271EO1Z20
21	Ambient	No copepods			96		750.00					ZJR271EO1Z21
22	Ambient	No copepods			96			250.00		50.00	50.00	ZJR271EO1Z22
23	550	5 C finmarchicus CV	2 alive, 3 dead	2 dead	96		750.00					ZJR271EO1Z23
24	550	5 C finmarchicus CV	5 alive	4 alive, 2 dead	96			250.00		50.00	50.00	ZJR271EO1Z24
25	550	5 C finmarchicus CV	4 alive	2 alive, 1 in jelly	96					50.00	50.00	ZJR271EO1Z25
26	550	No copepods			96			250.00		50.00	50.00	ZJR271EO1Z26
27	750	5 C finmarchicus CV	4 alive	2 alive	96		750.00					ZJR271EO1Z27
28	750	5 C finmarchicus CV	5 alive	3 alive, 2 dead	96			250.00		50.00	50.00	ZJR271EO1Z28

Annex 2: Zooplankton bioassays (Cont.)

Zooplankton Bioassay EO1 (3-7/6/12) – Cont.												
Bottle Number	**Treatment**	**Zooplankton**	**Intact bottle estimates**	**Filtered down obs**	**Stop (hrs)**	**Bacteria and protists (ml)**	**TEP and DOC**	**TA and DIC**	**Microplankton (ml)**	**NO3, Si, PO4 (ml)**	**NH4 (ml)**	**Code**
29	750	5 C finmarchicus CV	2 alive, 1 dead	2 alive	96					50.00	50.00	ZJR271EO1Z29
30	750	No copepods			96			250.00		50.00	50.00	ZJR271EO1Z30
31	1000	5 C finmarchicus CV	3 alive, 1 dead	3 alive, 1 dead	96		750.00					ZJR271EO1Z31
32	1000	5 C finmarchicus CV	5 alive	4 alive	96			250.00		50.00	50.00	ZJR271EO1Z32
33	1000	5 C finmarchicus CV	3 alive, 1 dead	3 alive	96					50.00	50.00	ZJR271EO1Z33
34	1000	No copepods			96			250.00		50.00	50.00	ZJR271EO1Z34
35	Ambient	30 live ptero	no dead		96			250.00	100.00	50.00	50.00	ZJR271EO1Z35
36	550	30 live ptero	1 dead		96			250.00	100.00	50.00	50.00	ZJR271EO1Z36
37	750	30 live ptero	4 dead		96			250.00	100.00	50.00	50.00	ZJR271EO1Z37
38	1000	30 live ptero	2 dead		96			250.00	100.00	50.00	50.00	ZJR271EO1Z38

Zooplankton Bioassay EO3 (13-17/6/12)												
Bottle No.	**Treatment**	**Zooplankton**	**Stop (hrs)**	**Bacteria**	**TEP/DOC (ml)**	**DIC +TA (ml)**	**Microplankt. (ml)**	**NO3, Si, PO4 (ml)**	**NH4 (ml)**	**Winkler (ml)**	**Code**	**Animals after decant**
1	Ambient	5 C hyperboreus female	24	2.00	898.00		100*				ZJR271EO3Z01	5 alive (returned from TEP)
2	Ambient	5 C hyperboreus female	24	2.00		250.00		50.00	50.00		ZJR271EO3Z02	5 alive
3	Ambient	5 C hyperboreus female	24	2.00				50.00	50.00	300.00	ZJR271EO3Z03	5 alive
4	Ambient	No copepods	24	2.00	898.00		100*				ZJR271EO3Z04	,
5	Ambient	No copepods	24	2.00		250.00		50.00	50.00	300.00	ZJR271EO3Z05	,
6	750	5 C hyperboreus female	24	2.00	998.00						ZJR271EO3Z06	4 alive (after returned from TEP analysis)
7	750	5 C hyperboreus female	24	2.00		250.00	100.00	50.00	50.00		ZJR271EO3Z07	4 alive, 1 dead
8	750	5 C hyperboreus female	24	2.00			100.00	50.00	50.00	300.00	ZJR271EO3Z08	5 alive
9	750	No copepods	24	2.00		250.00	100.00	50.00	50.00	300.00	ZJR271EO3Z09	,
10	1000	5 C hyperboreus female	24	2.00	998.00						ZJR271EO3Z10	4 alive, 1 dead (returned from TEP)
11	1000	5 C hyperboreus female	24	2.00		250.00	100.00	50.00	50.00		ZJR271EO3Z11	5 alive

Annex 2: Zooplankton bioassays (Cont.)

Zooplankton Bioassay EO3 (13-17/6/12) – Cont.												
Bottle No.	**Treatment**	**Zooplankton**	**Stop (hrs)**	**Bacteria**	**TEP/DOC (ml)**	**DIC +TA (ml)**	**Microplankt. (ml)**	**NO3, Si, PO4 (ml)**	**NH4 (ml)**	**Winkler (ml)**	**Code**	**Animals after decant**
12	1000	5 C hyperboreus female	24	2.00			100.00	50.00	50.00	300.00	ZJR271EO3Z12	4 alive, 1 dead
13	1000	No copepods	24	1.00		250.00	100.00	50.00	50.00	300.00	ZJR271EO3Z13	,
14	Ambient	5 C hyperboreus female	96		1000.00						ZJR271EO3Z14	discarded
15	Ambient	5 C hyperboreus female	96			250.00		50.00	50.00		ZJR271EO3Z15	5 alive
16	Ambient	5 C hyperboreus female	96					50.00	50.00	300.00	ZJR271EO3Z16	5 alive
17	Ambient	No copepods	96		1000.00						ZJR271EO3Z17	,
18	Ambient	No copepods	96			250.00		50.00	50.00	300.00	ZJR271EO3Z18	,
19	750	5 C hyperboreus female	96		1000.00						ZJR271EO3Z19	discarded
20	750	5 C hyperboreus female	96			250.00		50.00	50.00		ZJR271EO3Z20	5 alive
21	750	5 C hyperboreus female	96					50.00	50.00	300.00	ZJR271EO3Z21	5 alive
22	750	No copepods	96			250.00		50.00	50.00	300.00	ZJR271EO3Z22	,
23	1000	5 C hyperboreus female	96		1000.00						ZJR271EO3Z23	discarded
24	1000	5 C hyperboreus female	96			250.00		50.00	50.00		ZJR271EO3Z24	5 alive + 1 in bad state = 6
25	1000	5 C hyperboreus female	96					50.00	50.00	300.00	ZJR271EO3Z25	5 alive
26	1000	No copepods	96			250.00		50.00	50.00	300.00	ZJR271EO3Z26	,

Zooplankton bioassay EO4 (18-22/6/12)													
Bottle No.	**Treatment**	**Zooplankton**	**Stop (hrs)**	**Bacteria**	**Bacterial production**	**TEP/DOC (ml)**	**DIC +TA (ml)**	**Microplankt. (ml)**	**NO3, Si, PO4 (ml)**	**NH4 (ml)**	**Winkler (ml)**	**Animals after decant**	**Code**
1	Ambient	C hyperboreus female	24	2.00		998.00							ZJR271EO4Z01
2	Ambient	C hyperboreus female	24	2.00			250.00	100.00	50.00	50.00		5 alive	ZJR271EO4Z02
3	Ambient	C hyperboreus female	24	2.00	10.00			100.00	50.00	50.00	300.00	5 alive	ZJR271EO4Z03
4	Ambient	No copepods	24	2.00		998.00							ZJR271EO4Z04

Annex 2: Zooplankton bioassays (Cont.)

Zooplankton bioassay EO4 (18-22/6/12) – Cont.													
Bottle No.	**Treatment**	**Zooplankton**	**Stop (hrs)**	**Bacteria**	**Bacterial production**	**TEP/DOC (ml)**	**DIC +TA (ml)**	**Microplankt. (ml)**	**NO3, Si, PO4 (ml)**	**NH4 (ml)**	**Winkler (ml)**	**Animals after decant**	**Code**
5	Ambient	No copepods	24	2.00	10.00		250.00	100.00	50.00	50.00	300.00		ZJR271EO4Z05
6	750	C hyperboreus female	24	2.00		998.00							ZJR271EO4Z06
7	750	C hyperboreus female	24	2.00			250.00	100.00	50.00	50.00		5 alive	ZJR271EO4Z07
8	750	C hyperboreus female	24	2.00	10.00			100.00	50.00	50.00	300.00	5 alive	ZJR271EO4Z08
9	750	No copepods	24	2.00	10.00		250.00	100.00	50.00	50.00	300.00		ZJR271EO4Z09
10	1000	C hyperboreus female	24	2.00		998.00							ZJR271EO4Z10
11	1000	C hyperboreus female	24	2.00			250.00	100.00	50.00	50.00		5 alive	ZJR271EO4Z11
12	1000	C hyperboreus female	24	2.00	10.00			100.00	50.00	50.00	300.00	5 alive	ZJR271EO4Z12
13	1000	No copepods	24	2.00	10.00		250.00	100.00	50.00	50.00	300.00		ZJR271EO4Z13
14	Ambient	C hyperboreus female	96			1000.00							ZJR271EO4Z14
15	Ambient	C hyperboreus female	96				250.00		50.00	50.00		5 alive	ZJR271EO4Z15
16	Ambient	C hyperboreus female	96						50.00	50.00	300.00	4 alive 1 dead	ZJR271EO4Z16
32	Ambient	No copepods	96			1000.00							ZJR271EO4Z32
18	Ambient	No copepods	96				250.00		50.00	50.00	300.00		ZJR271EO4Z18
19	750	C hyperboreus female	96			1000.00							ZJR271EO4Z19
21	750	C hyperboreus female	96						50.00	50.00	300.00	4 alive, 1 dead	ZJR271EO4Z21
22	750	No copepods	96				250.00		50.00	50.00	300.00	5 alive	ZJR271EO4Z22
23	1000	C hyperboreus female	96			1000.00							ZJR271EO4Z23
24	1000	C hyperboreus female	96				250.00		50.00	50.00			ZJR271EO4Z24
25	1000	C hyperboreus female	96						50.00	50.00	300.00	5 alive	ZJR271EO4Z25

Annex 2: Zooplankton bioassays (Cont.)

Zooplankton bioassay EO4 (18-22/6/12) – Cont.													
Bottle No.	**Treatment**	**Zooplankton**	**Stop (hrs)**	**Bacteria**	**Bacterial production**	**TEP/DOC (ml)**	**DIC +TA (ml)**	**Microplankt. (ml)**	**NO3, Si, PO4 (ml)**	**NH4 (ml)**	**Winkler (ml)**	**Animals after decant**	**Code**
26	1000	No copepods	96				250.00		50.00	50.00	300.00	4 alive (only 4 found)	ZJR271EO4Z26
27	Ambient	6 pteropods	96				250.00	100.00	50.00	50.00	300.00		ZJR271EO4Z27
28	,												,
29	750	6 pteropods	96				250.00	100.00	50.00	50.00	300.00		ZJR271EO4Z29
31	Ambient	6 dead pteropods	96	,	,	,	,	,	,	,	,		Some animals still alive after immersion in mercuric chloride for 5 mins. Not analysed
32	,	,	,	,	,	,	,	,	,	,	,		,
33	750	6 dead pteropods	96	,	,	,	250.00	,	,	,	,		Some animals still alive after immersion in mercuric chloride for 5 mins. Not analysed
34	1000	6 dead pteropods	96	,	,	,	250.00	,	,	,	,		Some animals still alive after immersion in mercuric chloride for 5 mins. Not analysed

Zooplankton bioassay EO5 (24-28/6/12)													
Bottle No.	**Treatment**	**Zooplankton**	**Stop (hrs)**	**Bacteria**	**Bacterial production**	**TEP/DOC (ml)**	**DIC +TA (ml)**	**Microplankt. (ml)**	**NO3, Si, PO4 (ml)**	**NH4 (ml)**	**Winkler (ml)**	**Code**	**Animals after decant**
1	Ambient	10 C glacialis CV	24	2.00		998.00						ZJR271EO5Z01	
2	Ambient	10 C glacialis CV	24	2.00	10.00		250.00	100.00	50.00	50.00		ZJR271EO5Z02	10 live (into 2 Eppendorfs)
3	Ambient	10 C glacialis CV	24	2.00				100.00	50.00	50.00	300.00	ZJR271EO5Z03	10 live (into 2 Eppendorfs)
4	Ambient	No copepods	24	2.00		998.00						ZJR271EO5Z04	
5	Ambient	No copepods	24	2.00	10.00		250.00	100.00	50.00	50.00	300.00	ZJR271EO5Z05	
6	750	10 C glacialis CV	24	2.00		998.00						ZJR271EO5Z06	
7	750	10 C glacialis CV	24	2.00	10.00		250.00	100.00	50.00	50.00		ZJR271EO5Z07	10 live (into 2 Eppendorfs)
8	750	10 C glacialis CV	24	2.00				100.00	50.00	50.00	300.00	ZJR271EO5Z08	1 dead; 5 into 1 Eppendorf, 3 into another

Annex 2: Zooplankton bioassays (Cont.)

Zooplankton bioassay EO5 (24-28/6/12) – Cont.													
Bottle No.	**Treatment**	**Zooplankton**	**Stop (hrs)**	**Bacteria**	**Bacterial production**	**TEP/DOC (ml)**	**DIC +TA (ml)**	**Microplankt. (ml)**	**NO3, Si, PO4 (ml)**	**NH4 (ml)**	**Winkler (ml)**	**Code**	**Animals after decant**
9	750	No copepods	24	2.00	10.00		250.00	100.00	50.00	50.00	300.00	ZJR271EO5Z09	
10	1000	10 C glacialis CV	24	2.00		998.00						ZJR271EO5Z10	
11	1000	10 C glacialis CV	24	2.00	10.00		250.00	100.00	50.00	50.00		ZJR271EO5Z11	10 live (into 2 Eppendorfs)
12	1000	10 C glacialis CV	24	2.00				100.00	50.00	50.00	300.00	ZJR271EO5Z12	10 live (into 2 Eppendorfs)
13	1000	No copepods	24	2.00	10.00		250.00	100.00	50.00	50.00	300.00	ZJR271EO5Z13	
14	Ambient	10 C glacialis CV	96			1000.00						ZJR271EO5Z14	
15	Ambient	10 C glacialis CV	96				250.00		50.00	50.00		ZJR271EO5Z15	10 live (into 2 Eppendorfs) + 1 more live and 3 dead
16	Ambient	10 C glacialis CV	96						50.00	50.00	300.00	ZJR271EO5Z16	10 live (into 2 Eppendorfs) + 1 C gla CV and 2 C gla CIV both live
17	Ambient	No copepods	96			1000.00						ZJR271EO5Z32	
18	Ambient	No copepods	96				250.00		50.00	50.00	300.00	ZJR271EO5Z18	
19	750	10 C glacialis CV	96			1000.00						ZJR271EO5Z19	
20	750	10 C glacialis CV	96				250.00		50.00	50.00		ZJR271EO5Z20	7 live (5 into 1 Eppendorf, 2 into other) + 1 female and 1 CIV into extra vial + 1 dead
21	750	10 C glacialis CV	96						50.00	50.00	300.00	ZJR271EO5Z21	10 live (into 2 Eppendorfs) + 2 more C gla CV live
22	750	No copepods	96				250.00		50.00	50.00	300.00	ZJR271EO5Z22	
23	1000	10 C glacialis CV	96			1000.00						ZJR271EO5Z23	
24	1000	10 C glacialis CV	96				250.00		50.00	50.00		ZJR271EO5Z24	10 live (into 2 Eppendorfs) + 1 more C gla CV live)
25	1000	10 C glacialis CV	96						50.00	50.00	300.00	ZJR271EO5Z25	10 live (into 2 Eppendorfs) + 1 more C gla CV + 1 Metridia - both live
26	1000	No copepods	96				250.00		50.00	50.00	300.00	ZJR271EO5Z26	

SCIENTIFIC REPORT 26: Phytoplankton community structure and carbon export

Helen Smith

Introduction

The aim of this research is to provide a greater understanding of the link between phytoplankton community structure and carbon export in the Arctic. The cruise track of JR271 enabled sampling in temperate, polar and ice-covered areas each with distinct water mass characteristics. Surface water phytoplankton community structure is likely to change across carbonate chemistry gradients and ocean front systems encountered during the cruise. It has been hypothesised that the strength of the Biological Carbon Pump (BCP) varies depending on the dominant phytoplankton in the surface ocean, particularly when considering diatoms and coccolithophores. The form, composition and sinking speed of marine snow (particles > 0.5mm) is likely to be affected by the variation in surface community structure. The Marine Snow Catcher was deployed to capture particles sinking out of the euphotic zone to test this hypothesis. The cruise track of JR271 allows comparison of both coccolithophore (Barents Sea) and diatom dominated (Greenland Sea) waters.

Methods

Marine Snow Catcher

A 100 litre capacity cylinder designed for minimum disturbance to the water column and particles (Lampitt *et al*., 1993). Top and bottom shut by valves via a messenger release mechanism. The snow catcher was deployed to coincide with the 1% light depth, the base of the euphotic zone, to capture particles leaving the mixed layer. It was secured upright on deck, after water collection, for 2-3 hours to allow particles to settle to the base. Once on deck, samples (filtered through 200µm mesh to remove large zooplankton) were taken from the bottom tap for particulate inorganic carbon (PIC), particulate organic carbon (POC), biogenic silica (BSi) and image analysis (SEM) at T0 and T120. POC samples were taken every 30 minutes at T0, T30, T60, T90 and T120. After at least two hours the top section was drained slowly, so as not to disturb the particles in the base section. The top section was then carefully removed and any particles present in the base section were picked and stored in individual wells. Where there were large numbers of particles present, half were collected and the rest were resuspended to be Water for PIC, POC, BSi, SEM and TEP analysis was siphoned from the base section. A total of 17 snow catcher deployments were achieved during the cruise (Table 1).

MSC	Date	Station	Lat (^{o}N)	Long (^{o}E)	Depth (m)	Fired @	T0 sample @
1	05.06.2012	3	60.134	-6.712	65	11:25	11:40
2	07.06.2012	5	60.001	-18.670	40	10:40	10:50
3	10.06.2012	7	65.979	-10.718	45	06:35	06:45
4	11.06.2012	8	69.896	-7.577	50	06:30	06:40
5	12.06.2012	9	74.117	-4.693	50	11:15	11:25
6	14.06.2012	11	78.718	0.000	30	10:05	10:15
7	16.06.2012	14	78.214	-5.998	80	09:10	09:25
8	17.06.2012	15	77.819	-4.983	130	07:35	07:45
9	18.06.2012	18	78.266	-4.336	30	13:10	13:20
10	19.06.2012	19	77.846	-1.298	50	09:28	09:40
11	22.06.2012	26	76.262	12.541	60	08:48	08:55
12	24.06.2012	30	72.889	26.002	60	07:15	07:25
13	25.06.2012	32	71.752	17.901	30	08:45	08:50
14	26.06.2012	34	71.733	8.433	30	08:35	08:45
15	27.06.2012	36	71.745	-1.267	50	08:35	08:45
16	29.06.2012	40	68.695	-10.575	60	08:40	08:50
17	30.06.2012	42	67.830	-16.422	60	08:45	08:55

Water samples

Filtering for PIC, POC, BSi and SEM was done as soon as possible after collection using a 3-port manifold at -300 (millibar) pressure. Each PIC, BSi and SEM sample was rinsed with pH adjusted (ammonium) milli-Q water to minimise formation of salt crystals on filter paper, dried at 37^{o}C and stored with silica gel desiccators, in the dark in Millipore petri slides for SEM and cryovial tubes for PIC and BSi. Each POC sample was rinsed with 1ml 1% phosphoric acid, rinsed with filtered seawater, placed in Eppendorf tubes and dried in an oven at 37^{o}C for 12 hours. 51 samples were taken for PIC, BSi and SEM/LM and 147 samples were taken for POC. Volumes and filters listed below:

BSi & PIC = 500ml, on 25mm diameter, 0.8µm Whatman® nucleopore track etched membrane filters

SEM = ≤1000ml, on 25mm diameter, 0.8µm Whatman® nucleopore track etched membrane filters

POC = 1000ml, on 25mm pre-ashed Whatman® GF/F filters

Marine snow

In order to classify each particle an image was taken using a digital camera mounted on an inverted light microscope, SP-95-I (Brunel Microscopes Ltd). Sinking experiments were done in a 1 litre settling chamber after imaging. The chamber was filled with filtered seawater from the base of the snow catcher. Experiments were conducted at *in situ* water temperature (<10°C). The particles were handled as few times as possible to reduce degradation. However, some particles were very fragile and broke up before a sinking speed could be obtained. The particles from the base of the cylinder were then preserved in 20ml filtered seawater added to acidified Lugols and stored in the dark. Large aggregates were also added to acidified Lugols. The remaining particles, or those to fragile to sink were dropped onto cellulose nitrate filters, rinsed with pH adjusted milli-Q and stored in Petri slides. A total of 280 individual particles were collected and imaged over the cruise period and sinking speeds were obtained for 215. More detailed analysis will take place on return to the NOC.

Acknowledgements

Many thanks to the deck crew of the JCR for deploying the snow catcher, to Simon Wright for keeping it functional throughout the cruise and to all those who helped with dismantling.

Reference

R. S. Lampitt, K. F. Wishner, C. M. Turley and M. V. Angel (1993). Marine snow studies in the Northeast Atlantic Ocean: distribution, composition and role as a food source for migrating plankton. *Marine Biology*, **116** (4), 689-702. DOI: 10.1007/BF00355486.

SCIENTIFIC REPORT 27: Particle flux determined by radiochemistry (^{234}Thorium) and stand-alone pumps (SAPS)

Fred Le Moigne

^{234}Thorium- derived carbon and biomineral fluxes

Scientific motivation

The Radioactive short-lived Thorium-234 (^{234}Th, t1/2=24,1d) has been used as a tracer of several transport processes and particle cycling in aquatic systems by different techniques (Van der Loeff *et al.*, 2006). It can be used to estimate how much POC is exported into the deep ocean (Buesseler *et al.*, 1992). ^{234}Th is the daughter isotope of naturally occurring 238-Uranium (^{238}U, t1/2=4,47.10^9y) which conservative in the seawater and proportional to salinity in well oxygenated environment (Ku *et al.*, 1977). Unlike ^{238}U, ^{234}Th is particle reactive in the water column. As particles with ^{234}Th sink through the water column, a radioactive disequilibrium is formed between ^{238}U and ^{234}Th, which can be used to quantify the rate of carbon and biominerals export from the surface ocean. This is possible with the ratios of POC, PIC or BSI to particulate ^{234}Th activity (Tsunogai and Minagawa, 1976) obtained from large volume samples (e.g. *in situ* pumps: SAPS). ^{234}Th POC, PIC and opal downward fluxes will be calculated to assess the strength of downward export of particulate matter and relationships between POC and biomineral fluxes (Le Moigne *et al.*, accepted).

Sampling methodology and sampling treatment on board

Samples for thorium analysis were collected from a stainless steel CTD rosette at various stations (see figure 1 and table 1). 4L water samples were collected at ten horizons from surface to to 500m depth where a significant export of particles are expected and thereby a disequilibrium between ^{234}Th and ^{238}U. ^{238}U concentration is derived from salinity measurement and thus is not directly measured from seawater samples. Total ^{234}Th is obtained by adding $KMnO_6$ (potassium permanganate), $MnCl_2$ (manganese dichloride) and concentrated ammonia (NH_3) to the 4L. Thorium is precipitated with MnO_2 within 8 hours after a spike a ^{230}Th was added as a yield monitor as described in Pike *et al* (2006). The formed precipitate is filtered onto 25mm precombusted QMA filters. Filters were then wrapped in mylar foil and counted in a Riso beta counter as described in (Morris *et al.*, 2007). Corrections are made for ^{234}Th decay and ^{234}Th in growth from ^{238}U decay since sampling. To calibrate ^{234}Th counting efficiency, mid water (1000m) samples were used, away from the surface ocean, coastal areas and seafloor nephleloid layers, where the secular equilibrium between ^{234}Th and ^{238}U is expected. The ratios of POC, PIC or BSI to particulate ^{234}Th activity will be obtained from particles from several depths sampled using SAPS.

Further work and scientific outcomes

These results of ^{234}Th will be corrected with two “background counting” in three and six month. The ^{238}U results will be calculated from calibrated salinity measurements. The recovery will be calculated by ^{230}Th measured with an ICPMS at NOCS. Once corrected, the ^{234}Th results will be integrated in order to obtain the ^{234}Th fluxes (dpm m^{-2} d^{-1}) to further extrapolate POC, calcite and opal export (g m^{-2} d^{-1}) with POC/^{234}Th, PIC/^{234}Th and Bsi/^{234}Th ratio obtained from high volume collection of particulate matter (SAPS).

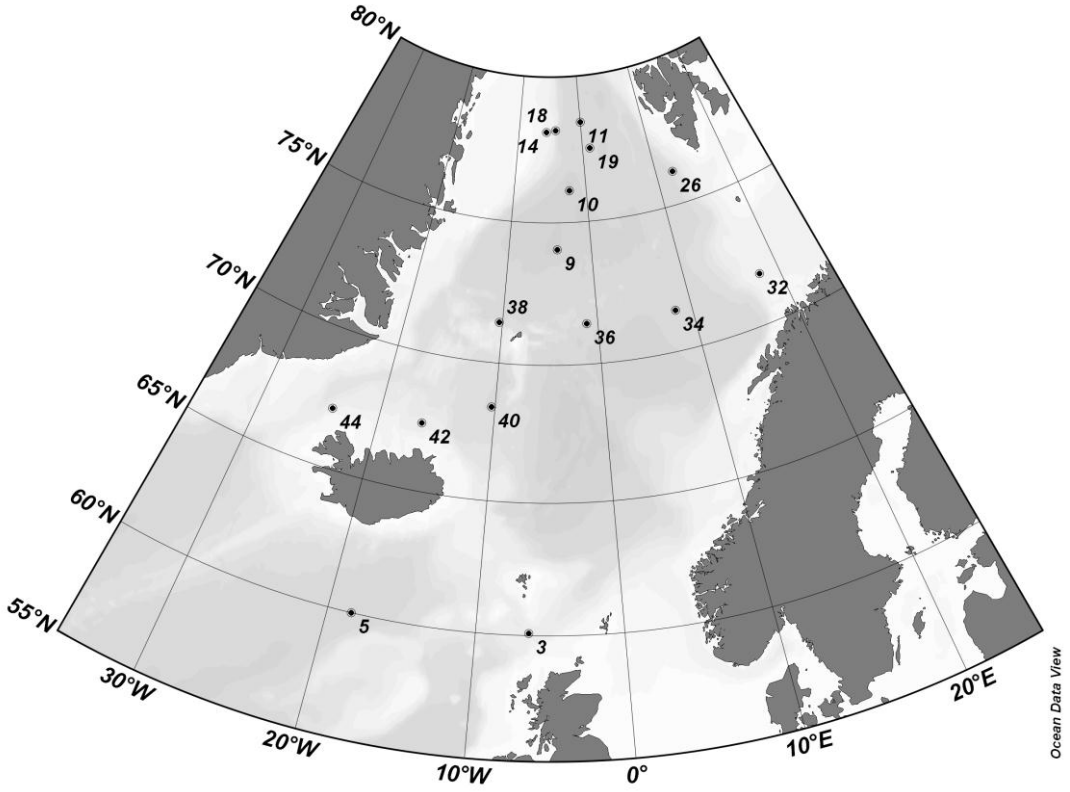

Figure 3: JCR 271 station positions**.**

Table 2: Station ID with sampling date, depth range and volume sampled.

Sample	Station	CTD No	Date	Niskin	Depth	Position
JCR271 1	3	T9	05-Jun	7	400	60º08N 06º42W
JCR271 2	3	T9	05-Jun	10	150	
JCR271 3	3	T9	05-Jun	12	100	
JCR271 4	3	T9	05-Jun	13	80	
JCR271 5	3	T9	05-Jun	14	60	
JCR271 6	3	T9	05-Jun	15	50	
JCR271 7	3	T9	05-Jun	17	40	
JCR271 8	3	T9	05-Jun	18	30	
JCR271 9	3	T9	05-Jun	21	20	
JCR271 10	3	T9	05-Jun	23	10	
Sample	**Station**	**CTD No**	**Date**	**Niskin**	**Depth**	**Position**
JCR271 1	5	T13	07-Jun	13	500	60º00N 18º40W
JCR271 2	5	T13	07-Jun	16	200	
JCR271 3	5	T13	07-Jun	17	150	
JCR271 4	5	T13	07-Jun	18	100	
JCR271 5	5	T13	07-Jun	19	65	
JCR271 6	5	T13	07-Jun	20	41	
JCR271 7	5	T13	07-Jun	21	30	
JCR271 8	5	T13	07-Jun	22	20	
JCR271 9	5	T13	07-Jun	23	10	
JCR271 10	5	T13	07-Jun	24	5	

Table 3: Station ID with sampling date, depth range and volume sampled (cont.)

Sample	Station	CTD No	Date	Niskin	Depth	Position
JCR271 1	9	T22	12-Jun	14	400	74º06N 04º41W
JCR271 2	9	T22	12-Jun	16	150	
JCR271 3	9	T22	12-Jun	17	100	
JCR271 4	9	T22	12-Jun	18	80	
JCR271 5	9	T22	12-Jun	19	60	
JCR271 6	9	T22	12-Jun	20	50	
JCR271 7	9	T22	12-Jun	21	40	
JCR271 8	9	T22	12-Jun	22	30	
JCR271 9	9	T22	12-Jun	23	20	
JCR271 10	9	T22	12-Jun	24	10	
Sample	**Station**	**CTD No**	**Date**	**Niskin**	**Depth**	**Position**
JCR271 1	10	T28	13-Jun	6	150	76º10N 02º32W
JCR271 2	10	T28	13-Jun	7	100	
JCR271 3	10	T28	13-Jun	8	80	
JCR271 4	10	T28	13-Jun	9	60	
JCR271 5	10	T28	13-Jun	10	40	
JCR271 6	10	T28	13-Jun	11	20	
JCR271 7	10	T28	13-Jun	12	10	
Sample	**Station**	**GoFlo**	**Date**	**OTE**	**Depth**	**Position**
JCR271 1	11	1	14-Jun	9	400	78º43N 00º00W
JCR271 2	11		14-Jun	8	300	
JCR271 3	11		14-Jun	6	150	
JCR271 4	11		14-Jun	4	100	
JCR271 5	11		14-Jun	11	60	
JCR271 6	11		14-Jun	3	40	
JCR271 7	11		14-Jun	1	20	
Sample	**Station**	**GoFlo**	**Date**	**OTE**	**Depth**	**Position**
JCR271 1	14	3	16-Jun	8	330	78º12N 05º59W
JCR271 2	14		16-Jun	4	230	
JCR271 3	14		16-Jun	1	130	
JCR271 4	14		16-Jun	3	80	
JCR271 5	14		16-Jun	12	60	
JCR271 6	14		16-Jun	6	40	
JCR271 7	14		16-Jun	7	25	
Sample	**Station**	**GoFlo**	**Date**	**OTE**	**Depth**	**Position**
JCR271 1	18	5	18-Jun	10	500	78º17N 04º14W
JCR271 2	18		18-Jun	8	200	
JCR271 3	18		18-Jun	14	150	
JCR271 4	18		18-Jun	7	100	
JCR271 5	18		18-Jun	16	60	
JCR271 6	18		18-Jun	11	40	
JCR271 7	18		18-Jun	6	25	

Table 4: Station ID with sampling date, depth range and volume sampled (cont.)

Sample	Station	GoFlo	Date	OTE	Depth	Position
JCR271 1	19	6	19-Jun	14	400	77º51N 01º15W
JCR271 2	19		19-Jun	8	200	
JCR271 3	19		19-Jun	12	150	
JCR271 4	19		19-Jun	10	100	
JCR271 5	19		19-Jun	16	60	
JCR271 6	19		19-Jun	6	40	
JCR271 7	19		19-Jun	11	25	
Sample	**Station**	**GoFlo**	**Date**	**OTE**	**Depth**	**Position**
JCR271 1	26	8	22-Jun	12	500	76º15N 12º32W
JCR271 2	26		22-Jun	10	200	
JCR271 3	26		22-Jun	`17	120	
JCR271 4	26		22-Jun	11	60	
JCR271 5	26		22-Jun	6	40	
JCR271 6	26		22-Jun	16	25	
Sample	**Station**	**GoFlo**	**Date**	**OTE**	**Depth**	**Position**
JCR271 1	32	11	25-Jun	16	260	71º75N 17º90E
JCR271 2	32		25-Jun	10	200	
JCR271 3	32		25-Jun	6	150	
JCR271 4	32		25-Jun	8	100	
JCR271 5	32		25-Jun	2	80	
JCR271 6	32		25-Jun	12	60	
JCR271 7	32		25-Jun	14	40	
JCR271 8	32		25-Jun	11	20	
Sample	**Station**	**GoFlo**	**Date**	**OTE**	**Depth**	**Position**
JCR271 1	34	12	26-Jun	10	500	71º44N 08º26E
JCR271 2	34		26-Jun	6	200	
JCR271 3	34		26-Jun	2	150	
JCR271 4	34		26-Jun	14	100	
JCR271 5	34		26-Jun	11	60	
JCR271 6	34		26-Jun	17	40	
JCR271 7	34		26-Jun	8	25	
Sample	**Station**	**GoFlo**	**Date**	**OTE**	**Depth**	**Position**
JCR271 1	36		27-Jun	10	500	71º44N 01º26W
JCR271 2	36		27-Jun	6	200	
JCR271 3	36		27-Jun	2	150	
JCR271 4	36		27-Jun	14	100	
JCR271 5	36		27-Jun	11	60	
JCR271 6	36		27-Jun	17	40	
JCR271 7	36		27-Jun	8	20	

Table 5: Station ID with sampling date, depth range and volume sampled (cont.)

Sample	Station	Ti	Date	OTE	Depth	Position
JCR271 1	38	28	28-Jun	13	400	71º44N 10º35W
JCR271 2	38	28	28-Jun	16	150	
JCR271 3	38	28	28-Jun	17	100	
JCR271 4	38	28	28-Jun	18	80	
JCR271 5	38	28	28-Jun	19	60	
JCR271 6	38	28	28-Jun	20	50	
JCR271 7	38	28	28-Jun	21	40	
JCR271 8	38	28	28-Jun	22	30	
JCR271 9	38	28	28-Jun	23	20	
JCR271 10	38	28	28-Jun	24	10	
Sample	**Station**	**Goflo**	**Date**	**OTE**	**Depth**	**Position**
JCR271 1	40		29-Jun	12	400	68º41N 10º34W
JCR271 2	40		29-Jun	2	200	
JCR271 3	40		29-Jun	6	150	
JCR271 4	40		29-Jun	16	100	
JCR271 5	40		29-Jun	11	60	
JCR271 6	40		29-Jun	17	40	
JCR271 7	40		29-Jun	8	20	
Sample	**Station**	**CTD Ti**	**Date**	**OTE**	**Depth**	**Position**
JCR271 1	42		30-Jun	5	500	67º49N 16º25W
JCR271 2	42		30-Jun	8	200	
JCR271 3	42		30-Jun	9	150	
JCR271 4	42		30-Jun	10	100	
JCR271 5	42		30-Jun	11	80	
JCR271 6	42		30-Jun	12	60	
JCR271 7	42		30-Jun	13	40	
JCR271 8	42		30-Jun	14	20	
Sample	**Station**	**CTD No**	**Date**	**OTE**	**Depth**	**Position**
JCR271 1	44		01-July	5	500	67º16N 24º04W
JCR271 2			01-July	8	200	
JCR271 3			01-July	9	150	
JCR271 4			01-July	10	100	
JCR271 5			01-July	11	80	
JCR271 6			01-July	12	60	
JCR271 7			01-July	13	40	
JCR271 8			01-July	14	20	

SAPS deployment

Stand alone pumping systems (SAPS) were deployed at every station during the D350. Four SAPS were deployed per cast. Two were devoted for Th derived carbon and biomineral fluxes as summarised in table 2. SAPS pumping time was set as 60-90min. After recovery, particles were rinsed off the mesh on Th devoted SAPS and splitted in four portion for further Th, POC, PIC and Bsi analisys back in homelab.

Table 2: SAPS depths, filter types and splits.

Station Number	Th SAPS Depths	Type of Mesh	Splits
3	65	53µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
		1µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
	165	53µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
		1µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
5	40	53µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
		1µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
	140	53µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
		1µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
9	50	53µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
		1µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
	150	53µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
		1µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
10	40	53µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
		1µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
	140	53µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
		1µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
11	30	53µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
		1µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
	130	53µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
		1µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
14	80	53µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
		1µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
	180	53µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
		1µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
18	30	53µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
		1µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
	130	53µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
		1µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
19	50	53µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
		1µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
	150	53µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
		1µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
26	60	53µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
		1µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
	160	53µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
		1µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
32	30	53µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
		1µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
	130	53µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
		1µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
34	30	53µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
		1µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
	130	53µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
		1µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
36	50	53µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
		1µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
	150	53µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
		1µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi

Table 2: SAPS depths, filter types and splits (cont.)

Station Number	Th SAPS Depths	Type of Mesh	Splits
38	60	53µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
		1µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
	160	53µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
		1µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
40	60	53µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
		1µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
	160	53µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
		1µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
42	60	53µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
		1µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
	160	53µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
		1µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
44	50	53µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
		1µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
	150	53µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi
		1µm NITEX	1/4Th, 1/4POC, 1/4 PIC, 1/4 Bsi

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SCIENTIFIC REPORT 28: Radioactive caesium isotope detection in the Arctic Ocean

Ben Russell

Introduction

Aim: Radioactive caesium isotopes Cs-135 and Cs-137 have entered the Arctic environment from atmospheric weapons test fallout and releases from European nuclear reactor and reprocessing facilities. The Cs-135/Cs-137 ratio varies with reactor, weapon and fuel type, and accurate measurement of this ratio will create a more powerful tool than previous investigations that have focused on Cs-137 detection alone.

The main objective for the cruise is to achieve chemical separation of radioactive caesium from seawater, with the separated samples stored for analysis upon return to the National Oceanography Centre, Southampton.

Methods

Sampling:

Seawater samples were collected at a range of depths from 20l Niskin bottles mounted on a stainless steel CTD profiler (see section 2.3)

Measurement of $^{135}Cs/^{137}Cs$:

20L seawater samples were filtered through a 10μm polycarbonate filter using silicon tubing and a Wetson Marlow 323 peristaltic pump. The filtered solution was pumped through a column containing ammonium molybdophosphate, an inorganic ion exchanger with high selectivity towards caesium.

The columns collected will be transported back to the NOC, Southampton, with final measurement carried out by a combination of high-resolution inductively coupled plasma mass spectrometry (HR-ICP-MS) and gamma spectrometry.

Sampled stations:

Date	Cast number	CTD station number	Latitude	Longitude
03.06.12	4	01	560 16.002N	0020 37.998E
05.06.12	8	03	600 08.005N	0060 42.776W
06.06.12	10	04	590 58.265N	0110 58.498W
07.06.12	12	05	60000.090N	018010.210W
08.06.12	17	06	60035.635N	018051.381N
10.06.12	19	07	65058.767N	010013.086W
11.06.12	20	08	69053.743N	007034.620W
13.06.12	23	10	76010.518N	002032.963W
16.06.12	32	14	78012.814N	005059.908W
18.06.12	39	18	78016.310N	004018.220W
19.06.12	40	19	77050.755N	001017.907W
21.06.12	44	25	77055.743N	009008.186E
22.06.12	46	27	76012.693N	018022.925E
23.06.12	48	29	74005.399N	025059.946E
24.06.12	53	31	71044.882N	022058.326E
25.06.12	55	33	71045.608N	013023.610E
26.06.12	57	35	71045.104N	005051.0838E
27.06.12	59	37	71044.720N	001016.037E
30.06.12	68	44	67015.91N	024002.73W

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PUBLIC OUTREACH – THE ARCTIC CRUISE BLOG

Jeremy Young and Athena Drakou

Background

Public outreach and knowledge transfer are an increasingly important priority in modern science but especially so in the current project the fundamental objective of which is to provide an assessment of the degree of threat posed by ocean acidification. So providing a good quality cruise blog was seen as an important component of the work. On the previous cruise a blog was produced which documented in some detail the range of science being undertaken (http://noc.ac.uk/news/rrs-discovery-cruise-366), this blog has also been reproduced as a separate publication. For this cruise we decided to produce a more informal blog (http://www.arcticoacruise.org) focused mainly to an audience of young scientists, undergraduate science students, and the general public.

Our aims were to:

Make known our research and describe the range of science being undertaken during the cruise
Present the places of interest and the wildlife on route
Show the daily life of a scientist on board a scientific vessel

People involved/process

Cruise participants: all members of the cruise science party were invited to contribute to the blog. After about a week the supply of spontaneous volunteers ended and instead people were asked individually to commit to providing a blog entry on a date of their choosing, the list then being posted on the noticeboard in the bar. This proved an effective way to get widespread participation. In addition to the science party one of the stewards, Tom, volunteered a blog post from the perspective of the ship's personnel, whilst Colin Leggett and Simon Wright contributed images.

Participants were left free to choose their own topic, with a general brief to write for a non-technical audience and a guide length of about a page (i.e. 200-400 words). Having a wide participation gave a diverse range of approaches and served to introduce the full range of cruise participants. In addition this meant that the blog was a communal effort and that all participants gained some experience of writing for a popular audience.

Blog committee: in addition to Jeremy Young the blog was overseen by a committee of Ray Leakey (PSO), Ben Russell (NOCS, new PhD student and first-time cruise participant), Laura Bretherton (Essex University), and Frances Hopkins (PML). The committee members started off the blog, encouraged contributions and made extra contributions themselves.

Blog editor: Jeremy Young took on the role of blog editor, compiling content on a daily basis and sending it to Athena for posting to the web. This included obtaining content from other participants, writing short items as needed to ensure coverage of events and continuity of coverage; light editing of submitted written content; photography for the blog; editing of photographs for posting on the blog. Typically this involved 1-2 hours work per day. At high latitudes the internet connection was limited hence it was important to conserve bandwidth. To achieve this, text was sent as email messages rather than Word attachments and photographs were reformatted in Photoshop, as 1000 pixel width, medium to high resolution JPEG images.

Content manager: in Southampton Athena Drakou reformatted the content and posted it on a daily basis to the main blog website – www.arcticoacruise.org. In addition Athena copied content and kept updated a Facebook page ("Arctic Ocean Acidification Cruise") and twitter stream @arcticoacruise, while she also maintained a Flickr photo account where the best photos of the cruise were posted.

She also developed and updated regularly a Google map showing the cruise route. All this involved about 1 1/2 - 2 hrs work per day, excluding the design and maintenance of the website.

JCR IT support: on ship the IT support expert Jeremy Robst set up a mirror of the blog on the ship's intranet thus making it available to the cruise participants and ship personnel.

Outcome

Blog posts were made daily throughout the cruise with two posts on some days: a total of 42 posts (from 30/5 to 02/05/2012) and over 100 images. Content covered included the range of science being undertaken, logistic aspects of cruise organisation, progress the cruise in terms of science and places visited, wildlife encountered, and aspects of the social life on the ship. Probably the most popular posts were those featuring the ice and polar bears, especially our encounter with a family of bears.

On ship the blog was well-received and formed part of the fabric of the cruise. Many participants and crew members also commented that their family appreciated having an explanation of what they were doing.

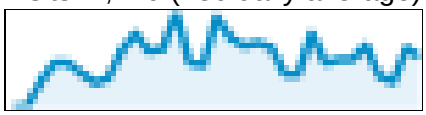
It was also evident that the combination of the blog twitter feeds and facebook created a continuous connection between the scientists on board and friends (in and out academia) and family members.

Some of the participating institutions also followed the Arctic cruise's tweets, replying to and re-tweeting many of them to their followers.

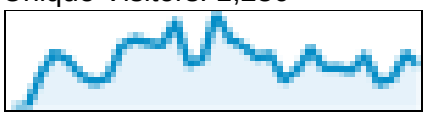
Statistics

Visitors to the website: Since 5 June, when we started keep statistics (the delay was because of the delay to develop the website) and until 3 July 2012:

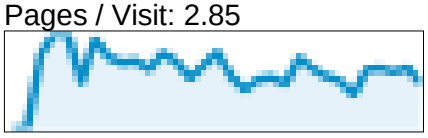
Visits: 4,279 (130 daily average)



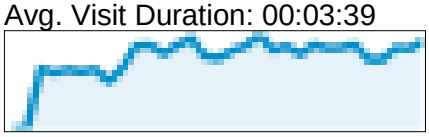
Unique Visitors: 1,286

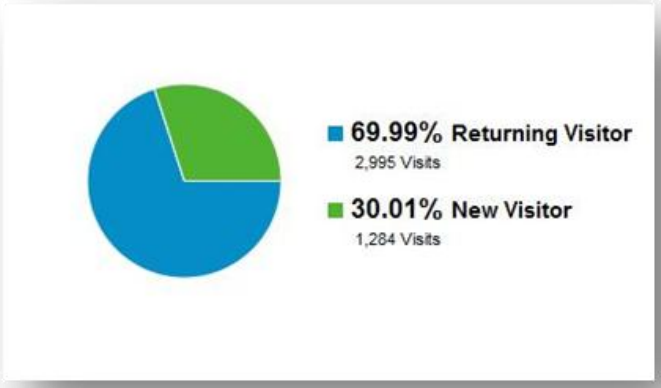


Pages / Visit: 2.85



Avg. Visit Duration: 00:03:39





Demographics

	Country / Territory	Visits ↓	Pages / Visit
1.	United Kingdom	2,651	2.93
2.	France	452	2.31
3.	Switzerland	370	3.16
4.	United States	300	2.74
5.	Spain	164	3.46
6.	Japan	82	1.70
7.	Germany	24	3.17
8.	Uruguay	21	4.48
9.	Canada	20	2.55
10.	(not set)	19	2.11
11.	Greece	16	2.81
12.	Norway	15	2.13
13.	Netherlands	12	1.83
14.	Italy	11	2.18
15.	Sweden	11	1.36
16.	Mexico	10	3.50
17.	Denmark	8	3.62
18.	Iceland	7	1.29
19.	China	6	1.50
20.	Pakistan	6	1.17

Facebook: 36 group visitors.
Mostly young marine scientists. Lots of likes and comments

Twitter: 24 followers.
Mostly scientific institutions and young scientists.
Re-tweets by institutions of the participants on the cruise institutions, friends and family members of the researchers in the cruise.

Surface OA Channel
Two short movies

First CTD station	-------	146 views
Big waves	-------	397 views

Areas for improvement

For the next cruise in the Antarctic, and outreach in general

Movies: We had been hoping to upload to you tube and post to the cruise blog a series of movie clips. In practice only two movies were sent (of the first CTD and of a storm early in the cruise). This reflected the fact that video filming, preparation, reformatting and editing requires both time and computer resources. It would be possible to do more in this direction.

Podcasts: Development of short, about 2 min each, podcasts with the lead scientists and researchers. Again, it requires time and technical equipment.

Blog advance publicity: In order to get a good readership for the blog it would be useful to start it a few weeks (2 weeks) before the cruise mobilisation when participants still have access to social media and are able to get their friends involved. This also involves - if decided to develop a new website for the Antarctica cruise – an early decision and organisation for the development of the website.

Facebook - active participation: There were quite a few comments on Facebook, some from fellow scientists and colleagues. It would be nice if the researchers could spare some minutes to respond and create the conditions for further discussions within the scientific community.

APPENDIX 1: Scientific & technical personnel affiliation and e-mail

Person	Affiliation	E-mail
Eric Achterberg	University of Southampton, UK	eric@noc.soton.ac.uk
Cecilia Balesteri	Marine Biological Association, Plymouth, UK	cecbal@mba.ac.uk
Gianna Battaglia	University of Southampton, UK	bgianna@student.ethz.ch
Jeff Benson	National Marine Facilities, Southampton, UK	jrbn@noc.soton.ac.uk
Laura Bretherton	University of Essex, Colchester, UK	lmjbre@essex.ac.uk
Ian Brown	Plymouth Marine Laboratory, UK	iaian2@pml.ac.uk
Darren Clark	Plymouth Marine Laboratory, UK	drcl@pml.ac.uk
Chris Daniels	University of Southampton, UK	c.daniels@noc.soton.ac.uk
Mario Esposito	University of Southampton, UK	me9g10@soton.ac.uk
Sara Fowell	University of Southampton, UK	sef1g10@soton.ac.uk
Polly Hill	National Oceanography Centre, Southampton, UK	polly.hill@noc.ac.uk
Frances Hopkins	Plymouth Marine Laboratory, UK	fhop@pml.ac.uk
Matt Humphreys	University of Southampton, UK	m.p.humphreys@soton.ac.uk
Ray Leakey	Scottish Association for Marine Science, Oban, UK	ray.leakey@sams.ac.uk
Fred Le Moigne	University of Southampton, UK	f.lemoigne@noc.soton.ac.uk
Elaine Mitchell	Scottish Association for Marine Science, Oban, UK	elaine.mitchell@sams.ac.uk
Mark Moore	University of Southampton, UK	c.moore@noc.soton.ac.uk
* Matthew Palmer	National Oceanography Centre, Liverpool, UK	rolm@noc.ac.uk
Victoria Peck	British Antarctic Survey, Cambridge, UK	vlp@bas.ac.uk
Ben Poole	National Marine Facilities, UK	bgp@noc.ac.uk
Alex Poulton	National Oceanography Centre, Southampton, UK	alex.poulton@noc.ac.uk
Victorie Rérolle	University of Southampton, UK	victoire.rerolle@noc.soton.ac.uk
Mariana Ribas-Ribas	University of Southampton, UK	m.ribas-ribas@soton.ac.uk
Sophie Richier	University of Southampton, UK	s.richier@noc.soton.ac.uk
Brandy Robinson	University of Southampton, UK	tcr1g11@soton.ac.uk
Jeremy Robst	British Antarctic Survey, Cambridge, UK	jpro@bas.ac.uk
Ben Russell	University of Southampton, UK	ben.russell@noc.soton.ac.uk
* Rachael Sanders	National Oceanography Centre, Liverpool, UK	racnde@noc.ac.uk
Tingting Shi	University of Southampton, UK	tts1e09@noc.soton.ac.uk
Helen Smith	University of Southampton, UK	heks1e10@noc.soton.ac.uk
John Stephens	Plymouth Marine Laboratory, UK	jas@pml.ac.uk
Geraint Tarling	British Antarctic Survey, Cambridge, UK	gant@bas.ac.uk
Seth Thomas	British Antarctic Survey, Cambridge, UK	setoma@bas.ac.uk
Eithne Tynan	University of Southampton, UK	e.tynan@soton.ac.uk>
Stephen Whittle	National Marine Facilities, Southampton, UK	spwh@noc.ac.uk
Jeremy Young	University College London, UK	jeremy.young@ucl.ac.uk
Mike Zubkov	National Oceanography Centre, Southampton, UK	mvz@noc.soton.ac.uk

* Contribution to cruise report only (non-cruise participant)

APPENDIX 2: Ships meteorological observations

Date	Latitude	Longitude	Time LT	Wind	Pressure	Air Temp	Sea Temp	Comment about weather	Comment about location/ ice
01/06/12	54°04.2 N	000°43.7 E	2400	Lt. Airs	1018.1	10.6	11.0	Clear sky and dry with good vis.	Departed Immingham 1548hrs. FAOP 1806hrs.
02/06/12	55°03.0 N	001°33.8 E	1200	NNW 3	1016.0	9.9	12.4	Cloudy and dry with good vis. Slight sea and swell.	Clocks retarded 1 hour to GMT
02/06/12	56°06.0 N	002° 28.7 E	2400	NNW 3-4	1011.7	9.3	11.3	Cloudy and dry with good vis. Slight sea and swell.	
03/06/12	56°34.1 N	002°13.1 E	1200	NNW 4-5	1008.8	9.5	10.8	Vessel pitching easily in slight to moderate sea and swell. Part cloudy, dry and clear.	
03/06/12	58°04.5 N	000°05.8 E	2400	NNW 5-6	1011.1	9.4	10.6	Vessel moving moderately to moderate sea and swell. Overcast with passing squally showers.	
04/06/12	59°06.8 N	001°24.8 W	1200	NNW 5	1012.5	8.3	10.3	Vessel pitching and rolling easily in moderate sea and swell. Part cloudy, dry and clear.	
04/06/12	59°56.5 N	005°14.1 W	2400	NW 3	1013.3	6.6	10.8	Vessel moving easily to slight sea and moderate swell. Cloudy, clear with occasional showers.	
05/06/12	60°08.1 N	006°42.7 W	1200	SE 3	1010.0	7.5	10.5	Vessel on DP pitching easily to slight sea and moderate swell. Cloudy, dry and clear.	
05/06/12	59°55.8 N	010°19.2 W	2400	ENE 3	1003.8	7.5	10.7	Vessel moving easily to slight sea and swell. Overcast with continuous drizzle and occasional rain and good visibility.	
06/06/12	59°59.5 N	012°54.3 W	1200	NNE 3	1002.0	7.5	10.7	Vessel moving easily in slight sea. Few clouds, dry and clear.	
06/06/12	60°01.0 N	016°54.6 W	2400	NE 2-3	1002.1	8.6	10.9	Vessel moving easily to slight sea and swell. Cloudy with occasional showers and good visibility.	
07/06/12	60°00.1 N	018°40.2 W	1200	NW 3	1002.6	10.7	10.5	Vessel sitting quietly on station. Part cloudy with showers in sight.	
07/06/12	60°47.8 N	018°48.4 W	2400	ENE 7-8	1001.4	9.7	10.4	Vessel moving moderately and heavily at times. Overcast with moderate rain. Shipping spray.	
08/06/12	60°50.1 N	018°28.3 W	1200	ENE 7	1000.3	9.8	10.3	Overcast with moderate rain. Vessel pitching and rolling moderately to rough sea and moderate swell. Shipping spray.	

08/06/12	61°52.7 N	016°45.5 W	2400	ESE 7-8	1007.3	9.3	9.8	Overcast and dry with moderate visibility. Pitching and rolling heavily at times in rough sea and moderate swell and shipping spray.	
09/06/12	63°17.2 N	014°22.8 W	1200	NE 5-6	1014.9	7.3	9.2	Cloudy, dry and clear. Slight to moderate sea and swell.	
09/06/12	65°01.5 N	011°24.5 W	2400	NNE 4	1019.1	4.8	5.6	Slight sea and swell. Overcast with showers and good visibility.	
10/06/12	66°54.4 N	010°01.5 W	1200	NNE 4	1021.2	1.9	3.7	Slight sea and swell. Cloudy with passing showers and patchy mist	
10/06/12	69°00.1 N	008°18.8 W	2400	NNE 4-5	1020.2	2.9	3.9	Pitching to moderate head sea and low swell. Cloudy with passing showers.	
11/06/12	70°51.6 N	007°21.1 W	1200	NNE 5	1020.6	2.6	5.0	Slight sea and swell. Few clouds, dry and very clear with Jan Mayen visible 16 miles northwest.	
11/06/12	73°09.5N	005°35.9 W	2400	NW 3-4	1017.0	1.4	1.8	Slight sea and swell. Overcast with wintry showers and light fog earlier.	
12/06/12	74°07.0 N	004°41.6 W	1200	NNE 3-4	1015.0	1.5	1.8	Vessel sitting quietly on DP. Overcast with wintry showers then light snow.	
12/06/12	75°55.2 N	002°49.9 W	2400	NNW 4	1014.8	1.5	2.1	Moving easily to slight sea and swell. Continuously changing skies with wintry showers.	
13/06/12	76°11.1 N	002°32.2 W	1200	N 4	1015.6	2.1	2.4	Mostly overcast with wintry showers. Slight sea and low swell.	
13/06/12	78°05.2 N	000°15.1 W	2400	NNE 3-4	1018.8	0.5	1.5	Overcast and dry with good, occasionally moderate visibility. Slight sea and swell.	
14/06/12	78°43.1 N	000°00.0 E	1200	NNW 4	1020.4	-1.7	1.5	Vessel sitting quietly on DP. Mist patches and wintry showers.	Pack ice visible to north and west.
14/06/12	78°17.8 N	005° 28.5 W	2400	N 2-3	1020.0	-0.7	0.0	Part cloudy and dry. Variable ice concentrations 8/10-4/10.	Entered Ice 1654hrs.
15/06/12	78°18.3 N	005°36.6 W	1200	Lt. Airs	1019.9	1.7	0.1	Clear skies and dry. 8-9/10 pack becoming medium and large floes.	
15/06/12	78°15.1 N	006°03.4 W	2400	SSW 2-3	1017.8	-0.4	0.5	1/8 cloud, fine and clear. 9/10 pack, some very large floes.	Stopped at 1530hrs Ice station, 9/10 pack.
16/06/12	78°12.0 N	005°55.2 W	1200	S 4	1015.7	3.0	-0.2	Partly cloudy, dry, fine and clear. Good visibility throughout.	Ice station, 9/10 pack becoming 6/10.
16/06/12	77°52.3 N	005°22.0 W	2400	SW 4	1014.7	1.2	-0.8	Low cloud and mist. 5/10 – 7/10 pack.	Steaming

									1512hrs to 2250hrs then drift.
17/06/12	77°43.3 N	004°09.1 W	1200	SSW 5	1014.0	1.9	-0.6	Overcast and dry. 6/10 pack, station in open pool then 6/10 to 9/10 while steaming until clear at 1345hrs.	Stn#15 0450 to 0830hrs then proceed to clear ice.
17/06/12	78°23.0 N	003°09.4 W	2400	SW 3-4	1014.2	0.0	0.8	Overcast and dry. Re-enter ice at 2241hrs. Ice 2/10 becoming 7/10.	7/10 small and medium floes.
18/06/12	78°16.7 N	004°19.0 W	1200	SSE 3	1015.1	-0.1	-0.6	Overcast with fog and mist. Station #17 in open pool with 9/10 pack around.	
18/06/12	78°05.6 N	003°04.2 W	2400	Lt. Airs	1014.0	0.0	0.1	Low cloud, mist and occasional light snow showers. Various 5/10 to 9/10 small to very large floes.	Finish station 1606hrs and proceeding east to clear ice.
19/06/12	77°56.1 N	000°46.1 W	1200	NE 3	1008.8	0.7	2.4	Overcast and poor vis. in snow. Ice reducing 9/10 to 7/10 then cleared edge at 0345.	Stn 19 in open water with ice strips in sight.
19/06/12	78°44.9 N	005°00.9 E	2400	NNE 2-3	1006.2	4.9	4.5	Vessel rolling easily to slight sea but moderate beam swell. Low cloud and visibility reduced in drizzle.	
20/06/12	79°00.1 N	010°58.0 E	1200	S 5	1008.3	4.4	4.6	Low cloud and visibility reduced in constant drizzle.	
20/06/12	78°55 N	011°56 E	2400	ESE 2	1010.6	3.0	5.8	Cloudy, fine and clear. Vessel moored alongside main jetty.	Arrived Ny Alesund 1600hrs.
21/06/12	79°01.3 N	009°49.7 E	1200	SSW 5-6	1008.4	4.2	5.0	Overcast but dry and clear. Vessel moving easily to slight sea and building swell.	Departed Ny Alesund 0700hrs.
21/06/12	77°10.7 N	010°42.9 E	2400	SW 5-6	1008.7	3.3	6.1	Overcast throughout with intermittent drizzle. Vessel rolling to moderate beam sea and low swell.	

22/06/12	76°15.2 N	013°34.4 E	1200	W 5	1009.3	6.3	6.6	Dry and mostly overcast. Vessel moving easily to moderate following sea and swell.	
22/06/12	76°11.6 N	021°51.6 E	2400	W 5	1006.0	5.5	3.3	Overcast and dry. Good visibility. Moving easily to moderate following sea and swell.	
23/06/12	75°18.1 N	026°00.0 E	1200	WSW 5	1008.0	3.5	3.6	Overcast with drizzle and mist at times. Slight sea and moderate swell.	
23/06/12	73°11.1 N	025°59.7 E	2400	SW 4-5	1010.3	7.1	6.7	Overcast with breaks, dry and clear. Slight to moderate sea and swell.	
24/06/12	72°31.2 N	025°00.2 E	1200	WNW 4	1006.6	7.1	7.0	Overcast with occasional drizzle and moderate visibility. Slight sea and low swell.	
24/06/12	71°45.0 N	020°33.0 E	2400	NW 3	1008.5	6.4	7.7	Overcast, dry and clear. Slight sea and low swell.	
25/06/12	71°45.5 N	016°59.4 E	1200	NNE 2	1008.4	5.6	7.8	Overcast, dry and clear. Slight sea and low swell.	
25/06/12	71°45.0 N	011°07.6 E	2400	NW 4	1006.6	5.9	7.9	Overcast with breaks, heavy showers but clear outside of showers. Slight sea and low swell.	
26/06/12	71°45.0 N	007°26.7 E	1200	NW 4	1010.1	5.9	7.5	Part cloudy, occasional showers otherwise clear. Slight sea and low swell.	
26/06/12	71°45.0 N	001°31.3 E	2400	N 4	1017.1	3.9	7.2	Overcast, dry and clear. Slight sea and low swell.	
27/06/12	71°45.0 N	002°12.1 W	1200	NNW 4	1018.5	2.8	5.3	Overcast, dry and clear. Slight sea and low swell.	
27/06/12	71°45.0 N	008°09.0 W	2400	SW 4	1017.2	1.1	4.3	Variable mist and fog throughout. Slight sea and swell.	
28/06/12	71°42.9 N	010°28.2 W	1200	SW 5	1012.6	2.5	4.3	Part cloudy, dry with fog lifting. Slight sea and swell.	1/10 to 2/10 pack drifting in sight of vessel.
28/06/12	69°42.8 N	010°18.9 W	2400	W 4	1014.6	5.5	5.5	Part cloudy, dry and clear but distant fog banks visible from ship. Slight sea	

								and swell.	
29/06/12	68°23.6 N	010°37.2 W	1200	NW 2	1012.6	5.8	6.1	4/8 cloud, fine and very good visibility. Rippled sea and low swell.	
29/06/12	67°50.0 N	013°11.9 W	2400	NE 4	1010.6	3.9	6.7	Overcast, dry and clear. Slight sea and low swell.	
30/06/12	67°50.0N	017°09.1 W	1200	NE 2	1011.5	2.5	6.2	Overcast, dry and clear. Slight sea and low swell.	
30/06/12	67°47.3 N	022°05.8 W	2400	SE 3	1010.9	5.0	6.8	4/8 cloud, fine and clear. Slight sea and low swell.	
01/07/12	67°02.4 N	024°00.1 W	1200	SE 2	1008.5	6.0	1.9	Overcast, dry and clear. Slight sea and low swell.	Vessel following alongside ice edge.
01/07/12	65°41.2 N	026°00.2 W	2400	Lt Airs	1009.3	7.6	10.9	Cloudy with fog patches but dry. Smooth sea and low swell.	Loose pack ice to NNW.
02/07/12	64°26.8 N	023°13.7 W	1200	SSE 5	1011.5	11.9	12.9	Overcast with showery precipitation otherwise clear. Slight se and swell.	
02/07/12	64°11.6 N	021°57.5 W	1600	SW 2-3	1014.5	14.6	12.5	Overcast with light showers.	1600hrs. Pilot on board. 1654hrs. All fast alongside at Reykjavik.

APPENDIX 3: NMF-SS technical detail report

Jeff Benson, Steve Whittle and Ben Poole

S/S CTD

On the first cast it was determined the configuration files for the primary and secondary temperature sensors had been switched (cast 004s). Also zero or approximately zero voltages were observed for both the transmissometer and the fluorometer. For the subsequent cast (006s) the xmlcon file was corrected, and two new cables installed on the null voltage instruments. No issues with any sensors from cast 006s onwards.

No surface soak cast 017s because of rough weather (CTD deployed to 10m, and once pumps on, then on down to depth.)

LADCP battery charged and vented at end of cruise.

Ti CTD

For the first four casts with this frame (001t-003t, 005t) the LADCP produced 2 files for each deployment, and these included very small amounts of on-deck data only. The fault was traced to a defective cable, and the cable replaced for the next cast (007t). Cable issues again caused no data be logged on cast 022t; the cable was cleaned and dried, then tested without failing. More cable problems occurred on cast 028t; with a small file and data quality unacceptable. Switched to other leg on Star cable, no further communication errors until cast 034t. Similar problem to 028t, but in this instance caused by low battery voltage. Low battery voltage again caused two files to be created for cast 061t (named as 961m and 061m); approximately 45 minutes missing from the deployment between the end of first file and the start of second data file. Continuing problems with Star cable; no communications for cast 066t.

The Sea-Bird dissolved oxygen sensor did not output adequate voltage on the same cast set as the LADCP cable problem, even with new cables installed. The sensor was replaced for cast 007t, and this new SBE 43 (s/n 2291) performed as expected.

No surface soak casts 014t through 018t because of rough weather (CTD deployed to 10m, and once pumps on, then on down to depth.)

LADCP battery charged and vented at end of cruise.

LADCP

No problems with either instrument deployed.

Total number of casts - 42 S/S frame, 28 Ti frame.
Casts deeper than 2000m - 0 S/S frame, 4 Ti frame.
Deepest casts -503m S/S frame, 3462m Ti frame.

Autosal

Both heater lamps required replacement at beginning of cruise.

FRRF

Flash card reported as full at 0626 GMT during cast 030s; however this was on-deck for the recovery and therefore no useful data lost. Re-formatted for next series of casts.

No data for casts 033s (battery low), and for cast 054s (flash card full).

Battery pack has intermittent charging fault after cast 039s: casts 040s through 042s ceased recording prior to completion of profile. The pack will not take a charge whilst on frame, so moved to bench & charged correctly; suspect the deck unit or charging lead. Deck unit & lead investigated and both function properly, the pack now will not charge on bench; battery pack removed & disassembled after cast 045s, solder track corrosion found on board, as well as fresh water in case (condensation?) Cleaned tracks on power board & re-soldered where possible; pack connected & charges appropriately; pack dried & reassembled with two silica gel bags, installed back onto CTD frame for cast 046s. Still problems with battery pack ability to re-charge, cast 053s also ceased recording prior to completion of profile. Removed the battery pack every 4 casts to charge on bench for the remainder of the cruise.

SAPS

Serial number 03-05 did not finish its pump cycle on casts 1 through 4, leaving 12 to 24 minutes on the timer. The timer board was exchanged for the one installed in s/n 03-03, and this did not alter the result. Filters clogging (using two 263mm diameter filters, one 53 micron and one 1 micron) are the suspected cause, and the pump times will be reduced to one hour from 1.5 hours. Now trickle-charging both SAPS after each profile. S/n 03-05 finished its pump cycle on casts 5 through 16.

10L C-Free samplers

C-Free sampler s/n 01: Did not seal properly on bottom ball, deployment 1.
C-Free sampler s/n 12: Pressure relief valve did not activate, removed from cast, deployment 1. Lanyard found to be fouled, and re-routed.
C-Free sampler s/n's 7, 9 & 11: Bottom wheel spindle mount broken, deployments 3 & 4. Re-glued.
C-Free sampler s/n's 01, 03 & 04: Lost on deployment 5, as wire fouled on large block on starboard gantry.
C-Free sampler s/n 2: Top wheel spindle mount broken. Re-glued.

APPENDIX 4: NMF-SS configuration, protocol and command files

Jeff Benson, Steve Whittle and Ben Poole

Stainless CTD frame:

```
Date: 06/03/2012

Instrument configuration file: D:\data\JR271\JR271_stainless.xmlcon

Configuration report for SBE 911plus/917plus CTD
------------------------------------------------

Frequency channels suppressed : 0
Voltage words suppressed      : 0
Computer interface            : RS-232C
Deck unit                     : SBE11plus Firmware Version >= 5.0
Scans to average              : 1
NMEA position data added      : No
NMEA depth data added         : No
NMEA time added               : No
Surface PAR voltage added     : No
Scan time added               : No

1) Frequency 0, Temperature

   Serial number : 5645
   Calibrated on : 12/04/2012
   G             : 4.35334476e-003
   H             : 6.30144469e-004
   I             : 2.00303701e-005
   J             : 1.51938536e-006
   F0            : 1000.000
   Slope         : 1.00000000
   Offset        : 0.0000

2) Frequency 1, Conductivity

   Serial number : 4087
   Calibrated on : 12/04/2012
   G             : -9.96036279e+000
   H             : 1.23524413e+000
   I             : -2.45620460e-003
   J             : 2.30694549e-004
   CTcor         : 3.2500e-006
   CPcor         : -9.57000000e-008
   Slope         : 1.00000000
   Offset        : 0.00000

3) Frequency 2, Pressure, Digiquartz with TC

   Serial number : 106017
   Calibrated on : 11/05/2011
   C1            : -4.386649e+004
   C2            : -9.603009e-002
   C3            : 1.227900e-002
   D1            : 3.567400e-002
   D2            : 0.000000e+000
   T1            : 3.027135e+001
   T2            : -2.840429e-004
   T3            : 3.284660e-006
   T4            : 5.341290e-009
   T5            : 0.000000e+000
   Slope         : 1.00004000
   Offset        : -0.02890
   AD590M        : 1.283280e-002
   AD590B        : -9.474490e+000

4) Frequency 3, Temperature, 2

   Serial number : 5623
   Calibrated on : 13/04/2012
   G             : 4.33512720e-003
   H             : 6.27614049e-004
   I             : 1.98087267e-005
   J             : 1.51407011e-006
   F0            : 1000.000
```

```
   Slope         : 1.00000000
   Offset        : 0.0000

5) Frequency 4, Conductivity, 2

   Serial number : 4126
   Calibrated on : 12/04/2012
   G             : -9.94279356e+000
   H             : 1.24324961e+000
   I             : -2.27836797e-003
   J             : 2.19477346e-004
   CTcor         : 3.2500e-006
   CPcor         : -9.57000000e-008
   Slope         : 1.00000000
   Offset        : 0.00000

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

   Serial number : 2290
   Calibrated on : 31/03/2012
   Equation      : Sea-Bird
   Soc           : 3.97900e-001
   Offset        : -4.91300e-001
   A             : -2.09220e-003
   B             : 1.03780e-004
   C             : -1.69350e-006
   E             : 3.60000e-002
   Tau20         : 1.57000e+000
   D1            : 1.92634e-004
   D2            : -4.64803e-002
   H1            : -3.30000e-002
   H2            : 5.00000e+003
   H3            : 1.45000e+003

7) A/D voltage 1, Free

8) A/D voltage 2, Altimeter

   Serial number : 244738
   Calibrated on : 09/05/2012
   Scale factor  : 15.000
   Offset        : 0.000

9) A/D voltage 3, PAR/Irradiance, Biospherical/Licor

   Serial number        : 7235
   Calibrated on        : 12/07/2010
   M                    : 1.00000000
   B                    : 0.00000000
   Calibration constant : 38610038610.04000100
   Multiplier           : 1.00000000
   Offset               : -0.03666484

10) A/D voltage 4, Free

11) A/D voltage 5, Free

12) A/D voltage 6, Transmissometer, WET Labs C-Star

    Serial number : CST-1497DR
    Calibrated on : 29/12/2011
    M             : 23.3664
    B             : -0.1140
    Path length   : 0.250

13) A/D voltage 7, Fluorometer, Chelsea Aqua 3

    Serial number : 088-249
    Calibrated on : 13/11/2007
    VB            : 0.181700
    V1            : 2.097600
    Vacetone      : 0.202800
    Scale factor  : 1.000000
    Slope         : 1.000000
    Offset        : 0.000000

Scan length                  : 30
```

Titanium CTD frame:

Date: 06/03/2012

Instrument configuration file: D:\data\JR271\JR271_titanium.xmlcon

Configuration report for SBE 911plus/917plus CTD

Frequency channels suppressed : 0
Voltage words suppressed : 0
Computer interface : RS-232C
Deck unit : SBE11plus Firmware Version >= 5.0
Scans to average : 1
NMEA position data added : No
NMEA depth data added : No
NMEA time added : No
Surface PAR voltage added : No
Scan time added : No

1) Frequency 0, Temperature

Serial number : 03P-4381
Calibrated on : 12 October 2011
G : 4.42347037e-003
H : 6.44699950e-004
I : 2.25343392e-005
J : 1.94924554e-006
F0 : 1000.000
Slope : 1.00000000
Offset : 0.0000

2) Frequency 1, Conductivity

Serial number : 04C-2165
Calibrated on : 12 October 2011
G : -9.76382130e+000
H : 1.34259051e+000
I : -2.23353012e-003
J : 2.16675947e-004
CTcor : 3.2500e-006
CPcor : -9.57000000e-008
Slope : 1.00000000
Offset : 0.00000

3) Frequency 2, Pressure, Digiquartz with TC

Serial number : 93896
Calibrated on : 12 May 2011
C1 : -8.331332e+004
C2 : -3.281962e-001
C3 : 2.216060e-002
D1 : 2.906000e-002
D2 : 0.000000e+000
T1 : 3.005232e+001
T2 : -3.843669e-004
T3 : 4.436390e-006
T4 : 0.000000e+000
T5 : 0.000000e+000
Slope : 0.99996000
Offset : -1.07670
AD590M : 1.289250e-002
AD590B : -8.106440e+000

4) Frequency 3, Temperature, 2

Serial number : 03P-4593
Calibrated on : 28 February 2012
G : 4.35408778e-003
H : 6.44630442e-004
I : 2.18123649e-005
J : 1.76590030e-006
F0 : 1000.000
Slope : 1.00000000
Offset : 0.0000

5) Frequency 4, Conductivity, 2

Serial number : 04C-3272
Calibrated on : 9 March 2012

```
   G             : -9.77016880e+000
   H             : 1.27118658e+000
   I             : 3.60822598e-004
   J             : 3.42154246e-005
   CTcor         : 3.2500e-006
   CPcor         : -9.57000000e-008
   Slope         : 1.00000000
   Offset        : 0.00000

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

   Serial number : 43-1940
   Calibrated on : 3 September 2011
   Equation      : Sea-Bird
   Soc           : 4.50400e-001
   Offset        : -5.10800e-001
   A             : -3.74480e-003
   B             : 1.84100e-004
   C             : -3.30380e-006
   E             : 3.60000e-002
   Tau20         : 1.78000e+000
   D1            : 1.92634e-004
   D2            : -4.64803e-002
   H1            : -3.30000e-002
   H2            : 5.00000e+003
   H3            : 1.45000e+003

7) A/D voltage 1, Free

8) A/D voltage 2, Fluorometer, Chelsea Aqua 3

   Serial number : 88-2615-126
   Calibrated on : 4 May 2012
   VB            : 0.316800
   V1            : 2.173800
   Vacetone      : 0.370300
   Scale factor  : 1.000000
   Slope         : 1.000000
   Offset        : 0.000000

9) A/D voltage 3, Transmissometer, Chelsea/Seatech

   Serial number : 161047
   Calibrated on : 18 March 2008
   M             : 23.9551
   B             : -0.4767
   Path length   : 0.250

10) A/D voltage 4, Altimeter

    Serial number : 6196.118171
    Calibrated on : 15 November 2006
    Scale factor  : 15.000
    Offset        : 0.000

11) A/D voltage 5, PAR/Irradiance, Biospherical/Licor

    Serial number        : PAR 02
    Calibrated on        : 28 January 2010
    M                    : 0.48485000
    B                    : 1.04840900
    Calibration constant : 100000000000.00000000
    Multiplier           : 0.99990000
    Offset               : 0.00000000

12) A/D voltage 6, PAR/Irradiance, Biospherical/Licor, 2

    Serial number        : PAR 04
    Calibrated on        : 1 October 2010
    M                    : 0.44451700
    B                    : 1.58770300
    Calibration constant : 100000000000.00000000
    Multiplier           : 0.99960000
    Offset               : 0.00000000

13) A/D voltage 7, Turbidity Meter, WET Labs, ECO-BB

    Serial number : BBRTD-168
    Calibrated on : 19 October 2009
```

```
    ScaleFactor   : 0.003036
    Dark output   : 0.084900

Scan length                  : 30

Date: 06/03/2012

Instrument configuration file: D:\data\JR271\JR271_titanium_oxy.xmlcon

Configuration report for SBE 911plus/917plus CTD
------------------------------------------------

Frequency channels suppressed : 0
Voltage words suppressed      : 0
Computer interface            : RS-232C
Deck unit                     : SBE11plus Firmware Version >= 5.0
Scans to average              : 1
NMEA position data added      : No
NMEA depth data added         : No
NMEA time added               : No
Surface PAR voltage added     : No
Scan time added               : No

1) Frequency 0, Temperature

   Serial number : 03P-4381
   Calibrated on : 12 October 2011
   G             : 4.42347037e-003
   H             : 6.44699950e-004
   I             : 2.25343392e-005
   J             : 1.94924554e-006
   F0            : 1000.000
   Slope         : 1.00000000
   Offset        : 0.0000

2) Frequency 1, Conductivity

   Serial number : 04C-2165
   Calibrated on : 12 October 2011
   G             : -9.76382130e+000
   H             : 1.34259051e+000
   I             : -2.23353012e-003
   J             : 2.16675947e-004
   CTcor         : 3.2500e-006
   CPcor         : -9.57000000e-008
   Slope         : 1.00000000
   Offset        : 0.00000

3) Frequency 2, Pressure, Digiquartz with TC

   Serial number : 93896
   Calibrated on : 12 May 2011
   C1            : -8.331332e+004
   C2            : -3.281962e-001
   C3            : 2.216060e-002
   D1            : 2.906000e-002
   D2            : 0.000000e+000
   T1            : 3.005232e+001
   T2            : -3.843669e-004
   T3            : 4.436390e-006
   T4            : 0.000000e+000
   T5            : 0.000000e+000
   Slope         : 0.99996000
   Offset        : -1.07670
   AD590M        : 1.289250e-002
   AD590B        : -8.106440e+000

4) Frequency 3, Temperature, 2

   Serial number : 03P-4593
   Calibrated on : 28 February 2012
   G             : 4.35408778e-003
   H             : 6.44630442e-004
   I             : 2.18123649e-005
   J             : 1.76590030e-006
   F0            : 1000.000
   Slope         : 1.00000000
   Offset        : 0.0000
```

5) Frequency 4, Conductivity, 2

```
   Serial number : 04C-3272
   Calibrated on : 9 March 2012
   G             : -9.77016880e+000
   H             : 1.27118658e+000
   I             : 3.60822598e-004
   J             : 3.42154246e-005
   CTcor         : 3.2500e-006
   CPcor         : -9.57000000e-008
   Slope         : 1.00000000
   Offset        : 0.00000
```

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

```
   Serial number : 43-2291
   Calibrated on : 31 March 2012
   Equation      : Sea-Bird
   Soc           : 4.05500e-001
   Offset        : -5.00500e-001
   A             : -3.00790e-003
   B             : 1.33030e-004
   C             : -2.03740e-006
   E             : 3.60000e-002
   Tau20         : 2.28000e+000
   D1            : 1.92634e-004
   D2            : -4.64803e-002
   H1            : -3.30000e-002
   H2            : 5.00000e+003
   H3            : 1.45000e+003
```

7) A/D voltage 1, Free

8) A/D voltage 2, Fluorometer, Chelsea Aqua 3

```
   Serial number : 88-2615-126
   Calibrated on : 4 May 2012
   VB            : 0.316800
   V1            : 2.173800
   Vacetone      : 0.370300
   Scale factor  : 1.000000
   Slope         : 1.000000
   Offset        : 0.000000
```

9) A/D voltage 3, Transmissometer, Chelsea/Seatech

```
   Serial number : 161047
   Calibrated on : 18 March 2008
   M             : 23.9551
   B             : -0.4767
   Path length   : 0.250
```

10) A/D voltage 4, Altimeter

```
    Serial number : 6196.118171
    Calibrated on : 15 November 2006
    Scale factor  : 15.000
    Offset        : 0.000
```

11) A/D voltage 5, PAR/Irradiance, Biospherical/Licor

```
    Serial number        : PAR 02
    Calibrated on        : 28 January 2010
    M                    : 0.48485000
    B                    : 1.04840900
    Calibration constant : 100000000000.00000000
    Multiplier           : 0.99990000
    Offset               : 0.00000000
```

12) A/D voltage 6, PAR/Irradiance, Biospherical/Licor, 2

```
    Serial number        : PAR 04
    Calibrated on        : 1 October 2010
    M                    : 0.44451700
    B                    : 1.58770300
    Calibration constant : 100000000000.00000000
    Multiplier           : 0.99960000
    Offset               : 0.00000000
```

```
13) A/D voltage 7, Turbidity Meter, WET Labs, ECO-BB

    Serial number : BBRTD-168
    Calibrated on : 19 October 2009
    ScaleFactor   : 0.003036
    Dark output   : 0.084900

Scan length                  : 30
```

LADCP command file:

```
;
$P ************************************************************************
$P *******  LADCP Deployment with one ADCP.  Usually looking down **********
$P ************************************************************************
; Send ADCP a BREAK
$B
; Wait for command prompt (sent after each command)
$W62
;**Start**
; Display real time clock setting
tt?
$W62
; Set to factory defaults
CR1
$W62
; use WM15 for firmware 16.3
WM15
$W62
; Save settings as User defaults
CK
$W62
; Name data file
RN JR271
$W62
; Set transducer depth to zero
ED0000
$W62
; Set salinity to 35ppt
ES35
$W62
; Set system coordinate.
EX11111
$W62
; Set one ensemble/sec
TE00000100
$W62
; Set one second between pings
TP000100
$W62
; Set LADCP to output Velocity, Correlations, Amplitude, and Percent Good
LD111100000
$W62
; Set one ping per ensemble. Use WP if LADCP option is not enabled.
LP1
$W62
; Set to record 25 bins. Use WN if LADCP option is not enabled.
LN025
$W62
; Set bin size to 400 cm. Use WS if LADCP option is not enabled.
LS400
$W62
; Set blank to 176 cm (default value) Use WF if LADCP option is not enabled.
LF0176
$W62
; Set max radial (along the axis of the beam) water velocity to 176 cm/sec.
; Use WV if LADCP option is not enabled.
LV170
$W62
; Set ADCP to narrow bandwidth and extend range by 10%
LW1
$W62
; Set to use a fixed speed of the sound
EZ0111111
$W62
; Set speed of sound value.   1500 m/sec is default.
EC1500
$W62
```

```
; Heading alignment set to 0 degrees
EA00000
$W62
; Heading bias set to 0 degrees
EB00000
$W62
; Record data internally
CF11101
$W62
; Save set up
CK
$W62
; Start pinging
CS
; Delay 3 seconds
$D3
$p ************************************************************************
$P Please disconnect the ADCP from the computer.
$p ************************************************************************
; Close the log file
$l
```

FRRF boot protocol:

```
 =====================
   System Setup
 =====================

Fast Repetition Rate Fluorometer -  Ver 1.18
FPGA Version -  Ver 0.1
Instrument ID - Ser 05-5335-001
Flashcard Size -  24 MB
AutoAcquire is ENABLED

Mon Jun 11 09:08:07 2012
System Battery Voltage = 14.49 V
System Current         = 0.311 A
Electronics Temp       = 4.15 Deg C

A:      Set Date and Time
B:      Boot protocol slot number -   1
C:      AutoAcquire is ENABLED
D:      REF Amplifier offset (counts)-       117
E:      PMT Amplifier offset (counts)-       125
F:      Reserved
G:      Reserved
H:      F0 analog output scale maximum - 1.000000
I:      FM analog output scale maximum - 1.000000
J:      PMT calibration threshhold is -  200 counts
K:      Ref calibration threshhold is -  200 counts
L:      Set PMT gain constants
M:      Check PMT calibration
X:      Reset to Safe values

Select option or '0' to return:

 =====================
   Main Menu
 =====================

   1. Run
   2. File
   3. System Status & Setup
   4. Error and PMT Log
   X. Shutdown

 =====================
   Run Menu
 =====================

   1. Discrete Acquire
   2. Programmed Acquire
   3. View/Edit Current Protocol
   4. Save Protocol
   5. Restore Protocol

   0. to Return:
```

```
    *** Boot Protocol = 1 ***

6. 65535    Acquisitions
7.    16    Flash sequences per acquisition
8.   100    Saturation flashes per sequence
9.     4    Saturation flash duration (in instrument units)
A.     0    Saturation interflash delay (in instrument units)
B. DISABLED Relaxation flashes
C.    20    Relaxation flashes per sequence
D.     4    Relaxation flash duration (in instrument units)
E.    61    Relaxation interflash delay (in instrument units)
F.    30    ms Sleeptime between acquisition pairs
G.     1    PMT Gain in Normal Mode
H. DISABLED Analog Output
I. DISABLED Desktop (verbose) Mode
J. ACTIVE   Light Chamber (A)
K. ACTIVE   Dark Chamber (B)
L. ENABLED  Logging mode to internal flashcard
M:    90    Upper Limit Autoranging Threshold value
N:    15    Lower Limit Autoranging Threshold value
```

APPENDIX 5

JR271 – CTD log

Station	1 (E05)	CTD No	001	Date	3/6/12	CTD type: 24 bottles 10 litre Titanium
Lat	56° 16.000’	Event No	001	Time I/W	02:29	
Lon	02° 37.997’	Depth	75m	Time bottom	02:34	
Filename	JR271_CTD_Log_001	Cast Depth		Time O/W		
Weather / Comments						

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Bioassay													
1	1	16	02:39	**X**													
2	2	16	02:39	**X**													
3	3	16	02:40	**X**													
4	4	16	02:40	**X**													
5	5	16	02:40	**X**													
6	6	16	02:40	**X**													
7	7	16	02:40	**X**													
8	8	16	02:40	**X**													
9	9	16	02:40	**X**													
10	10	16	02:41	**X**													
11	11	16	02:41	**X**													
12	12	16	02:41	**X**													
13	13	16	02:41	**X**													
14	14	16	02:41	**X**													
15	15	16	02:42	**X**													
16	16	16	02:42	**X**													
17	17	16	02:42	**X**													
18	18	16	02:42	**X**													
19	19	16	02:42	**X**													
20	20	16	02:42	**X**													
21	21	16	02:42	**X**													
22	22	16	02:42	**X**													
23	23	16	02:43	**X**													
24	24	16	02:43	**X**													
Sampler / Analyst				Mark													

JR271 – CTD log

Station	1 (E05)	CTD No	002	Date	3/6/12	CTD type: 24 bottles 10 litre Titanium
Lat	56° 16.002' N	Event No	002	Time I/W	04:23	
Lon	02° 37.990' E	Depth	75m	Time bottom	04:30	
Filename	JR271_CTD_Log_002	Cast Depth		Time O/W	04:41	
Weather / Comments						

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Bioassay													
1	1	51	02:39	X													
2	2	51	02:39	X													
3	3	51	02:40	X													
4	4	50	02:40	X													
5	5	51	02:40	X													
6	6	50	02:40	X													
7	7	51	02:40	X													
8	8	11	02:40	X													
9	9	11	02:40	X													
10	10	11	02:41	X													
11	11	11	02:41	X													
12	12	11	02:41	X													
13	13	10	02:41	X													
14	14	11	02:41	X													
15	15	11	02:42	X													
16	16	11	02:42	X													
17	17	10	02:42	X													
18	18	11	02:42	X													
19	19	11	02:42	X													
20	20	11	02:42	X													
21	21	11	02:42	X													
22	22	11	02:42	X													
23	23	11	02:43	X													
24	24	10	02:43	X													
Sampler / Analyst				Mark													

JR271 – CTD log

Station	1 (E05)	CTD No	003	Date	3/6/12	CTD type: 24 bottles 10 litre Titanium
Lat	56° 16.000' N	Event No	003	Time I/W	05:56	
Lon	02° 37.998' E	Depth	74m	Time bottom	06:00	
Filename	JR271_CTD_Log_003	Cast Depth		Time O/W	ND	
Weather / Comments						

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Bioassay													
1	1	13	06:01	X													
2	2	13	06:02	X													
3	3	13	06:02	X													
4	4	13	06:02	X													
5	5	10	06:04	X													
6	6	10	06:04	X													
7	7	10	06:05	X													
8	8	10	06:05	X													
9	9	10	06:05	X													
10	10	10	06:05	X													
11	11	10	06:06	X													
12	12	10	06:06	X													
13	13	10	06:06	X													
14	14	10	06:06	X													
15	15	10	06:07	X													
16	16	10	06:07	X													
17	17	10	06:07	X													
18	18	10	06:07	X													
19	19	10	06:08	X													
20	20	10	06:08	X													
21	21	10	06:08	X													
22	22	10	06:09	X													
23	23	10	06:09	X													
24	24	10	06:09	X													
Sampler / Analyst				Mark													

JR271 – CTD log

Station	1 (E05)	CTD No	004	Date	3/6/12	CTD type: 24 bottles 20 litre Standard
Lat	56° 16.002' N	Event No	007	Time I/W	07:15	
Lon	02° 37.998' E	Depth	74m	Time bottom	07:35	
Filename	JR271_CTD_Log_004	Cast Depth		Time O/W	07:56	
Weather / Comments	Bottles 2, 3, 4, 14, 15 and 20 Leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Oxygen	Carbonate pH	N_2O	DMS	TEP	DOC	Nutrients	DOM	Cytometry	Bact Prod	Calc/PP	Lugols	SEM	Psi/PIC
1	1	60	07:37	X	X	X		X	X	X	X		X				
2	2	60	07:38							X		X					
3	3	50	07:39	X													
4	4	50	07:40														
5	5	40	07:41	X	X	X	X		X	X	X						
6	6	40	07:42							X		X	X			X	
7	7	30	07:43		X		X		X	X	X						
8	8	30	07:43							X		X	X			X	
9	9	25	07:44		X	X	X		X	X	X						
10	10	25	07:44							X		X					
11	11	20	07:45	X	X		X		X	X	X						
12	12	20	07:45							X		X	X			X	
13	13	15	07:47		X	X	X		X	X	X						
14	14	15	07:47														
15	15	15	07:47														
16	16	15	07:48							X		X				X	
17	17	10	07:48	X	X	X	X			X	X						
18	18	10	07:49							X		X	X			X	X
19	19	10	07:49					X	X	X							
20	20	10	07:49							X							
21	21	5	07:51		X		X	X	X	X	X						
22	22	5	07:51							X		X				X	
23	23	1	07:52	X	X	X	X	X	X	X	X						
24	24	1	07:52							X		X	X				
Sampler / Analyst				Helen	Matt	Ian	Frances	Tingting	Tingting	Mario	Mario	Elaine	Ben	Alex	Alex	Jeremy	Jeremy

JR271 – CTD log

Station	1 (E05) - Continued	CTD No	004	Date	3/6/12	CTD type: 24 bottles 20 litre Standard
Lat		Event No	007	Time I/W		
Lon		Depth		Time bottom		
Filename	JR271_CTD_Log_004	Cast Depth		Time O/W		
Weather / Comments	Bottles 2, 3, 4, 14, 15 and 20 Leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Chloro	POC/N/P	HPLC	Photophy	RNA/DNA	N Cycle	Micro Expt	Salinity						
1	1	60	07:37														
2	2	60	07:38														
3	3	50	07:39														
4	4	50	07:40														
5	5	40	07:41														
6	6	40	07:42														
7	7	30	07:43														
8	8	30	07:43														
9	9	25	07:44														
10	10	25	07:44														
11	11	20	07:45														
12	12	20	07:45														
13	13	15	07:47														
14	14	15	07:47														
15	15	15	07:47														
16	16	15	07:48														
17	17	10	07:48														
18	18	10	07:49														
19	19	10	07:49														
20	20	10	07:49														
21	21	5	07:51														
22	22	5	07:51														
23	23	1	07:52														
24	24	1	07:52														
Sampler / Analyst				Sophie	Sophie	Mark	Laura	Cecelia	Darren	Polly	Jeff						

JR271 – CTD log

Station	1 (E05)	CTD No	005	Date	3/6/12	CTD type: 24 bottles 10 litre Titanium
Lat	56° 16.004	Event No	008	Time I/W	08:59	
Lon	2° 37.998	Depth	74m	Time bottom	09:04	
Filename	JR271_CTD_Log_005	Cast Depth		Time O/W	09:20	
Weather / Comments	Bottle 7 removed					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Nutrients	DOM	Trace Metals	Carbonate Calibr	Oxygen Calibr	Thorium	Salinity							
1	1	60	09:04	X		X											
2	2	50	09:05	X		X				X							
3	3	40	09:06	X		X											
4	4	30	09:07	X		X											
5	5	25	09:08	X		X											
6	6	20	09:09	X		X											
7	7																
8	8	20	09:10			X											
9	9	20	09:10			X											
10	10	20	09:10			X											
11	11	20	09:10			X											
12	12	20	09:11			X											
13	13	20	09:11			X											
14	14	20	09:12			X											
15	15	20	09:12			X				X							
16	16	20	09:12			X											
17	17	20	09:12			X											
18	18	20	09:12			X											
19	19	21	09:13			X											
20	20	21	09:13			X											
21	21	15	09:14	X		X											
22	22	15	09:15	X		X											
23	23	16	09:16	X		X											
24	24	16	09:16	X		X											
Sampler / Analyst				Mario	Mario	Eric	Eithne	Matt	Fred	Jeff							

JR271 – CTD log

Station	2	CTD No	006	Date	4/6/12	CTD type: 24 bottles 20 litre Standard
Lat	58° 44.385' N	Event No	013	Time I/W	06:48	
Lon	00° 51.691' W	Depth	119m	Time bottom	06:56	
Filename	JR271_CTD_Log_006	Cast Depth		Time O/W	07:16	
Weather / Comments	Bottles 9, 15 and 22 Leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Oxygen	Carbonate pH	N_2O	DMS	TEP	DOC	Nutrients	DOM	Cytometry	Bact Prod	Calc/PP	Lugols	SEM	PSi/PIC
2	1	100	06:58	X	X	X	X		X	X	X						
3	2	60	06:59							X		X	X				
4	3	60	07:01	X	X	X	X		X	X	X						
5	4	40	07:01							X		X	X			X	
6	5	40	07:03	X	X	X	X		X	X	X						
7	6	30	07:03							X		X	X			X	
8	7	30	07:05		X		X	X	X	X	X						
9	8	25	07:05							X		X	X			X	X
10	9	25	07:06						X	X							
11	10	20	07:06							X	X	X	X				
12	11	20	07:07	X	X	X	X		X	X	X						
13	12	20	07:07							X		X	X			X	
14	13	20	07:08						X	X							
15	14	12	07:08							X							
16	15	12	07:09							X	X						
17	16	12	07:09							X		X	X			X	
18	17	12	07:09		X	X	X	X	X	X							
19	18	8	07:10							X	X						
20	19	8	07:11		X	X	X	X	X	X							
21	20	8	07:11							X		X	X	X	X	X	
22	21	8	07:11							X							
23	22	5	07:12							X							
24	23	5	07:13	X	X	X	X	X	X	X	X						
1	24	100	07:13							X		X	X				
Sampler / Analyst				Helen	Matt	Ian	Frances	Tingting	Tingting	Mario	Mario	Elaine	Ben	Alex	Alex	Jeremy	Jeremy

JR271 – CTD log

Station	2 - Continued	CTD No	006	Date	4/6/12	CTD type: 24 bottles 20 litre Standard
Lat		Event No	013	Time I/W		
Lon		Depth		Time bottom		
Filename	JR271_CTD_Log_006	Cast Depth		Time O/W		
Weather / Comments	Bottles 9, 15 and 22 Leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Chloro	POC/N/P	HPLC	Photophy	RNA/DNA	N Cycle	Micro Expt	Salinity						
2	1	100	06:58								X						
3	2	60	06:59														
4	3	60	07:01								X						
5	4	40	07:01														
6	5	40	07:03								X						
7	6	30	07:03	X													
8	7	30	07:05														
9	8	25	07:05	X				X									
10	9	25	07:06														
11	10	20	07:06														
12	11	20	07:07														
13	12	20	07:07														
14	13	20	07:08														
15	14	12	07:08	X													
16	15	12	07:09														
17	16	12	07:09														
18	17	12	07:09														
19	18	8	07:10	X													
20	19	8	07:11														
21	20	8	07:11	X		X											
22	21	8	07:11							X							
23	22	5	07:12														
24	23	5	07:13														
1	24	100	07:13	X													
Sampler / Analyst				Sophie	Sophie	Mark	Laura	Cecelia	Darren	Polly	Jeff						

JR271 – CTD log

Station	2	CTD No	007	Date	4/6/12	CTD type: 24 bottles 10 litre Titanium
Lat	58° 44.384	Event No	014	Time I/W	07:56	
Lon	00° 51.685	Depth	119m	Time bottom	08:01	
Filename	JR271_CTD_Log_007	Cast Depth	100m	Time O/W	08:16	
Weather / Comments	Only 8 bottles on CTD Rosette					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Nutrients	DOM	Trace Metals	Carbonate Calibr	Oxygen Calibr	Thorium	Salinity							
1	1	100	08:03	X		X				X							
2																	
3																	
4	2	80	08:04	X		X											
5																	
6																	
7	3	60	08:06	X		X											
8																	
9																	
10	4	40	08:07	X		X											
11																	
12																	
13	5	30	08:09	X		X											
14																	
15																	
16	6	25	08:10	X		X											
17																	
18																	
19	7	20	08:12	X		X											
20																	
21																	
22	8	15	08:13	X		X				X							
23																	
24																	
Sampler / Analyst				Mario	Mario	Eric	Eithne	Matt	Fred	Jeff							

JR271 – CTD log

Station	3	CTD No	008	Date	5/6/12	CTD type: 24 bottles 20 litre Standard
Lat	60° 08.055 N	Event No	20	Time I/W	07:03	
Lon	06° 43.776	Depth	1176m	Time bottom	07:12	
Filename	JR271_CTD_Log_008	Cast Depth	300m	Time O/W	07:35	
Weather / Comments	Bottles 1, 4, 7, 12 and 13 Leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Oxygen	Carbonate pH	N_2O	DMS	TEP	DOC	Nutrients	DOM	Cytometry	Bact Prod	Calc/PP	Lugols	SEM	Psi/PIC
1	1	300	07:14														
2	2	300	07:15		X				X	X		X					
3	3	100	07:19		X				X	X		X					
4	4	100	07:20														
5	5	66	07:21		X			X	X								
6	6	66	07:21							X		X	X			X	
7	7	40	07:23														
8	8	40	07:23		X				X	X		X	X			X	
9	9	30	07:25		X				X								
10	10	31	07:25							X		X	X			X	
11	11	20	07:26		X			X	X								
12	12	20	07:26														
13	13	20	07:27														
14	14	20	07:27							X		X	X			X	
15	15	14	07:28		X				X								
16	16	14	07:29							X		X				X	
17	17	14	07:29														
18	18	14	07:29														
19	19	10	07:30		X			X	X								
20	20	10	07:31							X				X	X	X	X
21	21	10	07:31														
22	22	10	07:31									X	X				
23	23	5	07:32		X			X	X								
24	24	5	07:32							X		X	X				
Sampler / Analyst				Helen	Matt	Ian	Frances	Tingting	Tingting	Mario	Mario	Elaine	Ben	Alex	Alex	Jeremy	Jeremy

JR271 – CTD log

Station	3 (continued)	CTD No	008	Date	5/6/12	CTD type: 24 bottles 20 litre Standard
Lat		Event No	20	Time I/W		
Lon		Depth		Time bottom		
Filename	JR271_CTD_Log_008	Cast Depth		Time O/W		
Weather / Comments	Bottles 1, 4, 7, 12 and 13 Leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Chloro	POC/N/P	HPLC	Photophy	RNA/DNA	N Cycle	Micro Expt	Salinity						
1	1	300	07:14														
2	2	300	07:15								X						
3	3	100	07:19								X						
4	4	100	07:20														
5	5	66	07:21								X						
6	6	66	07:21	X													
7	7	40	07:23														
8	8	40	07:23														
9	9	30	07:25														
10	10	31	07:25	X													
11	11	20	07:26														
12	12	20	07:26														
13	13	20	07:27														
14	14	20	07:27	X						X							
15	15	14	07:28														
16	16	14	07:29	X													
17	17	14	07:29														
18	18	14	07:29														
19	19	10	07:30														
20	20	10	07:31	X	X			X									
21	21	10	07:31														
22	22	10	07:31														
23	23	5	07:32	X													
24	24	5	07:32														
Sampler / Analyst				Sophie	Sophie	Mark	Laura	Cecelia	Darren	Polly	Jeff						

JR271 – CTD log

Station	3	CTD No	009	Date	5/6/12	CTD type: 24 bottles 10 litre Titanium
Lat	60° 08.056	Event No	021	Time I/W	08:19	
Lon	06° 42.720	Depth	1176m	Time bottom	08:41	
Filename	JR271_CTD_Log_009	Cast Depth	1100M	Time O/W	09:25	
Weather / Comments						

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Nutrients	DOM	Trace Metals	Carbonate Calibr	Oxygen Calibr	Thorium	Salinity							
1	1	1102	08:42	X	X	X											
2	2	1103	08:42			X											
3	3	902	08:47	X	X	X											
4	4	703	08:52	X	X	X											
5	5	502	08:57	X	X	X											
6	6	401	09:00	X	X	X											
7	7	401	09:01			X			X								
8	8	300	09:03	X	X	X											
9	9	201	09:06	X	X	X											
10	10	150	09:09	X	X	X			X								
11	11	101	09:10	X	X	X											
12	12	100	09:11			X			X								
13	13	80	09:12	X	X	X			X								
14	14	61	09:14						X								
15	15	50	09:15						X								
16	16	50	09:16														
17	17	40	09:17	X	X	X			X								
18	18	30	09:19						X								
19	19	30	09:19														
20	20	20	09:20			X											
21	21	20	09:20	X	X	X			X								
22	22	20	09:21			X											
23	23	10	09:22						X								
24	24	10	09:22														
Sampler / Analyst				Mario	Mario	Eric	Eithne	Matt	Fred	Jeff							

JR271 – CTD log

Station	4	CTD No	010	Date	6/6/12	CTD type: 24 bottles 20 litre Standard
Lat	59° 58.265' N	Event No	028	Time I/W	06:34	
Lon	11° 58.498' N	Depth	1226	Time bottom	06:42	
Filename	JR271_CTD_Log_010	Cast Depth	300	Time O/W	07:10	
Weather / Comments	Bottles 8 and 20 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Oxygen	Carbonate pH	N_2O	DMS	TEP	DOC	Nutrients	DOM	Cytometry	Bact Prod	Calc/PP	Lugols	SEM	Psi/PIC
1	1	276	06:42	X	X				X								
2	2	277	06:48							X		X					
3	3	150	06:51	X	X	X			X								
4	4	150	06:52							X		X					
5	5	99	06:55	X	X	X	X	X	X								
6	6	100	06:55							X		X	X			X	
7	7	50	06:57		X	X	X		X								
8	8	50	06:57														
9	9	50	06:58													X	
10	10	50	06:58							X		X	X				
11	11	35	07:00	X	X	X	X	X	X								
12	12	35	07:00							X		X	X				
13	13	35	07:01														
14	14	35	07:01													X	
15	15	30	07:02		X		X		X								
16	16	30	07:02							X		X	X			X	
17	17	20	07:04	X	X	X	X	X	X								
18	18	20	07:04							X		X	X	X	X	X	X
19	19	20	07:04														
20	20	20	07:05														
21	21	6	07:06		X	X	X	X	X								
22	22	5	07:06							X		X	X			X	
23	23	5	07:07	X													
24	24	5	07:07														
Sampler / Analyst				Helen	Matt	Ian	Frances	Tingting	Tingting	Mario	Mario	Elaine	Ben	Alex	Alex	Jeremy	Jeremy

JR271 – CTD log

Station	4 (continued)	CTD No	010	Date	6/6/12	CTD type: 24 bottles 20 litre Standard
Lat		Event No		Time I/W		
Lon		Depth		Time bottom		
Filename	JR271_CTD_Log_010	Cast Depth		Time O/W		
Weather / Comments	Bottles 8 and 20 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Chloro	POC/N/P	HPLC	Photophy	RNA/DNA	N Cycle	Micro Expt	Salinity						
1	1	276	06:42		X						X						
2	2	277	06:48		X												
3	3	150	06:51								X						
4	4	150	06:52														
5	5	99	06:55								X						
6	6	100	06:55	X													
7	7	50	06:57														
8	8	50	06:57														
9	9	50	06:58														
10	10	50	06:58	X													
11	11	35	07:00														
12	12	35	07:00				X										
13	13	35	07:01														
14	14	35	07:01	X													
15	15	30	07:02														
16	16	30	07:02	X													
17	17	20	07:04														
18	18	20	07:04	X				X		X							
19	19	20	07:04														
20	20	20	07:05														
21	21	6	07:06														
22	22	5	07:06				X										
23	23	5	07:07	X													
24	24	5	07:07						X								
Sampler / Analyst				Sophie	Sophie	Mark	Laura	Cecelia	Darren	Polly	Jeff						

JR271 – CTD log

Station	4	CTD No	011	Date	6/6/12	CTD type: 24 bottles 10 litre Titanium
Lat	59° 58.267	Event No	029	Time I/W	07:43	
Lon	11° 58.500	Depth	1226	Time bottom	08:11	
Filename	JR271_CTD_Log_	Cast Depth	1200	Time O/W	08:50	
Weather / Comments						

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Nutrients	DOM	Trace Metals	Carbonate Calibr	Oxygen Calibr	Thorium	Salinity							
1	1	1202	08:12	X	X	X											
2																	
3	2	1000	08:17	X	X	X											
4																	
5	3	800	08:21	X	X	X				X							
6																	
7	4	600	08:26	X	X	X											
8																	
9	5	500	08:29	X	X	X											
10																	
11	6	400	08:32	X	X	X											
12																	
13	7	275	08:36	X	X	X											
14																	
15	8	150	08:39	X	X	X											
16																	
17	9	101	08:41	X	X	X											
18																	
19	10	50	08:43	X	X	X											
20																	
21	11	30	08:44	X	X	X											
22																	
23	12	20	08:46	X	X	X				X							
24																	
Sampler / Analyst				Mario	Mario	Eric	Eithne	Matt	Fred	Jeff							

JR271 – CTD log

Station	5	CTD No	012	Date	7/6/12	CTD type: 24 bottles 20 litre Standard
Lat	60° 00 090' N	Event No	036	Time I/W	06:35	
Lon	18° 40.210' W	Depth	2616	Time bottom	06:43	
Filename	JR271_CTD_Log_012	Cast Depth	300	Time O/W	07:08	
Weather / Comments	Bottles 8, 14, 17, 20, and 21 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Oxygen	Carbonate pH	N_2O	DMS	TEP	DOC	Nutrients	DOM	Cytometry	Bact Prod	Calc/PP	Lugols	SEM	Psi/PIC
1	1	275	06:46		X				X								
2	2	275	06:46							X		X					
3	3	200	06:48		X				X								
4	4	200	06:49							X		X					
5	5	150	06:51		X				X								
6	6	150	06:51							X		X	X				
7	7	100	06:53		X		X	X	X	X							
8	8	101	06:53														
9	9	65	06:55		X		X		X								
10	10	65	06:55							X		X	X			X	
11	11	40	06:57		X		X		X								
12	12	40	06:57							X		X	X			X	
13	13	30	06:58		X		X	X	X	X						X	
14	14	30	06:59														
15	15	20	07:00		X		X		X								
16	16	20	07:00							X		X	X			X	
17	17	20	07:00														
18	18	20	07:01														
19	19	10	07:02		X		X	X	X								
20	20	10	07:02														
21	21	10	07:02														
22	22	10	07:03							X		X	X	X	X	X	X
23	23	6	07:03		X		X	X	X								
24	24	5	07:04							X		X	X			X	
Sampler / Analyst				Helen	Matt	Ian	Frances	Tingting	Tingting	Mario	Mario	Elaine	Ben	Alex	Alex	Jeremy	Jeremy

JR271 – CTD log

Station	5 (continued)	CTD No	012	Date	7/6/12	CTD type: 24 bottles 20 litre Standard
Lat		Event No		Time I/W		
Lon		Depth		Time bottom		
Filename	JR271_CTD_Log_012	Cast Depth		Time O/W		
Weather / Comments	Bottles 8, 14, 17, 20, and 21 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Chloro	POC/N/P	HPLC	Photophy	RNA/DNA	N Cycle	Micro Expt	Salinity						
1	1	275	06:46								X						
2	2	275	06:46														
3	3	200	06:48								X						
4	4	200	06:49														
5	5	150	06:51								X						
6	6	150	06:51		X												
7	7	100	06:53														
8	8	101	06:53														
9	9	65	06:55														
10	10	65	06:55	X													
11	11	40	06:57														
12	12	40	06:57	X													
13	13	30	06:58	X	X												
14	14	30	06:59														
15	15	20	07:00														
16	16	20	07:00	X													
17	17	20	07:00														
18	18	20	07:01							X							
19	19	10	07:02														
20	20	10	07:02														
21	21	10	07:02														
22	22	10	07:03	X	X			X									
23	23	6	07:03														
24	24	5	07:04	X													
Sampler / Analyst				Sophie	Sophie	Mark	Laura	Cecelia	Darren	Polly	Jeff						

JR271 – CTD log

Station	5	CTD No	013	Date	7/6/12	CTD type: 24 bottles 10 litre Titanium
Lat	60° 00.090' N	Event No	037	Time I/W	07:56	
Lon	18° 40.216' W	Depth	2616	Time bottom	08:42	
Filename	JR271_CTD_Log_	Cast Depth	2500	Time O/W	10:00	
Weather / Comments						

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Nutrients	DOM	Trace Metals	Carbonate Calibr	Oxygen Calibr	Thorium	Salinity							
1	1	2500	08:46	X	X												
2	2	2500	08:46				X										
3	3	2501	08:46				X										
4	4	2499	08:47				X										
5	5	2500	08:47				X										
6	6	2499	08:48				X										
7	7	2001	08:48	X	X	X											
8	8	1602	09:06	X	X	X											
9	9	1202	09:15	X		X											
10	10	1002	09:20	X	X	X											
11	11	802	09:26	X		X											
12	12	602	09:31	X	X	X											
13	13	500	09:34	X		X			X								
14	14	400	09:37	X	X	X											
15	15	275	09:40	X		X											
16	16	200	09:43	X	X	X			X								
17	17	150	09:45	X		X			X								
18	18	100	09:47	X	X	X			X								
19	19	65	09:48	X	X	X			X								
20	20	41	09:50	X	X	X			X								
21	21	30	09:51	X	X	X			X								
22	22	20	09:53	X	X	X			X								
23	23	10	09:54	X	X	X			X								
24	24	5	09:55	X		X			X								
Sampler / Analyst				Mario	Mario	Eric	Eithne	Matt	Fred	Jeff							

JR271 – CTD log

Station	6	CTD No	014	Date	8/6/12	CTD type: 24 bottles 10 litre Titanium
Lat	60° 35.660' N	Event No	042	Time I/W	02:14	
Lon	18° 51.390' W	Depth	2513m	Time bottom	02:19	
Filename	JR271_CTD_Log_014	Cast Depth	100m	Time O/W	02:31	
Weather / Comments						

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Bioassay													
1	1	22	02:22	X													
2	2	21	02:23	X													
3	3	22	02:23	X													
4	4	21	02:23	X													
5	5	21	02:23	X													
6	6	22	02:23	X													
7	7	21	02:24	X													
8	8	22	02:24	X													
9	9	22	02:24	X													
10	10	21	02:25	X													
11	11	21	02:25	X													
12	12	21	02:25	X													
13	13	21	02:25	X													
14	14	21	02:26	X													
15	15	21	02:26	X													
16	16	21	02:26	X													
17	17	21	02:27	X													
18	18	21	02:27	X													
19	19	22	02:27	X													
20	20	21	02:27	X													
21	21	22	02:28	X													
22	22	21	02:28	X													
23	23	21	02:28	X													
24	24	21	02:28	X													
Sampler / Analyst				Mark													

JR271 – CTD log

Station	6	CTD No	014	Date	8/6/12	CTD type: 24 bottles 10 litre Titanium
Lat	60° 35.660' N	Event No	042	Time I/W	02:14	
Lon	18° 51.390' W	Depth	2513m	Time bottom	02:19	
Filename	JR271_CTD_Log_014	Cast Depth	100m	Time O/W	02:31	
Weather / Comments						

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Bioassay													
1	1	22	02:22	X													
2	2	21	02:23	X													
3	3	22	02:23	X													
4	4	21	02:23	X													
5	5	21	02:23	X													
6	6	22	02:23	X													
7	7	21	02:24	X													
8	8	22	02:24	X													
9	9	22	02:24	X													
10	10	21	02:25	X													
11	11	21	02:25	X													
12	12	21	02:25	X													
13	13	21	02:25	X													
14	14	21	02:26	X													
15	15	21	02:26	X													
16	16	21	02:26	X													
17	17	21	02:27	X													
18	18	21	02:27	X													
19	19	22	02:27	X													
20	20	21	02:27	X													
21	21	22	02:28	X													
22	22	21	02:28	X													
23	23	21	02:28	X													
24	24	21	02:28	X													
Sampler / Analyst				Mark													

JR271 – CTD log

Station	6	CTD No	016	Date	8/6/12	CTD type: 24 bottles 10 litre Titanium
Lat	60° 35.654' N	Event No	044	Time I/W	05:30	
Lon	18° 51.382' W	Depth	2515m	Time bottom	05:32	
Filename	JR271_CTD_Log_016	Cast Depth	50m	Time O/W	05:44	
Weather / Comments						

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Bioassay													
1	1	20	05:35	X													
2	2	20	05:35	X													
3	3	20	05:35	X													
4	4	22	05:36	X													
5	5	20	05:36	X													
6	6	20	05:36	X													
7	7	20	05:36	X													
8	8	20	05:37	X													
9	9	20	05:37	X													
10	10	20	05:37	X													
11	11	20	05:38	X													
12	12	20	05:38	X													
13	13	20	05:38	X													
14	14	20	05:38	X													
15	15	20	05:39	X													
16	16	22	05:39	X													
17	17	20	05:39	X													
18	18	20	05:40	X													
19	19	20	05:40	X													
20	20	21	05:40	X													
21	21	21	05:40	X													
22	22	21	05:41	X													
23	23	21	05:41	X													
24	24	20	05:41	X													
Sampler / Analyst				Mark													

JR271 – CTD log

Station	6	CTD No	017	Date	8/6/12	CTD type: 24 bottles 20 litre Standard
Lat	60° 35.653 N	Event No	045	Time I/W	06:11	
Lon	18° 51.381 W	Depth	2525m	Time bottom	06:20	
Filename	JR271_CTD_Log_017	Cast Depth	300m	Time O/W	06:44	
Weather / Comments	Bottles 2, 10and 19 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Oxygen	Carbonate pH	N_2O	DMS	TEP	DOC	Nutrients	DOM	Cytometry	Bact Prod	Calc/PP	Lugols	SEM	Psi/PIC
1	1	278	06:22	X	X				X	X							
2	2	276	06:22														
3	3	150	06:25	X	X				X								
4	4	150	06:26							X		X					
5	5	100	06:28	X	X		X		X								
6	6	101	06:28							X		X	X				
7	7	80	06:30		X	X	X	X	X								
8	8	81	06:30							X		X	X			X	
9	9	60	06:32		X	X	X		X	X						X	
10	10	60	06:32														
11	11	39	06:34		X	X	X		X								
12	12	41	06:34							X		X	X			X	
13	13	31	06:35		X	X	X	X	X								
14	14	30	06:36	X						X							
15	15	30	06:36														
16	16	30	06:36									X	X			X	
17	17	20	06:37	X	X	X	X	X	X								
18	18	20	06:37							X		X	X	X	X	X	X
19	19	20	06:38														
20	20	20	06:38														
21	21	7	06:39	X	X	X	X	X	X								
22	22	7	06:39							X						X	
23	23	7	06:39														
24	24	7	06:40									X	X				
Sampler / Analyst				Helen	Matt	Ian	Frances	Tingting	Tingting	Mario	Mario	Elaine	Ben	Alex	Alex	Jeremy	Jeremy

JR271 – CTD log

Station	6 (continued)	CTD No	017	Date	8/6/12	CTD type: 24 bottles 20 litre Standard
Lat		Event No		Time I/W		
Lon		Depth		Time bottom		
Filename	JR271_CTD_Log_017	Cast Depth		Time O/W		
Weather / Comments	Bottles 2, 10and 19 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Chloro	POC/N/P	HPLC	Photophy	RNA/DNA	N Cycle	Micro Expt	Salinity						
1	1	278	06:22								X						
2	2	276	06:22														
3	3	150	06:25								X						
4	4	150	06:26														
5	5	100	06:28								X						
6	6	101	06:28														
7	7	80	06:30														
8	8	81	06:30	X													
9	9	60	06:32	X	X												
10	10	60	06:32														
11	11	39	06:34														
12	12	41	06:34	X													
13	13	31	06:35														
14	14	30	06:36	X													
15	15	30	06:36														
16	16	30	06:36														
17	17	20	06:37														
18	18	20	06:37	X	X					X							
19	19	20	06:38														
20	20	20	06:38														
21	21	7	06:39														
22	22	7	06:39	X				X									
23	23	7	06:39														
24	24	7	06:40														
Sampler / Analyst				Sophie	Sophie	Mark	Laura	Cecelia	Darren	Polly	Jeff						

JR271 – CTD log

Station	6	CTD No	018	Date	8/6/12	CTD type: 24 bottles 10 litre Titanium
Lat	60° 35.652 N	Event No	046	Time I/W	07:15	
Lon	18° 51.384 W	Depth	2516m	Time bottom	07:33	
Filename	JR271_CTD_Log_018	Cast Depth	1000m	Time O/W	08:10	
Weather / Comments						

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Nutrients	DOM	Trace Metals	Carbonate Calibr	Oxygen Calibr	Thorium	Salinity							
1	1	1002	07:34	X	X	X				X							
2																	
3	2	802	07:39	X	X	X											
4																	
5	3	602	07:44	X	X	X											
6																	
7	4	403	07:49	X	X	X											
8																	
9	5	300	07:53	X	X	X											
10																	
11	6	201	07:55	X	X	X				X							
12																	
13	19	150	07:58	X	X	X											
14																	
15	20	100	08:00	X	X	X											
16																	
17	21	60	08:02	X	X	X											
18																	
19	22	40	08:04	X	X	X											
20																	
21	23	30	08:05	X	X	X											
22																	
23	24	21	08:06	X	X	X				X							
24																	
Sampler / Analyst				Mario	Mario	Eric	Eithne	Matt	Fred	Jeff							

JR271 – CTD log

Station	7	CTD No	019	Date	10.6.12	CTD type: 24 bottles 20 litre Standard
Lat	65° 58.767 N	Event No	052	Time I/W	06:18	
Lon	10° 43.086 W	Depth	1216	Time bottom	06:25	
Filename	JR271_CTD_Log_019	Cast Depth	250	Time O/W	06:50	
Weather / Comments	Bottles 7, 12 and 14 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Oxygen	Carbonate pH	N_2O	DMS	TEP	DOC	Nutrients	DOM	Cytometry	Bact Prod	Calc/PP	Lugols	SEM	Psi/PIC
1	1	252	06:30	X	X				X								
2	2	252	06:30							X		X					
3	3	101	06:34	X	X		X		X								
4	4	101	06:34							X		X					
5	5	50	06:36	X	X		X	X	X								
6	6	50	06:37							X		X	X			X	
7	7	30	06:38														
8	8	30	06:39		X		X		X	X		X	X			X	
9	9	25	06:40	X	X		X		X								
10	10	25	06:40							X		X		X	X	X	X
11	11	20	06:41	X	X		X		X	X							
12	12	20	06:41														
13	13	20	06:42									X	X			X	
14	14	20	06:42														
15	15	15	06:43		X		X	X	X								
16	16	14	06:44							X		X	X			X	
17	17	15	06:44														
18	18	15	06:44														
19	19	11	06:45		X		X	X	X								
20	20	10	06:45							X		X	X			X	
21	21	10	06:46														
22	22	11	06:46														
23	23	5	06:47	X	X		X	X	X								
24	24	5	06:47							X		X	X				
Sampler / Analyst				Helen	Matt	Ian	Frances	Tingting	Tingting	Mario	Mario	Elaine	Ben	Alex	Alex	Jeremy	Jeremy

JR271 – CTD log

Station	7 (continued)	CTD No	019	Date	10.6.12	CTD type: 24 bottles 20 litre Standard
Lat		Event No		Time I/W		
Lon		Depth		Time bottom		
Filename	JR271_CTD_Log_019	Cast Depth		Time O/W		
Weather / Comments						

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Chloro	POC/N/P	HPLC	Photophy	RNA/DNA	N Cycle	Micro Expt	Salinity						
1	1	252	06:30								X						
2	2	252	06:30														
3	3	101	06:34								X						
4	4	101	06:34														
5	5	50	06:36								X						
6	6	50	06:37	X	X												
7	7	30	06:38														
8	8	30	06:39	X			X										
9	9	25	06:40														
10	10	25	06:40	X	X												
11	11	20	06:41														
12	12	20	06:41														
13	13	20	06:42	X													
14	14	20	06:42														
15	15	15	06:43														
16	16	14	06:44	X													
17	17	15	06:44														
18	18	15	06:44	X													
19	19	11	06:45														
20	20	10	06:45	X	X												
21	21	10	06:46														
22	22	11	06:46					X		X							
23	23	5	06:47														
24	24	5	06:47				X										
Sampler / Analyst				Sophie	Sophie	Mark	Laura	Cecelia	Darren	Polly	Jeff						

JR271 – CTD log

Station	8	CTD No	020	Date	11.6.12	CTD type: 24 bottles 20 litre Standard
Lat	69° 53.743 N	Event No	060	Time I/W	06:06	
Lon	07° 34.620 W	Depth	1133	Time bottom	06:12	
Filename	JR271_CTD_Log_020	Cast Depth	250	Time O/W	06:37	
Weather / Comments	Bottles 2, 14, 15, 18, 24 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Oxygen	Carbonate pH	N_2O	DMS	TEP	DOC	Nutrients	DOM	Cytometry	Bact Prod	Calc/PP	Lugols	SEM	Psi/PIC
1	1	252	06:18		X				X	X		X					
2	2	252	06:18														
3	3	100	06:22		X		X	X	X	X							
4	4	101	06:22							X							
5	5	60	06:24		X	X	X		X	X							
6	6	61	06:25							X		X	X			X	
7	7	40	06:26		X	X	X	X	X	X							
8	8	40	06:26							X		X	X			X	
9	9	25	06:27		X	X	X		X	X							
10	10	25	06:28							X		X					
11	11	20	06:29		X	X	X		X	X							
12	12	20	06:29							X		X	X			X	
13	13	20	06:29							X							
14	14	21	06:30														
15	15	16	06:31														
16	16	15	06:31							X		X	X	X	X	X	X
17	17	15	06:31		X	X	X	X	X	X							
18	18	15	06:32														
19	19	10	06:32		X	X	X	X	X	X							
20	20	11	06:33							X		X	X				
21	21	10	06:33							X							
22	22	11	06:33							X						X	
23	23	5	06:34		X	X	X	X	X	X		X	X			X	
24	24	6	06:34														
Sampler / Analyst				Helen	Matt	Ian	Frances	Tingting	Tingting	Mario	Mario	Elaine	Ben	Alex	Alex	Jeremy	Jeremy

JR271 – CTD log

Station	8 (continued)	CTD No	020	Date	11.6.12	CTD type: 24 bottles 20 litre Standard
Lat		Event No		Time I/W		
Lon		Depth		Time bottom		
Filename	JR271_CTD_Log_020	Cast Depth		Time O/W		
Weather / Comments	Bottles 2, 14, 15, 18, 24 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Chloro	POC/N/P	HPLC	Photophy	RNA/DNA	N Cycle	Micro Expt	Salinity						
1	1	252	06:30								X						
2	2	252	06:30														
3	3	101	06:34								X						
4	4	101	06:34	X													
5	5	50	06:36								X						
6	6	50	06:37														
7	7	30	06:38														
8	8	30	06:39	X	X												
9	9	25	06:40														
10	10	25	06:40	X													
11	11	20	06:41														
12	12	20	06:41														
13	13	20	06:42														
14	14	20	06:42	X													
15	15	15	06:43														
16	16	14	06:44	X	X												
17	17	15	06:44														
18	18	15	06:44														
19	19	11	06:45														
20	20	10	06:45														
21	21	10	06:46														
22	22	11	06:46							X							
23	23	5	06:47														
24	24	5	06:47	X	X				X								
Sampler / Analyst				Sophie	Sophie	Mark	Laura	Cecelia	Darren	Polly	Jeff						

JR271 – CTD log

Station	9	CTD No	021	Date	12.6.12	CTD type: 24 bottles 20 litre Standard
Lat	74° 06.990 N	Event No	067	Time I/W	06:09	
Lon	04° 41.567 W	Depth	3529	Time bottom	06:16	
Filename	JR271_CTD_Log_021	Cast Depth	250	Time O/W	06:38	
Weather / Comments	Bottles 3, 20, 22 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Oxygen	Carbonate pH	N_2O	DMS	TEP	DOC	Nutrients	DOM	Cytometry	Bact Prod	Calc/PP	Lugols	SEM	Psi/PIC
1	1	252	06:18	X	X				X								
2	2	252	06:18							X		X					
3	3	100	06:22														
4	4	101	06:22		X				X	X		X					
5	5	60	06:24	X	X		X		X								
6	6	61	06:25							X		X					
7	7	40	06:26	X	X		X	X	X								
8	8	40	06:26							X		X	X			X	
9	9	25	06:27	X	X		X		X								
10	10	25	06:28							X		X	X			X	
11	11	20	06:29		X		X	X	X								
12	12	20	06:29							X		X	X			X	
13	13	20	06:29														
14	14	21	06:30														
15	15	16	06:31	X	X		X		X								
16	16	15	06:31							X				X	X		
17	17	15	06:31														
18	18	15	06:32									X	X			X	X
19	19	10	06:32		X		X	X	X	X							
20	20	11	06:33														
21	21	10	06:33									X	X			X	
22	22	11	06:33														
23	23	5	06:34	X	X		X	X	X								
24	24	6	06:34							X		X	X			X	
Sampler / Analyst				Helen	Matt	Ian	Frances	Tingting	Tingting	Mario	Mario	Elaine	Ben	Alex	Alex	Jeremy	Jeremy

JR271 – CTD log

Station	9 (continued)	CTD No	021	Date	12.6.12	CTD type: 24 bottles 20 litre Standard
Lat		Event No		Time I/W		
Lon		Depth		Time bottom		
Filename	JR271_CTD_Log_021	Cast Depth		Time O/W		
Weather / Comments	Bottles 3, 20, 22 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Chloro	POC/N/P	HPLC	Photophy	RNA/DNA	N Cycle	Micro Expt	Salinity						
1	1	252	06:30								X						
2	2	252	06:30														
3	3	101	06:34														
4	4	101	06:34								X						
5	5	50	06:36								X						
6	6	50	06:37														
7	7	30	06:38														
8	8	30	06:39	X	X	X											
9	9	25	06:40														
10	10	25	06:40	X			X										
11	11	20	06:41														
12	12	20	06:41	X													
13	13	20	06:42														
14	14	20	06:42														
15	15	15	06:43														
16	16	14	06:44														
17	17	15	06:44														
18	18	15	06:44	X	X	X											
19	19	11	06:45														
20	20	10	06:45														
21	21	10	06:46	X						X							
22	22	11	06:46														
23	23	5	06:47														
24	24	5	06:47	X	X	X	X										
Sampler / Analyst				Sophie	Sophie	Mark	Laura	Cecelia	Darren	Polly	Jeff						

JR271 – CTD log

Station	9	CTD No	022	Date	12/6/12	CTD type: 24 bottles 10 litre Titanium
Lat	74° 06.991 N	Event No	068	Time I/W	07:18	
Lon	04° 41.581 W	Depth	3527	Time bottom	08:19	
Filename	JR271_CTD_Log_	Cast Depth	3460	Time O/W	10:06	
Weather / Comments	Bottle 6 broken					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Nutrients	DOM	Trace Metals	Carbonate Calibr	Oxygen Calibr	Thorium	Salinity							
1	1	3462	08:20	X	X	X	X	X		X							
2	2	3250	08:30	X		X	X										
3	3	2999	08:36	X	X	X	X	X									
4	4	2750	08:42	X		X	X										
5	5	2501	08:51	X	X	X	X										
6	6	2251	08:58	X		X	X										
7	7	2001	09:04	X	X	X	X	X		X							
8	8	2001	09:05			X	X										
9	9	1750	09:12	X		X	X										
10	10	1750	09:12	X	X	X	X										
11	11	1251	09:24	X		X	X										
12	12	1001	09:30	X	X	X	X	X									
13	13	751	09:36	X		X	X										
14	14	500	09:42	X	X	X	X		X	X							
15	15	250	09:48	X	X	X	X										
16	16	150	09:52	X		X	X		X								
17	17	101	09:54	X	X	X	X		X								
18	18	81	09:56	X		X	X		X	X							
19	19	61	09:57	X	X	X	X		X								
20	20	51	09:58	X		X	X		X								
21	21	40	09:59	X	X	X	X		X								
22	22	30	10:01	X	X	X	X		X								
23	23	21	10:02	X	X	X	X		X								
24	24	10	10:03	X	X	X	X	X	X	X							
Sampler / Analyst				Mario	Mario	Eric	Eithne	Matt	Fred	Jeff							

JR271 – CTD log

Station	ARGO No 2	CTD No	023	Date	12/6/12	CTD type: 24 bottles 20 litre Standard
Lat	74° 59.449 N	Event No	None	Time I/W	18:17	
Lon	03° 49.260 W	Depth	3647	Time bottom	18:20	
Filename	JR271_CTD_Log_023	Cast Depth	30	Time O/W	18:27	
Weather / Comments	ARGO deployment in Greenland Basin (JR285 deployment). Bottles 10 and 15 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Oxygen	Carbonate pH	N_2O	DMS	TEP	DOC	Nutrients	DOM	Cytometry	Bact Prod	Calc/PP	Lugols	SEM	Psi/PIC
1	1	10	18:22														
2	2																
3	3																
4	4																
5	5	10	18:22														
6	6																
7	7																
8	8																
9	9																
10	10	10	18:23														
11	11																
12	12																
13	13																
14	14																
15	15	10	18:23														
16	16																
17	17																
18	18																
19	19																
20	20	10	18:23														
21	21																
22	22																
23	23																
24	24																
Sampler / Analyst				Helen	Eithne	Ian	Frances	Tingting	Tingting	Mario	Mario	Elaine	Ben	Alex	Alex	Jeremy	Jeremy

JR271 – CTD log

Station	ARGO No 2 (continued)	CTD No	023	Date	12/6/12	CTD type: 24 bottles 20 litre Standard
Lat		Event No		Time I/W		
Lon		Depth		Time bottom		
Filename	JR271_CTD_Log_023	Cast Depth		Time O/W		
Weather / Comments	Bottles 10 and 15 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Chloro	POC/N/P	HPLC	Photophy	RNA/DNA	N Cycle	Micro Resp	Salinity						
1	1	10	18:22														
2	2																
3	3																
4	4																
5	5	10	18:22														
6	6																
7	7																
8	8																
9	9																
10	10	10	18:23	**X**	**X**	**X**											
11	11																
12	12																
13	13																
14	14																
15	15	10	18:23														
16	16																
17	17																
18	18																
19	19																
20	20	10	18:23														
21	21																
22	22																
23	23																
24	24																
Sampler / Analyst				Sophie	Sophie	Mark	Laura	Cecelia	Darren	Polly	Jeff						

JR271 – CTD log

Station	10	CTD No	024	Date	13/6/12	CTD type: 24 bottles 10 litre Titanium
Lat	76° 10.518 N	Event No	074	Time I/W	02:10	
Lon	02° 32.961 W	Depth	3758	Time bottom	02:14	
Filename	JR271_CTD_Log_024	Cast Depth	100	Time O/W	02:27	
Weather / Comments	No bottle at position 18.					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Bioassay													
1	1	18	02:18	X													
2	2	19	02:19	X													
3	3	19	02:19	X													
4	4	19	02:19	X													
5	5	19	02:20	X													
6	6	19	02:20	X													
7	7	19	02:20	X													
8	8	19	02:20	X													
9	9	19	02:21	X													
10	10	19	02:21	X													
11	11	18	02:21	X													
12	12	18	02:22	X													
13	13	19	02:22	X													
14	14	18	02:22	X													
15	15	18	02:22	X													
16	16	19	02:23	X													
17	17	19	02:23	X													
18																	
19	19	19	02:23	X													
20	20	19	02:24	X													
21	21	19	02:24	X													
22	22	19	02:24	X													
23	23	19	02:25	X													
24	24	19	02:25	X													
Sampler / Analyst				Mark													

JR271 – CTD log

Station	10	CTD No	025	Date	13/6/12	CTD type: 24 bottles 10 litre Titanium
Lat	76° 10.518 N	Event No	075	Time I/W	03:44	
Lon	02° 32.962 W	Depth	3760	Time bottom	03:48	
Filename	JR271_CTD_Log_025	Cast Depth	100	Time O/W	04:02	
Weather / Comments						

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Bioassay													
1	1	61	03:50	**X**													
2	2	61	03:50	**X**													
3	3	60	03:50	**X**													
4	4	61	03:51	**X**													
5	5	61	03:51	**X**													
6	6	61	03:51	**X**													
7	7	60	03:52	**X**													
8	8	17	03:56	**X**													
9	9	17	03:56	**X**													
10	10	17	03:56	**X**													
11	11	17	03:57	**X**													
12	12	17	03:57	**X**													
13	13	17	03:57	**X**													
14	14	17	03:57	**X**													
15	15	16	03:58	**X**													
16	16	17	03:58	**X**													
17	17	17	03:58	**X**													
18	18	17	03:59	**X**													
19	19	17	03:59	**X**													
20	20	17	03:59	**X**													
21	21	17	03:59	**X**													
22	22	17	04:00	**X**													
23	23	16	04:00	**X**													
24	24	16	04:00	**X**													
Sampler / Analyst				Mark													

JR271 – CTD log

Station	10	CTD No	026	Date	13/6/12	CTD type: 24 bottles 10 litre Titanium
Lat	76° 10.516 N	Event No	076	Time I/W	05:33	
Lon	02° 32.959 W	Depth	3759	Time bottom	05:36	
Filename	JR271_CTD_Log_026	Cast Depth	30	Time O/W	05:48	
Weather / Comments						

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Bioassay													
1	1	18	05:38	**X**													
2	2	18	05:38	**X**													
3	3	18	05:39	**X**													
4	4	18	05:39	**X**													
5	5	18	05:39	**X**													
6	6	18	05:40	**X**													
7	7	18	05:40	**X**													
8	8	18	05:40	**X**													
9	9	18	05:41	**X**													
10	10	18	05:41	**X**													
11	11	18	05:41	**X**													
12	12	18	05:42	**X**													
13	13	18	05:42	**X**													
14	14	18	05:42	**X**													
15	15	18	05:43	**X**													
16	16	18	05:43	**X**													
17	17	18	05:43	**X**													
18	18	18	05:44	**X**													
19	19	18	05:44	**X**													
20	20	18	05:44	**X**													
21	21	18	05:45	**X**													
22	22	18	05:45	**X**													
23	23	18	05:45	**X**													
24	24	18	05:46	**X**													
Sampler / Analyst				Mark													

JR271 – CTD log

Station	10	CTD No	027	Date	13/6/12	CTD type: 24 bottles 20 litre Standard
Lat	76° 10.518 N	Event No	081	Time I/W	07:00	
Lon	02° 32.963 W	Depth	3758	Time bottom	07:06	
Filename	JR271_CTD_Log_027	Cast Depth	250	Time O/W	07:30	
Weather / Comments	Bottle 12 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Oxygen	Carbonate pH	N_2O	DMS	TEP	DOC	Nutrients	DOM	Cytometry	Bact Prod	Calc/PP	Lugols	SEM	Psi/PIC
1	1	252	07:09		X				X								
2	2	252	07:09							X		X					
3	3	150	07:12		X				X								
4	4	149	07:13							X		X					
5	5	81	07:15		X	X	X	X	X								
6	6	81	07:15							X		X	X			X	
7	7	41	07:16		X	X	X	X	X								
8	8	41	07:17							X		X	X				
9	9	41	07:18														
10	10	41	07:18													X	
11	11	26	07:19		X	X	X		X	X		X					
12	12	26	07:20													X	
13	13	21	07:21		X			X	X								
14	14	21	07:21							X		X	X				
15	15	21	07:22				X										
16	16	21	07:22											X	X	X	X
17	17	16	07:23		X	X	X		X								
18	18	16	07:24							X		X	X				
19	19	11	07:25		X	X	X	X	X								
20	20	11	07:25							X		X	X				
21	21	11	07:25														
22	22	11	07:26													X	
23	23	6	07:26		X	X	X	X	X								
24	24	6	07:27							X		X	X			X	
Sampler / Analyst				Helen	Matt	Ian	Frances	Tingting	Tingting	Mario	Mario	Elaine	Ben	Alex	Alex	Jeremy	Jeremy

JR271 – CTD log

Station	10 (continued)	CTD No	027	Date	13/6/12	CTD type: 24 bottles 20 litre Standard
Lat		Event No		Time I/W		
Lon		Depth		Time bottom		
Filename	JR271_CTD_Log_027	Cast Depth		Time O/W		
Weather / Comments	Bottle 12 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Chloro	POC/N/P	HPLC	Photophy	RNA/DNA	N Cycle	Micro Expt	Salinity						
1	1	252	07:09								X						
2	2	252	07:09														
3	3	150	07:12								X						
4	4	149	07:13														
5	5	81	07:15								X						
6	6	81	07:15	X													
7	7	41	07:16														
8	8	41	07:17	X	X		X										
9	9	41	07:18														
10	10	41	07:18					X									
11	11	26	07:19	X													
12	12	26	07:20														
13	13	21	07:21														
14	14	21	07:21	X	X												
15	15	21	07:22														
16	16	21	07:22														
17	17	16	07:23														
18	18	16	07:24														
19	19	11	07:25														
20	20	11	07:25	X			X										
21	21	11	07:25														
22	22	11	07:26							X							
23	23	6	07:26														
24	24	6	07:27	X	X												
Sampler / Analyst				Sophie	Sophie	Mark	Laura	Cecelia	Darren	Polly	Jeff						

JR271 – CTD log

Station	10	CTD No	028	Date	13/6/12	CTD type: 24 bottles 10 litre Titanium
Lat	76° 10.519 N	Event No	082	Time I/W	07:59	
Lon	02° 32.969 W	Depth	3758	Time bottom	08:20	
Filename	JR271_CTD_Log_028	Cast Depth	1000	Time O/W	08:57	
Weather / Comments						

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Nutrients	DOM	Trace Metals	Carbonate Calibr	Oxygen Calibr	Thorium	Salinity							
1	1	1000	08:21	X	X	X				X							
2																	
3	2	801	08:26	X	X	X											
4																	
5	3	600	08:33	X	X	X											
6																	
7	4	399	08:38	X	X	X											
8																	
9	5	201	08:42	X	X	X											
10																	
11	6	151	08:45	X	X	X			X	X							
12																	
13	7	101	08:47	X	X	X			X								
14																	
15	8	81	08:49	X	X	X			X								
16																	
17	9	61	08:51	X	X	X			X								
18																	
19	10	41	08:52	X	X	X			X								
20																	
21	11	20	08:54	X	X	X			X	X							
22																	
23	12	11	08:5	X	X	X			X								
24																	
Sampler / Analyst				Mario	Mario	Eric	Eithne	Matt	Fred	Jeff							

JR271 – CTD log

Station	11	CTD No	029	Date	14/6/12	CTD type: 24 bottles 20 litre Standard
Lat	78° 43.087 N	Event No	089	Time I/W	06:10	
Lon	00° 00.002W	Depth	2729	Time bottom	06:18	
Filename	JR271_CTD_Log_029	Cast Depth	250	Time O/W	06:45	
Weather / Comments	Bottles 3, 9, 10, 11, 12, 18, 20, 21 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Oxygen	Carbonate pH	N_2O	DMS	TEP	DOC	Nutrients	DOM	Cytometry	Bact Prod	Calc/PP	Lugols	SEM	Psi/PIC
1	1	251	06:24	X	X				X								
2	2	251	06:25							X		X					
3	3	100	06:28														
4	4	101	06:29	X	X				X	X		X					
5	5	65	06:30		X	X	X		X								
6	6	65	06:31							X		X	X				
7	7	40	06:32		X	X	X	X	X								
8	8	40	06:32							X		X	X			X	
9	9	25	06:33														
10	10	25	06:34														
11	11	25	06:34														
12	12	25	06:34													X	
13	13	20	06:35	X	X	X	X	X	X								
14	14	20	06:36							X		X	X			X	
15	15	15	06:36		X	X	X	X	X								
16	16	15	06:37							X		X	X			X	
17	17	15	06:37														
18	18	15	06:38														
19	19	11	06:39		X	X	X	X	X								
20	20	11	06:40														
21	21	11	06:40														
22	22	11	06:41							X		X	X	X	X	X	X
23	23	6	06:42	X	X	X	X	X	X								
24	24	6	06:42							X		X	X			X	
Sampler / Analyst				Helen	Eithne	Ian	Frances	Tingting	Tingting	Mario	Mario	Elaine	Ben	Alex	Alex	Jeremy	Jeremy

JR271 – CTD log

Station	11 (continued)	CTD No	029	Date	14/6/12	CTD type: 24 bottles 20 litre Standard
Lat		Event No		Time I/W		
Lon		Depth		Time bottom		
Filename	JR271_CTD_Log_029	Cast Depth		Time O/W		
Weather / Comments	Bottles 3, 9, 10, 11, 12, 18, 20, 21 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Chloro	POC/N/P	HPLC	Photophy	RNA/DNA	N Cycle	Micro Expt	Salinity						
1	1	251	06:24								X						
2	2	251	06:25														
3	3	100	06:28								X						
4	4	101	06:29		X												
5	5	65	06:30								X						
6	6	65	06:31	X													
7	7	40	06:32														
8	8	40	06:32	X													
9	9	25	06:33														
10	10	25	06:34														
11	11	25	06:34														
12	12	25	06:34														
13	13	20	06:35														
14	14	20	06:36	X	X		X	X									
15	15	15	06:36														
16	16	15	06:37	X													
17	17	15	06:37														
18	18	15	06:38														
19	19	11	06:39														
20	20	11	06:40							X							
21	21	11	06:40														
22	22	11	06:41	X	X												
23	23	6	06:42														
24	24	6	06:42	X			X		X								
Sampler / Analyst				Sophie	Sophie	Mark	Laura	Cecelia	Darren	Polly	Jeff						

JR271 – CTD log

Station	12	CTD No	030	Date	15/6/12	CTD type: 24 bottles 20 litre Standard
Lat	78° 14.772 N	Event No	095	Time I/W	05:46	
Lon	05° 32.949 W	Depth	362	Time bottom	05:57	
Filename	JR271_CTD_Log_030	Cast Depth	340	Time O/W	06:25	
Weather / Comments	Bottles 2, 6, 9, 10, 11, 15, 17 and 23 leaked					

Fire Seq	*Bot. No.*	*Depth (m)*	*Time (GMT)*	Oxygen	Carbonate pH	N_2O	DMS	TEP	DOC	Nutrients	DOM	Cytometry	Bact Prod	Calc/PP	Lugols	SEM	Psi/PIC
1	1	340	06:01		X				X	X		X					
2	2	340	06:01														
3	3	281	06:04		X				X								
4	4	281	06:04							X		X					
5	5	201	06:06		X				X	X		X					
6	6	201	06:07														
7	7	102	06:10		X			X	X								
8	8	102	06:10							X		X	X			X	
9	9	50	06:12														
10	10	50	06:12														
11	11	50	06:13														
12	12	50	06:13		X			X	X	X		X	X			X	
13	13	35	06:14		X				X								
14	14	35	06:15							X		X	X			X	
15	15	21	06:16														
16	16	21	06:16		X			X	X	X				X	X	X	X
17	17	21	06:17														
18	18	21	06:17									X	X				
19	19	11	06:19		X				X								
20	20	11	06:20							X							
21	21	11	06:20														
22	22	11	06:20									X	X			X	
23	23	6	06:21														
24	24	6	06:22		X			X	X	X		X	X			X	
Sampler / Analyst				Helen	Eithne	Ian	Frances	Tingting	Tingting	Mario	Mario	Elaine	Ben	Alex	Alex	Jeremy	Jeremy

JR271 – CTD log

Station	12 (continued)	CTD No	030	Date	15/6/12	CTD type: 24 bottles 20 litre Standard
Lat		Event No		Time I/W		
Lon		Depth		Time bottom		
Filename	JR271_CTD_Log_030	Cast Depth		Time O/W		
Weather / Comments	Bottles 15, 17 and 23 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Chloro	POC/N/P	HPLC	Photophy	RNA/DNA	N Cycle	Micro Expt	Salinity						
1	1	340	06:01								X						
2	2	340	06:01														
3	3	281	06:04								X						
4	4	281	06:04														
5	5	201	06:06								X						
6	6	201	06:07														
7	7	102	06:10														
8	8	102	06:10	X													
9	9	50	06:12														
10	10	50	06:12														
11	11	50	06:13														
12	12	50	06:13	X	X												
13	13	35	06:14														
14	14	35	06:15	X			X										
15	15	21	06:16														
16	16	21	06:16														
17	17	21	06:17														
18	18	21	06:17	X	X												
19	19	11	06:19														
20	20	11	06:20	X													
21	21	11	06:20														
22	22	11	06:20				X			X							
23	23	6	06:21														
24	24	6	06:22	X	X												
Sampler / Analyst				Sophie	Sophie	Mark	Laura	Cecelia	Darren	Polly	Jeff						

JR271 – CTD log

Station	13	CTD No	031	Date	15/6/12	CTD type: 24 bottles 20 litre Standard
Lat	78° 18.425 N	Event No	100	Time I/W	15:46	
Lon	06° 04.815 W	Depth	356	Time bottom	15;55	
Filename	JR271_CTD_Log_031	Cast Depth	335	Time O/W	16:15	
Weather / Comments	Bottles 7, 10, 11, 12, 18 and 22 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Oxygen	Carbonate pH	N_2O	DMS	TEP	DOC	Nutrients	DOM	Cytometry	Bact Prod	Calc/PP	Lugols	SEM	Psi/PIC
1	1	335	15:57		X												
2	2	335	15:57							X	X	X					
3	3	230	16:00		X												
4	4	230	16:00							X	X	X					
5	5	151	16:02		X												
6	6	151	16:02							X	X	X					
7	7	81	16:04														
8	8	81	16:04		X		X			X	X	X					
9	9	51	16:06		X		X			X	X	X					
10	10	51	16:06														
11	11	41	16:07														
12	12	41	16:07														
13	13	31	16:08		X		X										
14	14	31	16:08							X	X	X				X	
15	15	21	16:09		X		X										
16	16	21	16:09							X	X	X				X	
17	17	21	16:09														
18	18	21	16:10														
19	19	11	16:10		X		X										
20	20	11	16:11							X	X	X			X	X	X
21	21	11	16:11														
22	22	11	16:11														
23	23	6	16:12		X		X										
24	24	6	16:12							X	X	X				X	
Sampler / Analyst				Helen	Matt	Ian	Frances	Tingting	Tingting	Mario	Mario	Elaine	Ben	Alex	Alex	Jeremy	Jeremy

JR271 – CTD log

Station	13 (continued)	CTD No	031	Date	15/6/12	CTD type: 24 bottles 20 litre Standard
Lat		Event No		Time I/W		
Lon		Depth		Time bottom		
Filename	JR271_CTD_Log_031	Cast Depth		Time O/W		
Weather / Comments	Bottles 7, 10, 11, 12, 18 and 22 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Chloro	POC/N/P	HPLC	Photophy	RNA/DNA	N Cycle	Micro Expt	Salinity						
1	1	335	15:57								X						
2	2	335	15:57														
3	3	230	16:00								X						
4	4	230	16:00														
5	5	151	16:02								X						
6	6	151	16:02	X													
7	7	81	16:04														
8	8	81	16:04	X													
9	9	51	16:06	X													
10	10	51	16:06														
11	11	41	16:07														
12	12	41	16:07														
13	13	31	16:08														
14	14	31	16:08		X												
15	15	21	16:09														
16	16	21	16:09	X													
17	17	21	16:09														
18	18	21	16:10														
19	19	11	16:10														
20	20	11	16:11	X	X												
21	21	11	16:11														
22	22	11	16:11														
23	23	6	16:12														
24	24	6	16:12	X				X									
Sampler / Analyst				Sophie	Sophie	Mark	Laura	Cecelia	Darren	Polly	Jeff						

JR271 – CTD log

Station	14	CTD No	032	Date	16/6/12	CTD type: 24 bottles 20 litre Standard
Lat	78° 12.814 N	Event No	105	Time I/W	06:43	
Lon	05° 59.908 W	Depth	350	Time bottom	06:53	
Filename	JR271_CTD_Log_032	Cast Depth	330	Time O/W	07:17	
Weather / Comments	Bottles 3, 9, 10, 12, 18 and 19 leaked					

Fire Seq	*Bot. No.*	*Depth (m)*	*Time (GMT)*	Oxygen	Carbonate pH	N_2O	DMS	TEP	DOC	Nutrients	DOM	Cytometry	Bact Prod	Calc/PP	Lugols	SEM	Psi/PIC
1	1			X	X				X								
2	2									X	X	X					
3	3																
4	4			X	X				X	X	X	X					
5	5			X	X			X	X								
6	6									X	X	X					
7	7					X	X		X								
8	8									X	X	X	X				
9	9																
10	10									X	X				X		
11	11			X	X	X	X	X	X			X	X			X	X
12	12																
13	13				X	X	X	X	X								
14	14									X	X	X	X			X	X
15	15			X	X	X	X	X	X								
16	16									X	X	X	X				
17	17																
18	18																
19	19																
20	20									X	X	X	X	X	X		
21	21				X	X	X		X								
22	22																
23	23			X	X	X	X	X	X							X	X
24	24									X	X	X	X			X	X
Sampler / Analyst				Helen	Eithne	Ian	Frances	Tingting	Tingting	Mario	Mario	Elaine	Ben	Alex	Alex	Jeremy	Jeremy

JR271 – CTD log

Station	14 (continued)	CTD No	032	Date	16/6/12	CTD type: 24 bottles 20 litre Standard
Lat		Event No		Time I/W		
Lon		Depth		Time bottom		
Filename	JR271_CTD_Log_032	Cast Depth		Time O/W		
Weather / Comments	Bottles 3, 9, 10, 12, 18 and 19 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Chloro	POC/N/P	HPLC	Photophy	RNA/DNA	N Cycle	Micro Expt	Salinity						
1	1																
2	2										X						
3	3																
4	4																
5	5										X						
6	6																
7	7										X						
8	8			X													
9	9																
10	10						X										
11	11			X	X												
12	12																
13	13																
14	14			X													
15	15																
16	16			X			X										
17	17																
18	18																
19	19																
20	20																
21	21																
22	22			X	X					X							
23	23																
24	24			X	X				X								
Sampler / Analyst				Sophie	Sophie	Mark	Laura	Cecelia	Darren	Polly	Jeff						

JR271 – CTD log

Station	15	CTD No	033	Date	17/6/12	CTD type: 24 bottles 20 litre Standard
Lat	77° 49.139 N	Event No	113	Time I/W	06:10	
Lon	04° 58.994 W	Depth	1167	Time bottom	06:21	
Filename	JR271_CTD_Log_033	Cast Depth	500	Time O/W	06:50	
Weather / Comments	Bottles 12, 14 and 20 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Oxygen	Carbonate pH	N_2O	DMS	NH_4	TEP	DOC	Nutrients	Cytometry	Bact Prod	Calc/PP	Lugols	SEM	Psi/PIC
1	1	343	00:27		X					X							
2	2	343	00:28								X						
3	3	181	00:32		X				X	X							
4	4	181	00:32								X						
5	5	131	00:34		X		X			X							
6	6	131	00:35								X		X		X	X	
7	7	51	00:37		X		X		X	X							
8	8	51	00:38								X		X			X	
9	9	36	00:39		X		X		X	X							
10	10	36	00:40								X		X			X	
11	11	36	00:40														
12	12	36	00:40														
13	13	26	00:41		X		X		X	X							
14	14	26	00:42														
15	15	26	00:42														
16	16	26	00:42								X				X	X	X
17	17	15	00:44		X		X		X	X							
18	18	15	00:44								X		X	X	X	X	
19	19	15	00:44														
20	20	15	00:45														
21	21	11	00:46		X		X			X							
22	22	11	00:46								X		X			X	
23	23	6	00:47		X		X		X	X							
24	24	6	00:47								X		X				
Sampler / Analyst				Helen	Matt	Ian	Frances	Eric	Tingting	Tingting	Mario	Elaine	Ben	Alex	Alex	Jeremy	Jeremy

JR271 – CTD log

Station	15 (continued)	CTD No	033	Date	17/6/12	CTD type: 24 bottles 20 litre Standard
Lat		Event No		Time I/W		
Lon		Depth		Time bottom		
Filename	JR271_CTD_Log_033	Cast Depth		Time O/W		
Weather / Comments	Bottles 12, 14 and 20 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Chloro	POC/N/P	HPLC	Photophy	RNA/DNA	N Cycle	Micro Expt	Salinity						
1	1	343	00:27								X						
2	2	343	00:28														
3	3	181	00:32								X						
4	4	181	00:32														
5	5	131	00:34								X						
6	6	131	00:35	X	X		X										
7	7	51	00:37														
8	8	51	00:38	X													
9	9	36	00:39														
10	10	36	00:40	X	X		X										
11	11	36	00:40														
12	12	36	00:40														
13	13	26	00:41														
14	14	26	00:42														
15	15	26	00:42														
16	16	26	00:42	X													
17	17	15	00:44														
18	18	15	00:44	X	X		X			X							
19	19	15	00:44														
20	20	15	00:45														
21	21	11	00:46														
22	22	11	00:46	X													
23	23	6	00:47														
24	24	6	00:47														
Sampler / Analyst				Sophie	Sophie	Mark	Laura	Cecelia	Darren	Polly	Jeff						

JR271 – CTD log

Station	16	CTD No	034	Date	17/6/12	CTD type: 24 bottles 10 litre Titanium
Lat	77° 46.743 N	Event No	116	Time I/W	15:18	
Lon	03° 04.613 W	Depth	2939	Time bottom	16:11	
Filename	JR271_CTD_Log_034	Cast Depth	2877	Time O/W	17:45	
Weather / Comments	Bottles 4, 8, 13 and 23 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Nutrients	DOM	Trace Metals	Carbonate Calibr	Oxygen Calibr	Thorium	Salinity	DOC						
1	1	2877		X							X						
2	2	2750		X							X						
3	3	2550		X							X						
4	4	2500		X							X						
5	5	2001		X							X						
6	6	1900		X							X						
7	7	1800		X							X						
8	8	1700		X							X						
9	9	1600		X							X						
10	10	1500		X							X						
11	11	1400		X							X						
12	12	1200		X							X						
13	13	1000		X							X						
14	14	875		X							X						
15	15	750		X							X						
16	16	626		X							X						
17	17	501		X							X						
18	18	376		X							X						
19	19	250		X							X						
20	20	200		X							X						
21	21	150		X							X						
22	22	100		X							X						
23	23	51		X							X						
24	24	21		X							X						
Sampler / Analyst				Mario	Mario	Eric	Eithne	Matt	Fred	Jeff	Tingting						

JR271 – CTD log

Station	17	CTD No	035	Date	18/6/12	CTD type: 24 bottles 10 litre Titanium
Lat	78° 21.150 N	Event No	117	Time I/W	02:53	
Lon	03° 39.850 W	Depth	2257	Time bottom	02:58	
Filename	JR271_CTD_Log_035	Cast Depth	100	Time O/W	03:15	
Weather / Comments						

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Bioassay													
1	1	51	03:01	X													
2	2	51	03:01	X													
3	3	51	03:02	X													
4	4	51	03:02	X													
5	5	51	03:02	X													
6	6	51	03:02	X													
7	7	51	03:03	X													
8	8	6	03:09	X													
9	9	6	03:09	X													
10	10	6	03:09	X													
11	11	6	03:09	X													
12	12	6	03:10	X													
13	13	6	03:10	X													
14	14	6	03:10	X													
15	15	6	03:10	X													
16	16	6	03:10	X													
17	17	6	03:11	X													
18	18	6	03:11	X													
19	19	6	03:11	X													
20	20	6	03:11	X													
21	21	6	03:12	X													
22	22	6	03:12	X													
23	23	6	03:12	X													
24	24	6	03:13	X													
Sampler / Analyst				Mark													

JR271 – CTD log

Station	18	CTD No	036	Date	18/6/12	CTD type: 24 bottles 10 litre Titanium
Lat	78° 21.180 N	Event No	118	Time I/W	06:26	
Lon	04° 10.100 W	Depth	1744	Time bottom	06:31	
Filename	JR271_CTD_Log_036	Cast Depth	100	Time O/W	06:44	
Weather / Comments						

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Bioassay													
1	1	41	06:33	**X**													
2	2	41	06:34	**X**													
3	3	41	06:34	**X**													
4	4	41	06:34	**X**													
5	5	41	06:35	**X**													
6	6	41	06:35	**X**													
7	7	41	06:35	**X**													
8	8	9	06:38	**X**													
9	9	9	06:38	**X**													
10	10	9	06:38	**X**													
11	11	9	06:38	**X**													
12	12	9	06:39	**X**													
13	13	9	06:39	**X**													
14	14	9	06:39	**X**													
15	15	9	06:39	**X**													
16	16	9	06:40	**X**													
17	17	9	06:40	**X**													
18	18	9	06:40	**X**													
19	19	9	06:40	**X**													
20	20	9	06:41	**X**													
21	21	9	06:41	**X**													
22	22	9	06:41	**X**													
23	23	9	06:42	**X**													
24	24	9	06:42	**X**													
Sampler / Analyst				Mark													

JR271 – CTD log

Station	18	CTD No	037	Date	18/6/12	CTD type: 24 bottles 10 litre Titanium
Lat	78° 19.702 N	Event No	120	Time I/W	08:08	
Lon	04° 11.510 W	Depth	1772	Time bottom	08:11	
Filename	JR271_CTD_Log_037	Cast Depth	50	Time O/W	08:25	
Weather / Comments	Bottles 9 and 10 empty due to caught lanyard					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Bioassay													
1	1	7	08:16	X													
2	2	7	08:17	X													
3	3	8	08:17	X													
4	4	8	08:17	X													
5	5	7	08:18	X													
6	6	7	08:18	X													
7	7	8	08:18	X													
8	8	8	08:18	X													
9	9	7	08:19	X													
10	10	8	08:19	X													
11	11	7	08:19	X													
12	12	8	08:19	X													
13	13	7	08:20	X													
14	14	8	08:20	X													
15	15	7	08:20	X													
16	16	7	08:20	X													
17	17	7	08:21	X													
18	18	7	08:21	X													
19	19	7	08:21	X													
20	20	7	08:22	X													
21	21	7	08:22	X													
22	22	7	08:22	X													
23	23	7	08:23	X													
24	24	8	08:23	X													
Sampler / Analyst				Mark													

JR271 – CTD log

Station	18	CTD No	038	Date	18/6/12	CTD type: 24 bottles 10 litre Titanium
Lat	78° 17.760 N	Event No	121	Time I/W	10:11	
Lon	04° 15.040 W	Depth	1754	Time bottom	10:14	
Filename	JR271_CTD_Log_038	Cast Depth	50	Time O/W	10:27	
Weather / Comments						

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Bioassay													
1	1	7	10:18	**X**													
2	2	7	10:18	**X**													
3	3	7	10:19	**X**													
4	4	7	10:19	**X**													
5	5	7	10:19	**X**													
6	6	7	10:20	**X**													
7	7	7	10:20	**X**													
8	8	7	10:20	**X**													
9	9	7	10:20	**X**													
10	10	7	10:21	**X**													
11	11	7	10:21	**X**													
12	12	7	10:21	**X**													
13	13	7	10:21	**X**													
14	14	7	10:22	**X**													
15	15	7	10:22	**X**													
16	16	7	10:22	**X**													
17	17	7	10:23	**X**													
18	18	7	10:23	**X**													
19	19	7	10:23	**X**													
20	20	7	10:24	**X**													
21	21	7	10:24	**X**													
22	22	7	10:24	**X**													
23	23	7	10:25	**X**													
24	24	7	10:25	**X**													
Sampler / Analyst				Mark													

JR271 – CTD log

Station	18	CTD No	039	Date	18/6/12	CTD type: 24 bottles 20 litre Standard
Lat	78° 16.310 N	Event No	126	Time I/W	11:48	
Lon	04° 18.220 W	Depth	1745	Time bottom	11:54	
Filename	JR271_CTD_Log_039	Cast Depth	500	Time O/W	12:23	
Weather / Comments	Bottle 21 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Oxygen	Carbonate pH	N_2O	DMS	TEP	DOC	Nutrients	DOM	Cytometry	Bact Prod	Calc/PP	Lugols	SEM	Psi/PIC
1	1	350	12:05	X	X				X	X		X	X				
2	2	350	12:05														
3	3	175	12:08		X	X			X								
4	4	175	12:09							X		X	X				
5	5	61	12:12		X	X	X	X	X								
6	6	61	12:12							X		X	X				
7	7	61	12:13														
8	8	61	12:13													X	
9	9	27	12:15	X	X	X	X	X	X								
10	10	26	12:15							X		X	X				
11	11	26	12:15														
12	12	26	12:15													X	
13	13	20	12:16	X	X	X	X		X								
14	14	20	12:17							X		X	X			X	
15	15	20	12:17														
16	16	20	12:18														
17	17	13	12:19	X	X	X	X	X	X								
18	18	13	12:19							X		X	X			X	X
19	19	13	12:19														
20	20	13	12:20														
21	21	6	12:21	X	X	X	X	X	X								
22	22	5	12:21							X		X	X			X	
23	23	5	12:21														
24	24	6	12:22														
Sampler / Analyst				Helen	Matt	Ian	Frances	Tingting	Tingting	Mario	Mario	Elaine	Ben	Alex	Alex	Jeremy	Jeremy

JR271 – CTD log

Station	18 (continued)	CTD No	039	Date	18/6/12	CTD type: 24 bottles 20 litre Standard
Lat		Event No		Time I/W		
Lon		Depth		Time bottom		
Filename	JR271_CTD_Log_039	Cast Depth		Time O/W		
Weather / Comments	Bottle 21 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Chloro	POC/N/P	HPLC	Photophy	RNA/DNA	N Cycle	Micro Expt	Salinity						
1	1	350	12:05								**X**						
2	2	350	12:05														
3	3	175	12:08								**X**						
4	4	175	12:09														
5	5	61	12:12								**X**						
6	6	61	12:12														
7	7	61	12:13														
8	8	61	12:13	**X**	**X**												
9	9	27	12:15														
10	10	26	12:15														
11	11	26	12:15														
12	12	26	12:15	**X**	**X**												
13	13	20	12:16														
14	14	20	12:17														
15	15	20	12:17														
16	16	20	12:18	**X**													
17	17	13	12:19														
18	18	13	12:19														
19	19	13	12:19														
20	20	13	12:20	**X**													
21	21	6	12:21														
22	22	5	12:21														
23	23	5	12:21														
24	24	6	12:22	**X**	**X**												
Sampler / Analyst				Sophie	Sophie	Mark	Laura	Cecelia	Darren	Polly	Jeff						

JR271 – CTD log

Station	19	CTD No	040	Date	19/6/12	CTD type: 24 bottles 20 litre Standard
Lat	77° 50.755 N	Event No	134	Time I/W	06:34	
Lon	06° 17.907W	Depth	3051	Time bottom	06:46	
Filename	JR271_CTD_Log_040	Cast Depth	500	Time O/W	07:19	
Weather / Comments	Full set of bottles fired					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Oxygen	Carbonate pH	N_2O	DMS	TEP	DOC	Nutrients	DOM	Cytometry	Bact Prod	Calc/PP	Lugols	SEM	Psi/PIC
1	1	350	06:50	X	X				X								
2	2	350	06:51							X		X					
3	3	250	06:57	X	X				X								
4	4	250	06:58							X		X					
5	5	150	07:01	X	X	X		X	X								
6	6	150	07:01							X		X	X			X	
7	7	60	07:04	X	X	X	X	X	X								
8	8	60	07:04							X		X	X			X	
9	9	25	07:06		X	X	X		X								
10	10	26	07:07							X		X	X			X	
11	11	25	07:07														
12	12	25	07:07														
13	13	16	07:11		X	X	X	X	X								
14	14	16	07:11							X		X	X	X	X	X	X
15	15	16	07:11														
16	16	16	07:12														
17	17	10	07:13	X	X	X	X		X								
18	18	10	07:13							X						X	
19	19	10	07:13														
20	20	10	07:14									X	X				
21	21	6	07:15	X	X	X	X	X	X								
22	22	6	07:15							X		X	X			X	
23	23	6	07:15														
24	24	6	07:16														
Sampler / Analyst				Helen	Matt	Ian	Frances	Tingting	Tingting	Mario	Mario	Elaine	Ben	Alex	Alex	Jeremy	Jeremy

JR271 – CTD log

Station	19 (continued)	CTD No	040	Date	19/6/12	CTD type: 24 bottles 20 litre Standard
Lat		Event No		Time I/W		
Lon		Depth		Time bottom		
Filename	JR271_CTD_Log_040	Cast Depth		Time O/W		
Weather / Comments	Full set of bottles fired					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Chloro	POC/N/P	HPLC	Photophy	RNA/DNA	N Cycle	Micro Expt	Salinity						
1	1	350	06:50								X						
2	2	350	06:51														
3	3	250	06:57								X						
4	4	250	06:58														
5	5	150	07:01								X						
6	6	150	07:01	X	X												
7	7	60	07:04														
8	8	60	07:04	X			X										
9	9	25	07:06														
10	10	26	07:07														
11	11	25	07:07														
12	12	25	07:07	X	X												
13	13	16	07:11														
14	14	16	07:11				X	X		X							
15	15	16	07:11														
16	16	16	07:12	X													
17	17	10	07:13														
18	18	10	07:13														
19	19	10	07:13														
20	20	10	07:14	X													
21	21	6	07:15														
22	22	6	07:15														
23	23	6	07:15														
24	24	6	07:16	X	X												
Sampler / Analyst				Sophie	Sophie	Mark	Laura	Cecelia	Darren	Polly	Jeff						

JR271 – CTD log

Station	20	CTD No	041	Date	19/6/12	CTD type: 24 bottles 20 litre Standard
Lat	78° 25.306 N	Event No	141	Time I/W	19:06	
Lon	02° 45.966 E	Depth	2329 m	Time bottom	19:15	
Filename	JR271_CTD_Log_041	Cast Depth	500 m	Time O/W	19:42	
Weather / Comments	Bottle 22 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Oxygen	Carbonate pH	N_2O	DMS	TEP	DOC	Nutrients	DOM	Cytometry	Bact Prod	Calc/PP	Lugols	SEM	Psi/PIC
1	1	352	19:20		X				X								
2	2	352	19:20							X	X	X					
3	3	120	19:25		X				X								
4	4	120	19:26							X	X	X					
5	5	90	19:27		X				X								
6	6	90	19:27							X	X	X					
7	7	50	19:29		X		X	X	X								
8	8	50	19:30							X	X	X				X	
9	9	30	19:31		X		X		X								
10	10	30	19:31							X	X	X				X	
11	11	26	19:32		X		X	X	X								
12	12	26	19:33							X	X	X				X	
13	13	21	19:34		X		X		X								
14	14	21	19:34							X	X					X	
15	15	21	19:35														
16	16	21	19:35									X					
17	17	14	19:36		X		X	X	X								
18	18	14	19:36							X	X				X	X	X
19	19	14	19:37														
20	20	14	19:37									X					
21	21	5	19:38		X		X	X	X								
22	22	5	19:38														
23	23	5	19:39														
24	24	6	19:39							X	X	X				X	
Sampler / Analyst				Helen	Matt	Ian	Frances	Tingting	Tingting	Mario	Mario	Elaine	Ben	Alex	Alex	Jeremy	Jeremy

JR271 – CTD log

Station	20 (continued)	CTD No	041	Date	19/6/12	CTD type: 24 bottles 20 litre Standard
Lat		Event No		Time I/W		
Lon		Depth		Time bottom		
Filename	JR271_CTD_Log_041	Cast Depth		Time O/W		
Weather / Comments	Bottle 22 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Chloro	POC/N/P	HPLC	Photophy	RNA/DNA	N Cycle	Micro Expt	Salinity						
1	1	352	19:20								X						
2	2	352	19:20														
3	3	120	19:25								X						
4	4	120	19:26														
5	5	90	19:27								X						
6	6	90	19:27														
7	7	50	19:29														
8	8	50	19:30														
9	9	30	19:31														
10	10	30	19:31				X										
11	11	26	19:32														
12	12	26	19:33														
13	13	21	19:34														
14	14	21	19:34														
15	15	21	19:35														
16	16	21	19:35														
17	17	14	19:36														
18	18	14	19:36				X	X									
19	19	14	19:37														
20	20	14	19:37														
21	21	5	19:38														
22	22	5	19:38														
23	23	5	19:39														
24	24	6	19:39														
Sampler / Analyst				Sophie	Sophie	Mark	Laura	Cecelia	Darren	Polly	Jeff						

JR271 – CTD log

Station	21	CTD No	042	Date	20/6/12	CTD type: 24 bottles 20 litre Standard
Lat	78° 59.210 N	Event No	147	Time I/W	06;06	
Lon	07° 58.790 E	Depth	1104	Time bottom	06:17	
Filename	JR271_CTD_Log_042	Cast Depth	500	Time O/W	06:47	
Weather / Comments	Bottles 3, 14 and 19 leaked					

Fire Seq	*Bot. No.*	*Depth (m)*	*Time (GMT)*	Oxygen	Carbonate pH	N_2O	DMS	TEP	DOC	Nutrients	DOM	Cytometry	Bact Prod	Calc/PP	Lugols	SEM	Psi/PIC
1	1	502	06:18		X				X								
2	2	502	06:19							X		X					
3	3	350	06:23														
4	4	350	06:23		X				X	X		X					
5	5	250	06:26		X				X								
6	6	250	06:27							X		X					
7	7	50	06:31		X		X	X	X								
8	8	50	06:31							X		X	X			X	
9	9	23	06:34		X		X		X								
10	10	23	06:35							X		X	X			X	
11	11	23	06:35														
12	12	23	06:35														
13	13	19	06:38		X		X	X	X								
14	14	19	06:38														
15	15	19	06:39														
16	16	19	06:39							X		X	X			X	
17	17	16	06:40		X		X		X								
18	18	16	06:40							X		X	X	X	X	X	X
19	19	11	06:41														
20	20	11	06:42							X		X	X			X	
21	21	11	06:42		X		X	X	X								
22	22	11	06:42														
23	23	6	06:43		X		X	X	X								
24	24	6	06:44							X		X	X			X	
Sampler / Analyst				Helen	Matt	Ian	Frances	Tingting	Tingting	Mario	Mario	Elaine	Ben	Alex	Alex	Jeremy	Jeremy

JR271 – CTD log

Station	21 (continued)	CTD No	042	Date	20/6/12	CTD type: 24 bottles 20 litre Standard
Lat		Event No		Time I/W		
Lon		Depth		Time bottom		
Filename	JR271_CTD_Log_042	Cast Depth		Time O/W		
Weather / Comments	Bottles 3, 14 and 19 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Chloro	POC/N/P	HPLC	Photophy	RNA/DNA	N Cycle	Micro Expt	Salinity						
1	1	502	06:18								X						
2	2	502	06:19														
3	3	350	06:23														
4	4	350	06:23								X						
5	5	250	06:26								X						
6	6	250	06:27														
7	7	50	06:31														
8	8	50	06:31	X	X												
9	9	23	06:34														
10	10	23	06:35	X													
11	11	23	06:35														
12	12	23	06:35														
13	13	19	06:38														
14	14	19	06:38														
15	15	19	06:39														
16	16	19	06:39	X			X	X									
17	17	16	06:40														
18	18	16	06:40	X	X					X							
19	19	11	06:41														
20	20	11	06:42	X													
21	21	11	06:42														
22	22	11	06:42														
23	23	6	06:43														
24	24	6	06:44	X	X		X										
Sampler / Analyst				Sophie	Sophie	Mark	Laura	Cecelia	Darren	Polly	Jeff						

JR271 – CTD log

Station	22	CTD No	043	Date	20/6/12	CTD type: 24 bottles 10 litre Titanium
Lat	78° 57.335 N	Event No	154	Time I/W	14:59	
Lon	11° 55.488 E	Depth	358	Time bottom	15:08	
Filename	JR271_CTD_Log_043	Cast Depth	340	Time O/W	15:31	
Weather / Comments	Bottle 20 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Pteropod Count	Pteropod Water	Carbonate	Salinity										
1	1	341	15:10				X										
2	2	341	15:10	X													
3	3	341	15:10				X										
4	4	300	15:12														
5	5	300	15:12	X													
6	6	300	15:13				X										
7	7	250	15:14														
8	8	250	15:15	X													
9	9	250	15:15														
10	10	200	15:17														
11	11	200	15:17	X													
12	12	200	15:18														
13	13	150	15:20														
14	14	150	15:20	X													
15	15	150	15:20														
16	16	100	15:22														
17	17	100	15:22	X													
18	18	100	15:22														
19	19	51	15:24		X												
20	20	51	15:25	X		X											
21	21	51	15:25		X												
22	22	12	15:27														
23	23	12	15:28	X													
24	24	12	15:28														
Sampler / Analyst				Geraint	Geraint	Matt	Jeff										

JR271 – CTD log

Station	25	CTD No	044	Date	21/6/12	CTD type: 24 bottles 20 litre Standard
Lat	77° 55.743 N	Event No	163	Time I/W	19:03	
Lon	09° 08.166 E	Depth	1156	Time bottom	19:14	
Filename	JR271_CTD_Log_044	Cast Depth	500	Time O/W	19:41	
Weather / Comments	Bottles 16 and 22 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Oxygen	Carbonate pH	N_2O	DMS	TEP	DOC	Nutrients	DOM	Cytometry	Bact Prod	Calc/PP	Lugols	SEM	Psi/PIC
1	1	502	19:15		X				X								
2	2	502	19:15							X	X	X					
3	3	351	19:19		X				X								
4	4	350	19:19							X	X	X					
5	5	180	19:23		X				X								
6	6	181	19:23							X	X	X					
7	7	50	19:26		X		X	X	X								
8	8	51	19:27							X	X	X				X	
9	9	35	19:29		X		X	X	X								
10	10	35	19:30							X	X	X					
11	11	35	19:30														
12	12	35	19:31													X	
13	13	31	19:32		X		X		X								
14	14	31	19:32							X	X	X				X	
15	15	21	19:33		X		X	X	X								
16	16	20	19:34													X	
17	17	20	19:34														
18	18	21	19:35							X	X	X					
19	19	11	19:36		X		X	X	X								
20	20	11	19:36							X	X	X			X		
21	21	10	19:36				X										
22	22	11	19:37													X	X
23	23	6	19:38		X			X	X								
24	24	6	19:38							X	X	X				X	
Sampler / Analyst				Helen	Matt	Ian	Frances	Tingting	Tingting	Mario	Mario	Elaine	Ben	Alex	Alex	Jeremy	Jeremy

JR271 – CTD log

Station	25 (continued)	CTD No	044	Date	21/6/12	CTD type: 24 bottles 20 litre Standard
Lat		Event No		Time I/W		
Lon		Depth		Time bottom		
Filename	JR271_CTD_Log_044	Cast Depth		Time O/W		
Weather / Comments	Bottles 16 and 22 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Chloro	POC/N/P	HPLC	Photophy	RNA/DNA	N Cycle	Micro Expt	Salinity						
1	1	502	19:15								**X**						
2	2	502	19:15														
3	3	351	19:19								**X**						
4	4	350	19:19														
5	5	180	19:23								**X**						
6	6	181	19:23														
7	7	50	19:26														
8	8	51	19:27														
9	9	35	19:29														
10	10	35	19:30				**X**	**X**									
11	11	35	19:30														
12	12	35	19:31														
13	13	31	19:32														
14	14	31	19:32														
15	15	21	19:33														
16	16	20	19:34														
17	17	20	19:34														
18	18	21	19:35														
19	19	11	19:36														
20	20	11	19:36				**X**										
21	21	10	19:36														
22	22	11	19:37														
23	23	6	19:38														
24	24	6	19:38														
Sampler / Analyst				Sophie	Sophie	Mark	Laura	Cecelia	Darren	Polly	Jeff						

JR271 – CTD log

Station	26	CTD No	045	Date	22/6/12	CTD type: 24 bottles 20 litre Standard
Lat	76° 15.716 N	Event No	169	Time I/W	06:06	
Lon	12° 32.486 E	Depth	1714	Time bottom	06:17	
Filename	JR271_CTD_Log_045	Cast Depth	500	Time O/W	06:40	
Weather / Comments	All bottles fired					

Fire Seq	*Bot. No.*	*Depth (m)*	*Time (GMT)*	Oxygen	Carbonate pH	N_2O	DMS	TEP	DOC	Nutrients	DOM	Cytometry	Bact Prod	Calc/PP	Lugols	SEM	Psi/PIC
1	1	501	06:18		X				X								
2	2	501	06:19							X		X					
3	3	350	06:24	X	X				X								
4	4	350	06:24							X		X					
5	5	151	06:29	X	X				X								
6	6	151	06:29							X		X					
7	7	90	06:31		X		X	X	X								
8	8	91	06:32							X		X	X			X	
9	9	60	06:33	X	X		X		X								
10	10	61	06:34							X		X	X			X	
11	11	37	06:36	X	X		X	X	X								
12	12	37	06:37							X		X	X			X	
13	13	37	06:37														
14	14	37	06:38														
15	15	21	06:39	X	X		X		X								
16	16	21	06:39							X		X	X	X	X	X	X
17	17	21	06:40														
18	18	21	06:40							X							
19	19	16	06:41		X		X	X	X								
20	20	16	06:42									X	X			X	
21	21	16	06:42														
22	22	16	06:42							X							
23	23	5	06:43	X	X		X	X	X								
24	24	6	06:44							X		X	X			X	
Sampler / Analyst				Helen	Matt	Ian	Frances	Tingting	Tingting	Mario	Mario	Elaine	Ben	Alex	Alex	Jeremy	Jeremy

JR271 – CTD log

Station	26 (continued)	CTD No	045	Date	22/6/12	CTD type: 24 bottles 20 litre Standard
Lat		Event No		Time I/W		
Lon		Depth		Time bottom		
Filename	JR271_CTD_Log_045	Cast Depth		Time O/W		
Weather / Comments	All bottles fired					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Chloro	POC/N/P	HPLC	Photophy	RNA/DNA	N Cycle	Micro Expt	Salinity					
1	1	501	06:18								X					
2	2	501	06:19													
3	3	350	06:24								X					
4	4	350	06:24													
5	5	151	06:29								X					
6	6	151	06:29													
7	7	90	06:31													
8	8	91	06:32	X	X											
9	9	60	06:33													
10	10	61	06:34	X	X											
11	11	37	06:36													
12	12	37	06:37	X			X	X								
13	13	37	06:37													
14	14	37	06:38													
15	15	21	06:39													
16	16	21	06:39	X	X											
17	17	21	06:40													
18	18	21	06:40							X						
19	19	16	06:41													
20	20	16	06:42	X												
21	21	16	06:42													
22	22	16	06:42				X									
23	23	5	06:43													
24	24	6	06:44	X												
Sampler / Analyst				Sophie	Sophie	Mark	Laura	Cecelia	Darren	Polly	Jeff					

JR271 – CTD log

Station	27	CTD No	046	Date	22/6/12	CTD type: 24 bottles 20 litre Standard
Lat	76° 12.693 N	Event No	175	Time I/W	18:57	
Lon	18° 22.925 E	Depth	248	Time bottom	19:04	
Filename	JR271_CTD_Log_046	Cast Depth	234	Time O/W	19:26	
Weather / Comments	All bottles fired					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Oxygen	Carbonate pH	N_2O	DMS	TEP	DOC	Nutrients	DOM	Cytometry	Bact Prod	Calc/PP	Lugols	SEM	Psi/PIC
1	1	237	19:05		X				X								
2	2	237	19:05							X	X	X					
3	3	150	19:08		X				X								
4	4	149	19:08							X	X	X					
5	5	71	19:11		X		X	X	X								
6	6	71	19:11							X	X	X					
7	7	56	19:13		X		X		X								
8	8	56	19:13							X	X	X				X	
9	9	44	19:16		X			X	X								
10	10	44	19:16							X	X	X				X	
11	11	44	19:17				X										
12	12	44	19:17														
13	13	21	19:18		X				X								
14	14	21	19:18							X	X	X			X	X	X
15	15	21	19:19				X										
16	16	21	19:19														
17	17	11	19:20		X			X	X								
18	18	11	19:21							X	X	X				X	
19	19	11	19:21				X										
20	20	11	19:22														
21	21	5	19:22		X			X	X								
22	22	6	19:23							X	X	X				X	
23	23	6	19:23				X										
24	24	5	19:23														
Sampler / Analyst				Helen	Matt	Ian	Frances	Tingting	Tingting	Mario	Mario	Elaine	Ben	Alex	Alex	Jeremy	Jeremy

JR271 – CTD log

Station	27 (continued)	CTD No	046	Date	22/6/12	CTD type: 24 bottles 20 litre Standard
Lat		Event No		Time I/W		
Lon		Depth		Time bottom		
Filename	JR271_CTD_Log_046	Cast Depth		Time O/W		
Weather / Comments	All bottles fired					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Chloro	POC/N/P	HPLC	Photophy	RNA/DNA	N Cycle	Micro Expt	Salinity						
1	1	237	19:05								X						
2	2	237	19:05														
3	3	150	19:08								X						
4	4	149	19:08														
5	5	71	19:11								X						
6	6	71	19:11	X													
7	7	56	19:13														
8	8	56	19:13	X													
9	9	44	19:16														
10	10	44	19:16	X			X										
11	11	44	19:17														
12	12	44	19:17														
13	13	21	19:18														
14	14	21	19:18	X	X												
15	15	21	19:19														
16	16	21	19:19														
17	17	11	19:20														
18	18	11	19:21				X										
19	19	11	19:21														
20	20	11	19:22	X													
21	21	5	19:22														
22	22	6	19:23														
23	23	6	19:23														
24	24	5	19:23	X													
Sampler / Analyst				Sophie	Sophie	Mark	Laura	Cecelia	Darren	Polly	Jeff						

JR271 – CTD log

Station	28	CTD No	047	Date	23/6/12	CTD type: 24 bottles 20 litre Standard
Lat	76° 09.455 N	Event No	181	Time I/W	05:49	
Lon	26° 04.011 E	Depth	133	Time bottom	05:55	
Filename	JR271_CTD_Log_047	Cast Depth	125	Time O/W	06:17	
Weather / Comments	Bottles 7 and 20 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Oxygen	Carbonate pH	N_2O	DMS	TEP	DOC	Nutrients	DOM	Cytometry	Bact Prod	Calc/PP	Lugols	SEM	Psi/PIC
1	1	127	05:56		X		X		X								
2	2	126	05:57							X	X	X	X				
3	3	80	05:59				X	X	X								
4	4	80	06:00							X	X	X					
5	5	60	06:02		X		X		X								
6	6	60	06:02							X	X	X	X				
7	7	40	06:03			X			X								
8	8	40	06:04				X			X	X	X				X	
9	9	29	06:06		X		X	X	X								
10	10	29	06:06							X	X	X	X			X	
11	11	29	06:07			X											
12	12	29	06:07														
13	13	25	06:08		X		X		X								
14	14	25	06:09							X	X	X	X	X	X	X	X
15	15	20	06:10		X		X		X								
16	16	20	06:10													X	
17	17	20	06:11			X											
18	18	20	06:11							X	X	X					
19	19	9	06:12		X		X	X	X								
20	20	10	06:12													X	
21	21	9	06:13			X											
22	22	10	06:13							X	X	X	X				
23	23	5	06:14		X		X	X	X								
24	24	5	06:15							X	X	X	X			X	
Sampler / Analyst				Helen	Matt	Ian	Frances	Tingting	Tingting	Mario	Mario	Elaine	Ben	Alex	Alex	Jeremy	Jeremy

JR271 – CTD log

Station	28 (continued)	CTD No	047	Date	23/6/12	CTD type: 24 bottles 20 litre Standard
Lat		Event No		Time I/W		
Lon		Depth		Time bottom		
Filename	JR271_CTD_Log_047	Cast Depth		Time O/W		
Weather / Comments	Bottles 7 and 20 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Chloro	POC/N/P	HPLC	Photophy	RNA/DNA	N Cycle	Micro Expt	Salinity						
1	1	127	05:56								X						
2	2	126	05:57														
3	3	80	05:59								X						
4	4	80	06:00														
5	5	60	06:02								X						
6	6	60	06:02	X	X												
7	7	40	06:03														
8	8	40	06:04	X													
9	9	29	06:06														
10	10	29	06:06				X	X									
11	11	29	06:07														
12	12	29	06:07	X													
13	13	25	06:08														
14	14	25	06:09	X	X												
15	15	20	06:10														
16	16	20	06:10														
17	17	20	06:11														
18	18	20	06:11														
19	19	9	06:12														
20	20	10	06:12				X										
21	21	9	06:13														
22	22	10	06:13	X						X							
23	23	5	06:14														
24	24	5	06:15	X	X				X								
Sampler / Analyst				Sophie	Sophie	Mark	Laura	Cecelia	Darren	Polly	Jeff						

JR271 – CTD log

Station	29	CTD No	048	Date	23/6/12	CTD type: 24 bottles 20 litre Standard
Lat	74° 05.399 N	Event No	186	Time I/W	18:52	
Lon	25° 59.946 E	Depth	435	Time bottom	19:03	
Filename	JR271_CTD_Log_048	Cast Depth	418	Time O/W	19:25	
Weather / Comments	Bottles 19 and 22 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Oxygen	Carbonate pH	N_2O	DMS	TEP	DOC	Nutrients	DOM	Cytometry	Bact Prod	Calc/PP	Lugols	SEM	Psi/PIC
1	1	351	19:05		X				X								
2	2	351	19:05							X	X	X					
3	3	100	19:10		X		X		X								
4	4	101	19:11							X	X	X					
5	5	60	19:12		X		X	X	X								
6	6	60	19:13							X	X	X					
7	7	41	19:14		X		X		X								
8	8	42	19:15							X	X	X				X	
9	9	31	19:16		X		X	X	X								
10	10	31	19:16							X	X					X	
11	11	31	19:16						X								
12	12	31	19:17									X					
13	13	20	19:18		X		X										
14	14	21	19:18							X	X					X	
15	15	21	19:18														
16	16	21	19:19									X					
17	17	11	19:20		X		X	X	X								
18	18	11	19:20							X	X			X	X	X	X
19	19	11	19:20														
20	20	11	19:21									X					
21	21	6	19:22		X		X	X	X								
22	22	6	19:22													X	
23	23	6	19:22														
24	24	6	19:23							X	X	X					
Sampler / Analyst				Helen	Matt	Ian	Frances	Tingting	Tingting	Mario	Mario	Elaine	Ben	Alex	Alex	Jeremy	Jeremy

JR271 – CTD log

Station	29 (continued)	CTD No	048	Date	23/6/12	CTD type: 24 bottles 20 litre Standard
Lat		Event No		Time I/W		
Lon		Depth		Time bottom		
Filename	JR271_CTD_Log_048	Cast Depth		Time O/W		
Weather / Comments	Bottles 19 and 22 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Chloro	POC/N/P	HPLC	Photophy	RNA/DNA	N Cycle	Micro Expt	Salinity						
1	1	351	19:05								X						
2	2	351	19:05														
3	3	100	19:10								X						
4	4	101	19:11														
5	5	60	19:12								X						
6	6	60	19:13	X													
7	7	41	19:14														
8	8	42	19:15	X	X												
9	9	31	19:16														
10	10	31	19:16														
11	11	31	19:16														
12	12	31	19:17	X													
13	13	20	19:18														
14	14	21	19:18					X									
15	15	21	19:18														
16	16	21	19:19	X	X												
17	17	11	19:20														
18	18	11	19:20														
19	19	11	19:20														
20	20	11	19:21	X													
21	21	6	19:22														
22	22	6	19:22														
23	23	6	19:22														
24	24	6	19:23	X													
Sampler / Analyst				Sophie	Sophie	Mark	Laura	Cecelia	Darren	Polly	Jeff						

JR271 – CTD log

Station	30	CTD No	049	Date	24/6/12	CTD type: 24 bottles 10 litre Titanium
Lat	72° 53.497 N	Event No	188	Time I/W	01:59	
Lon	26° 00.091 E	Depth	364	Time bottom	02:05	
Filename	JR271_CTD_Log_049	Cast Depth	100	Time O/W	02:21	
Weather / Comments	All bottles fired					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Bioassay													
1	1	62	02:06	**X**													
2	2	61	02:07	**X**													
3	3	62	02:07	**X**													
4	4	61	02:08	**X**													
5	5	61	02:08	**X**													
6	6	61	02:08	**X**													
7	7	61	02:09	**X**													
8	8	11	02:13	**X**													
9	9	10	02:14	**X**													
10	10	10	02:14	**X**													
11	11	10	02:14	**X**													
12	12	10	02:15	**X**													
13	13	10	02:15	**X**													
14	14	10	02:15	**X**													
15	15	10	02:16	**X**													
16	16	10	02:16	**X**													
17	17	10	02:16	**X**													
18	18	11	02:17	**X**													
19	19	11	02:17	**X**													
20	20	11	02:17	**X**													
21	21	10	02:18	**X**													
22	22	11	02:18	**X**													
23	23	10	02:18	**X**													
24	24	10	02:19	**X**													
Sampler / Analyst				Mark													

JR271 – CTD log

Station	30	CTD No	050	Date	24/6/12	CTD type: 24 bottles 10 litre Titanium
Lat	72° 53.500 N	Event No	189	Time I/W	03:31	
Lon	26° 00.088 E	Depth	362	Time bottom	03:36	
Filename	JR271_CTD_Log_050	Cast Depth	100	Time O/W	03:53	
Weather / Comments	All bottles fired					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Bioassay													
1	1	61	03:38	**X**													
2	2	61	03:39	**X**													
3	3	9	03:43	**X**													
4	4	9	03:43	**X**													
5	5	9	03:44	**X**													
6	6	9	03:44	**X**													
7	7	9	03:44	**X**													
8	8	9	03:45	**X**													
9	9	9	03:45	**X**													
10	10	9	03:45	**X**													
11	11	9	03:46	**X**													
12	12	9	03:46	**X**													
13	13	9	03:46	**X**													
14	14	9	03:47	**X**													
15	15	9	03:47	**X**													
16	16	10	03:48	**X**													
17	17	9	03:48	**X**													
18	18	9	03:48	**X**													
19	19	9	03:49	**X**													
20	20	9	03:49	**X**													
21	21	9	03:49	**X**													
22	22	9	03:50	**X**													
23	23	9	03:50	**X**													
24	24	9	03:50	**X**													
Sampler / Analyst				Mark													

JR271 – CTD log

Station	30	CTD No	051	Date	24/6/12	CTD type: 24 bottles 10 litre Titanium
Lat	72° 53.496 N	Event No	190	Time I/W	05:27	
Lon	26° 00.090 E	Depth	362	Time bottom	05:31	
Filename	JR271_CTD_Log_051	Cast Depth	100	Time O/W	05:46	
Weather / Comments	All bottles fired					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Bioassay													
1	1	61	05:32	**X**													
2	2	61	05:33	**X**													
3	3	9	05:37	**X**													
4	4	9	05:37	**X**													
5	5	9	05:38	**X**													
6	6	9	05:38	**X**													
7	7	9	05:38	**X**													
8	8	9	05:39	**X**													
9	9	9	05:39	**X**													
10	10	9	05:39	**X**													
11	11	9	05:40	**X**													
12	12	9	05:40	**X**													
13	13	9	05:41	**X**													
14	14	9	05:41	**X**													
15	15	10	05:41	**X**													
16	16	9	05:41	**X**													
17	17	9	05:42	**X**													
18	18	9	05:42	**X**													
19	19	9	05:42	**X**													
20	20	8	05:43	**X**													
21	21	9	05:43	**X**													
22	22	9	05:43	**X**													
23	23	9	05:44	**X**													
24	24	9	05:44	**X**													
Sampler / Analyst				Mark													

JR271 – CTD log

Station	30	CTD No	052	Date	24/6/12	CTD type: 24 bottles 20 litre Standard
Lat	72° 53.325 N	Event No	195	Time I/W	06:50	
Lon	26° 00.302 E	Depth	361	Time bottom	06:59	
Filename	JR271_CTD_Log_052	Cast Depth	350	Time O/W	07:24	
Weather / Comments	Bottle 22 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Oxygen	Carbonate pH	N_2O	DMS	TEP	DOC	Nutrients	DOM	Cytometry	Bact Prod	Calc/PP	Lugols	SEM	Psi/PIC
1	1	352	06:59		X				X								
2	2	353	07:00							X	X	X					
3	3	151	07:04		X				X								
4	4	151	07:05							X	X	X					
5	5	100	07:07		X	X	X	X	X								
6	6	101	07:07							X	X	X	X				
7	7	51	07:09		X	X	X		X								
8	8	50	07:09							X	X	X	X			X	
9	9	41	07:11		X	X	X	X	X								
10	10	41	07:11							X	X	X	X			X	
11	11	26	07:12		X	X			X								
12	12	26	07:12							X	X	X				X	
13	13	25	07:13														
14	14	25	07:13														
15	15	16	07:17		X	X	X	X	X								
16	16	16	07:18							X	X	X	X				
17	17	16	07:18														
18	18	16	07:18											X	X	X	X
19	19	11	07:19		X	X	X		X								
20	20	11	07:20							X	X	X	X				
21	21	11	07:20													X	
22	22	11	07:20														
23	23	6	07:21		X	X	X	X	X								
24	24	6	07:22							X	X	X	X			X	
Sampler / Analyst				Helen	Matt	Ian	Frances	Tingting	Tingting	Mario	Mario	Elaine	Ben	Alex	Alex	Jeremy	Jeremy

JR271 – CTD log

Station	30 (continued)	CTD No	052	Date	24/6/12	CTD type: 24 bottles 20 litre Standard
Lat		Event No		Time I/W		
Lon		Depth		Time bottom		
Filename	JR271_CTD_Log_052	Cast Depth		Time O/W		
Weather / Comments	Bottle 22 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Chloro	POC/N/P	HPLC	Photophy	RNA/DNA	N Cycle	Micro Expt	Salinity						
1	1	352	06:59								X						
2	2	353	07:00														
3	3	151	07:04								X						
4	4	151	07:05														
5	5	100	07:07								X						
6	6	101	07:07														
7	7	51	07:09														
8	8	50	07:09	X	X												
9	9	41	07:11														
10	10	41	07:11	X													
11	11	26	07:12														
12	12	26	07:12	X													
13	13	25	07:13														
14	14	25	07:13														
15	15	16	07:17														
16	16	16	07:18														
17	17	16	07:18														
18	18	16	07:18	X	X					X							
19	19	11	07:19														
20	20	11	07:20	X													
21	21	11	07:20														
22	22	11	07:20														
23	23	6	07:21														
24	24	6	07:22	X	X				X								
Sampler / Analyst				Sophie	Sophie	Mark	Laura	Cecelia	Darren	Polly	Jeff						

JR271 – CTD log

Station	31	CTD No	053	Date	24/6/12	CTD type: 24 bottles 20 litre Standard
Lat	71° 44.882 N	Event No	200	Time I/W	18:54	
Lon	22° 58.326 E	Depth	377	Time bottom	19:04	
Filename	JR271_CTD_Log_053	Cast Depth	365	Time O/W	19:27	
Weather / Comments	Bottle 10 and 12 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Oxygen	Carbonate pH	N_2O	DMS	TEP	DOC	Nutrients	DOM	Cytometry	Bact Prod	Calc/PP	Lugols	SEM	Psi/PIC
1	1	316	19:06		X				X								
2	2	315	19:07							X	X	X					
3	3	149	19:11		X				X								
4	4	149	19:11							X	X	X					
5	5	75	19:14					X	X								
6	6	75	19:14							X	X	X				X	
7	7	51	19:15		X				X								
8	8	51	19:16							X	X	X				X	
9	9	25	19:17		X				X	X	X	X				X	
10	10	26	19:18														
11	11	21	19:18					X	X								
12	12	21	19:19														
13	13	21	19:19														
14	14	21	19:20							X	X	X					
15	15	16	19:21		X				X								
16	16	16	19:21							X	X					X	X
17	17	16	19:21														
18	18	16	19:22									X					
19	19	11	19:23					X	X								
20	20	11	19:23							X	X	X			X		
21	21	11	19:23														
22	22	11	19:24														
23	23	6	19:25		X			X	X								
24	24	6	19:25							X	X	X				X	
Sampler / Analyst				Helen	Matt	Ian	Frances	Tingting	Tingting	Mario	Mario	Elaine	Ben	Alex	Alex	Jeremy	Jeremy

JR271 – CTD log

Station	31 (continued)	CTD No	053	Date	24/6/12	CTD type: 24 bottles 20 litre Standard
Lat		Event No		Time I/W		
Lon		Depth		Time bottom		
Filename	JR271_CTD_Log_053	Cast Depth		Time O/W		
Weather / Comments	Bottle 10 and 12 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Chloro	POC/N/P	HPLC	Photophy	RNA/DNA	N Cycle	Micro Expt	Salinity						
1	1	316	19:06								**X**						
2	2	315	19:07														
3	3	149	19:11								**X**						
4	4	149	19:11														
5	5	75	19:14								**X**						
6	6	75	19:14														
7	7	51	19:15														
8	8	51	19:16	**X**													
9	9	25	19:17														
10	10	26	19:18	**X**													
11	11	21	19:18														
12	12	21	19:19														
13	13	21	19:19														
14	14	21	19:20	**X**	**X**												
15	15	16	19:21														
16	16	16	19:21				**X**										
17	17	16	19:21														
18	18	16	19:22	**X**													
19	19	11	19:23														
20	20	11	19:23	**X**	**X**												
21	21	11	19:23														
22	22	11	19:24														
23	23	6	19:25														
24	24	6	19:25	**X**													
Sampler / Analyst				Sophie	Sophie	Mark	Laura	Cecelia	Darren	Polly	Jeff						

JR271 – CTD log

Station	32	CTD No	054	Date	25/6/12	CTD type: 24 bottles 20 litre Standard
Lat	71° 45.120 N	Event No	205	Time I/W	06:06	
Lon	17° 54.041 E	Depth	284	Time bottom	06:14	
Filename	JR271_CTD_Log_054	Cast Depth	273	Time O/W	06:35	
Weather / Comments	Bottle 1, 6, 10, 12 and 17 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Oxygen	Carbonate pH	N_2O	DMS	TEP	DOC	Nutrients	DOM	Cytometry	Bact Prod	Calc/PP	Lugols	SEM	Psi/PIC
1	1	274	06:15									X					
2	2	274	06:15		X				X	X	X						
3	3	151	06:18		X				X								
4	4	150	06:19							X	X	X	X				
5	5	61	06:21		X	X	X	X	X	X	X	X	X				
6	6	61	06:22													X	
7	7	26	06:23		X	X	X		X								
8	8	26	06:24							X	X	X				X	
9	9	21	06:25		X	X	X	X	X			X	X				
10	10	21	06:25													X	
11	11	21	06:25							X	X						
12	12	21	06:26														
13	13	14	06:27					X	X								
14	14	14	06:27							X	X	X	X	X	X		
15	15	14	06:28		X	X	X									X	
16	16	14	06:28														
17	17	11	06:29														
18	18	11	06:29							X	X	X	X			X	X
19	19	11	06:30		X	X	X		X								
20	20	11	06:30														
21	21	5	06:31		X	X	X	X	X								
22	22	5	06:31							X	X	X	X				
23	23	6	06:32														
24	24	6	06:32													X	
Sampler / Analyst				Helen	Matt	Ian	Frances	Tingting	Tingting	Mario	Mario	Elaine	Ben	Alex	Alex	Jeremy	Jeremy

JR271 – CTD log

Station	32 (continued)	CTD No	054	Date	25/6/12	CTD type: 24 bottles 20 litre Standard
Lat		Event No		Time I/W		
Lon		Depth		Time bottom		
Filename	JR271_CTD_Log_054	Cast Depth		Time O/W		
Weather / Comments	Bottle 1, 6, 10, 12 and 17 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Chloro	POC/N/P	HPLC	Photophy	RNA/DNA	N Cycle	Micro Expt	Salinity						
1	1	274	06:15														
2	2	274	06:15								X						
3	3	151	06:18								X						
4	4	150	06:19		X												
5	5	61	06:21	X							X						
6	6	61	06:22														
7	7	26	06:23														
8	8	26	06:24	X													
9	9	21	06:25	X													
10	10	21	06:25														
11	11	21	06:25														
12	12	21	06:26														
13	13	14	06:27														
14	14	14	06:27	X	X												
15	15	14	06:28														
16	16	14	06:28														
17	17	11	06:29														
18	18	11	06:29							X							
19	19	11	06:30														
20	20	11	06:30	X													
21	21	5	06:31														
22	22	5	06:31														
23	23	6	06:32														
24	24	6	06:32	X	X				X								
Sampler / Analyst				Sophie	Sophie	Mark	Laura	Cecelia	Darren	Polly	Jeff						

JR271 – CTD log

Station	33	CTD No	055	Date	25/6/12	CTD type: 24 bottles 20 litre Standard
Lat	71° 45.608 N	Event No	212	Time I/W	18:58	
Lon	13° 23.610 E	Depth	1857	Time bottom	19:09	
Filename	JR271_CTD_Log_055	Cast Depth	500	Time O/W	19:35	
Weather / Comments	Bottles 4 and 20 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Oxygen	Carbonate pH	N_2O	DMS	TEP	DOC	Nutrients	DOM	Cytometry	Bact Prod	Calc/PP	Lugols	SEM	Psi/PIC
1	1	501	19:10		X				X								
2	2	501	19:10							X	X	X					
3	3	350	19:14		X				X	X	X	X					
4	4	350	19:14														
5	5	150	19:19		X				X								
6	6	150	19:19							X	X	X					
7	7	51	19:22		X		X		X								
8	8	50	19:22							X	X	X				X	
9	9	26	19:23		X		X		X								
10	10	26	19:24							X	X	X				X	
11	11	20	19:25		X												
12	12	20	19:25							X	X					X	
13	13	20	19:26				X	X	X								
14	14	20	19:26									X					
15	15	14	19:28		X												
16	16	14	19:28							X	X				X	X	X
17	17	14	19:29				X	X	X								
18	18	14	19:29									X					
19	19	10	19:30		X				X	X	X						
20	20	10	19:31													X	
21	21	10	19:31				X										
22	22	10	19:32									X					
23	23	5	19:32		X		X	X	X								
24	24	5	19:33							X	X	X				X	
Sampler / Analyst				Helen	Matt	Ian	Frances	Tingting	Tingting	Mario	Mario	Elaine	Ben	Alex	Alex	Jeremy	Jeremy

JR271 – CTD log

Station	33 (continued)	CTD No	055	Date	25/6/12	CTD type: 24 bottles 20 litre Standard
Lat		Event No		Time I/W		
Lon		Depth		Time bottom		
Filename	JR271_CTD_Log_055	Cast Depth		Time O/W		
Weather / Comments	Bottles 4 and 20 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Chloro	POC/N/P	HPLC	Photophy	RNA/DNA	N Cycle	Micro Expt	Salinity						
1	1	501	19:10								**X**						
2	2	501	19:10														
3	3	350	19:14								**X**						
4	4	350	19:14														
5	5	150	19:19								**X**						
6	6	150	19:19														
7	7	51	19:22														
8	8	50	19:22														
9	9	26	19:23														
10	10	26	19:24														
11	11	20	19:25														
12	12	20	19:25														
13	13	20	19:26														
14	14	20	19:26														
15	15	14	19:28														
16	16	14	19:28	**X**	**X**		**X**	**X**									
17	17	14	19:29														
18	18	14	19:29														
19	19	10	19:30														
20	20	10	19:31	**X**													
21	21	10	19:31														
22	22	10	19:32														
23	23	5	19:32														
24	24	5	19:33	**X**													
Sampler / Analyst				Sophie	Sophie	Mark	Laura	Cecelia	Darren	Polly	Jeff						

JR271 – CTD log

Station	34	CTD No	056	Date	26/6/12	CTD type: 24 bottles 20 litre Standard
Lat	71° 44.854 N	Event No	217	Time I/W	05:55	
Lon	08° 26.563 E	Depth	2736	Time bottom	06:06	
Filename	JR271_CTD_Log_056	Cast Depth	500	Time O/W	06:35	
Weather / Comments	Bottle 13 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Oxygen	Carbonate pH	N_2O	DMS	TEP	DOC	Nutrients	DOM	Cytometry	Bact Prod	Calc/PP	Lugols	SEM	Psi/PIC
1	1	502	06:07	X	X				X								
2	2	502	06:08							X	X	X					
3	3	350	06:12	X	X				X								
4	4	350	06:12							X	X	X					
5	5	110	06:17	X	X				X								
6	6	110	06:18							X	X	X	X			X	
7	7	50	06:20	X	X		X	X	X								
8	8	50	06:20							X	X	X	X			X	
9	9	30	06:22	X	X				X								
10	10	30	06:22							X	X					X	
11	11	30	06:23				X										
12	12	30	06:23									X	X				
13	13	19	06:26														
14	14	19	06:26							X	X	X	X			X	
15	15	19	06:26	X	X		X	X									
16	16	19	06:27														
17	17	15	06:28		X				X								
18	18	15	06:28							X	X	X		X	X	X	X
19	19	10	06:29		X			X	X								
20	20	10	06:30							X	X					X	
21	21	10	06:30				X										
22	22	10	06:31									X	X				
23	23	5	06:32	X	X		X	X	X								
24	24	5	06:32							X	X	X	X			X	
Sampler / Analyst				Helen	Matt	Ian	Frances	Tingting	Tingting	Mario	Mario	Elaine	Ben	Alex	Alex	Jeremy	Jeremy

JR271 – CTD log

Station	34 (continued)	CTD No	056	Date	26/6/12	CTD type: 24 bottles 20 litre Standard
Lat		Event No		Time I/W		
Lon		Depth		Time bottom		
Filename	JR271_CTD_Log_056	Cast Depth		Time O/W		
Weather / Comments	Bottle 13 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Chloro	POC/N/P	HPLC	Photophy	RNA/DNA	N Cycle	Micro Expt	Salinity						
1	1	502	06:07								X						
2	2	502	06:08														
3	3	350	06:12								X						
4	4	350	06:12														
5	5	110	06:17								X						
6	6	110	06:18		X												
7	7	50	06:20														
8	8	50	06:20	X													
9	9	30	06:22														
10	10	30	06:22	X	X												
11	11	30	06:23														
12	12	30	06:23														
13	13	19	06:26														
14	14	19	06:26	X			X	X									
15	15	19	06:26														
16	16	19	06:27														
17	17	15	06:28														
18	18	15	06:28	X	X					X							
19	19	10	06:29														
20	20	10	06:30	X													
21	21	10	06:30														
22	22	10	06:31														
23	23	5	06:32														
24	24	5	06:32	X													
Sampler / Analyst				Sophie	Sophie	Mark	Laura	Cecelia	Darren	Polly	Jeff						

JR271 – CTD log

Station	35	CTD No	057	Date	26/6/12	CTD type: 24 bottles 20 litre Standard
Lat	71° 45.121 N	Event No	224	Time I/W	18:55	
Lon	03° 52.208 E	Depth	3080	Time bottom	19:06	
Filename	JR271_CTD_Log_057	Cast Depth	500	Time O/W	19:33	
Weather / Comments	Bottles 12 and 15 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Oxygen	Carbonate pH	N_2O	DMS	TEP	DOC	Nutrients	DOM	Cytometry	Bact Prod	Calc/PP	Lugols	SEM	Psi/PIC
1	1	502	19:07		X				X								
2	2	502	19:08							X	X	X					
3	3	351	19:11		X				X								
4	4	350	19:11							X	X	X					
5	5	151	19:16		X				X								
6	6	151	19:16							X	X	X					
7	7	71	19:19		X		X	X	X								
8	8	71	19:19							X	X	X					
9	9	36	19:21		X			X	X								
10	10	36	19:21							X	X	X				X	
11	11	36	19:22				X										
12	12	36	19:22														
13	13	21	19:23		X		X	X	X								
14	14	21	19:23							X	X						
15	15	21	19:24														
16	16	21	19:24									X				X	
17	17	16	19:25		X		X		X								
18	18	16	19:26							X	X	X			X	X	X
19	19	11	19:27		X			X	X								
20	20	11	19:27							X	X						
21	21	11	19:28				X										
22	22	11	19:28									X				X	
23	23	6	19:29		X		X	X	X								
24	24	6	19:30							X	X	X				X	
Sampler / Analyst				Helen	Matt	Ian	Frances	Tingting	Tingting	Mario	Mario	Elaine	Ben	Alex	Alex	Jeremy	Jeremy

JR271 – CTD log

Station	35 (continued)	CTD No	057	Date	26/6/12	CTD type: 24 bottles 20 litre Standard
Lat		Event No		Time I/W		
Lon		Depth		Time bottom		
Filename	JR271_CTD_Log_057	Cast Depth		Time O/W		
Weather / Comments	Bottles 12 and 15 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Chloro	POC/N/P	HPLC	Photophy	RNA/DNA	N Cycle	Micro Expt	Salinity						
1	1	502	19:07								X						
2	2	502	19:08														
3	3	351	19:11								X						
4	4	350	19:11														
5	5	151	19:16								X						
6	6	151	19:16														
7	7	71	19:19														
8	8	71	19:19	X													
9	9	36	19:21														
10	10	36	19:21	X													
11	11	36	19:22														
12	12	36	19:22														
13	13	21	19:23														
14	14	21	19:23					X									
15	15	21	19:24														
16	16	21	19:24	X													
17	17	16	19:25														
18	18	16	19:26	X	X												
19	19	11	19:27														
20	20	11	19:27	X													
21	21	11	19:28														
22	22	11	19:28														
23	23	6	19:29														
24	24	6	19:30	X													
Sampler / Analyst				Sophie	Sophie	Mark	Laura	Cecelia	Darren	Polly	Jeff						

JR271 – CTD log

Station	36	CTD No	058	Date	27/6/12	CTD type: 24 bottles 20 litre Standard
Lat	71° 44.720 N	Event No	229	Time I/W	05:58	
Lon	01° 16.037 W	Depth	1784	Time bottom	06:09	
Filename	JR271_CTD_Log_058	Cast Depth	500	Time O/W	06:40	
Weather / Comments	Bottles 3 and 18 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Oxygen	Carbonate pH	N_2O	DMS	TEP	DOC	Nutrients	DOM	Cytometry	Bact Prod	Calc/PP	Lugols	SEM	Psi/PIC
1	1	502	06:10		X				X								
2	2	502	06:10							X	X	X					
3	3	350	06:15														
4	4	350	06:15		X				X	X	X	X					
5	5	225	06:19		X				X								
6	6	226	06:19							X	X	X					
7	7	126	06:22		X	X		X	X								
8	8	126	06:23							X	X	X	X				
9	9	46	06:26		X	X	X	X	X								
10	10	46	06:26							X	X	X	X			X	
11	11	34	06:29		X	X		X	X								
12	12	35	06:29							X	X	X	X				
13	13	34	06:30				X										
14	14	34	06:30													X	
15	15	21	06:31		X	X	X	X	X								
16	16	20	06:32							X	X	X	X	X	X	X	
17	17	16	06:33		X		X		X	X	X	X	X			X	X
18	18	16	06:33														
19	19	11	06:34		X	X		X	X								
20	20	11	06:35							X	X	X	X			X	
21	21	11	06:35				X										
22	22	11	06:36														
23	23	6	06:37		X	X	X	X	X	X	X						
24	24	6	06:37									X	X			X	
Sampler / Analyst				Helen	Matt	Ian	Frances	Tingting	Tingting	Mario	Mario	Elaine	Ben	Alex	Alex	Jeremy	Jeremy

JR271 – CTD log

Station	36 (continued)	CTD No	058	Date	27/6/12	CTD type: 24 bottles 20 litre Standard
Lat		Event No		Time I/W		
Lon		Depth		Time bottom		
Filename	JR271_CTD_Log_058	Cast Depth		Time O/W		
Weather / Comments	Bottles 3 and 18 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Chloro	POC/N/P	HPLC	Photophy	RNA/DNA	N Cycle	Micro Expt	Salinity						
1	1	502	06:10								X						
2	2	502	06:10														
3	3	350	06:15														
4	4	350	06:15								X						
5	5	225	06:19								X						
6	6	226	06:19														
7	7	126	06:22														
8	8	126	06:23	X	X												
9	9	46	06:26														
10	10	46	06:26	X													
11	11	34	06:29														
12	12	35	06:29						X								
13	13	34	06:30														
14	14	34	06:30	X													
15	15	21	06:31														
16	16	20	06:32	X	X					X							
17	17	16	06:33														
18	18	16	06:33	X													
19	19	11	06:34														
20	20	11	06:35														
21	21	11	06:35														
22	22	11	06:36														
23	23	6	06:37														
24	24	6	06:37	X	X				X								
Sampler / Analyst				Sophie	Sophie	Mark	Laura	Cecelia	Darren	Polly	Jeff						

JR271 – CTD log

Station	37	CTD No	059	Date	27/6/12	CTD type: 24 bottles 20 litre Standard
Lat	71° 45.104 N	Event No	236	Time I/W	18:49	
Lon	05° 51.838 W	Depth	2348	Time bottom	19:00	
Filename	JR271_CTD_Log_059	Cast Depth	500	Time O/W	19:30	
Weather / Comments	Bottles 17 and 20 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Oxygen	Carbonate pH	N_2O	DMS	TEP	DOC	Nutrients	DOM	Cytometry	Bact Prod	Calc/PP	Lugols	SEM	Psi/PIC
1	1	501	19:01		X				X								
2	2	501	19:02							X	X	X					
3	3	301	19:07		X				X								
4	4	301	19:08							X	X	X					
5	5	100	19:12		X				X								
6	6	100	19:13							X	X	X					
7	7	70	19:14		X		X	X	X								
8	8	70	19:15							X	X	X					
9	9	36	19:17		X		X		X								
10	10	36	19:17							X	X	X				X	
11	11	26	19:19		X		X	X	X								
12	12	26	19:19							X	X	X					
13	13	26	19:20														
14	14	26	19:20												X	X	
15	15	20	19:21		X		X		X								
16	16	20	19:22							X	X	X				X	
17	17	15	19:22														
18	18	15	19:23				X			X	X	X			X	X	X
19	19	10	19:24		X		X	X	X	X	X						
20	20	10	19:24													X	
21	21	10	19:25									X					
22	22	10	19:25														
23	23	5	19:26		X		X	X	X								
24	24	5	19:27							X	X	X				X	
Sampler / Analyst				Helen	Matt	Ian	Frances	Tingting	Tingting	Mario	Mario	Elaine	Ben	Alex	Alex	Jeremy	Jeremy

JR271 – CTD log

Station	37 (continued)	CTD No	059	Date	27/6/12	CTD type: 24 bottles 20 litre Standard
Lat		Event No		Time I/W		
Lon		Depth		Time bottom		
Filename	JR271_CTD_Log_059	Cast Depth		Time O/W		
Weather / Comments	Bottles 17 and 20 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Chloro	POC/N/P	HPLC	Photophy	RNA/DNA	N Cycle	Micro Expt	Salinity						
1	1	501	19:01								**X**						
2	2	501	19:02														
3	3	301	19:07								**X**						
4	4	301	19:08														
5	5	100	19:12								**X**						
6	6	100	19:13														
7	7	70	19:14														
8	8	70	19:15	**X**	**X**												
9	9	36	19:17														
10	10	36	19:17	**X**													
11	11	26	19:19														
12	12	26	19:19														
13	13	26	19:20														
14	14	26	19:20	**X**				**X**									
15	15	20	19:21														
16	16	20	19:22	**X**													
17	17	15	19:22														
18	18	15	19:23	**X**													
19	19	10	19:24														
20	20	10	19:24														
21	21	10	19:25														
22	22	10	19:25														
23	23	5	19:26														
24	24	5	19:27	**X**													
Sampler / Analyst				Sophie	Sophie	Mark	Laura	Cecelia	Darren	Polly	Jeff						

JR271 – CTD log

Station	38	CTD No	060	Date	28/6/12	CTD type: 24 bottles 20 litre Standard
Lat	71° 44.899 N	Event No	241	Time I/W	05:52	
Lon	10° 35.839 W	Depth	2387	Time bottom	06:02	
Filename	JR271_CTD_Log_060	Cast Depth	500	Time O/W	06:33	
Weather / Comments	Bottles 14 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Oxygen	Carbonate pH	N_2O	DMS	TEP	DOC	Nutrients	DOM	Cytometry	Bact Prod	Calc/PP	Lugols	SEM	Psi/PIC
1	1	503	06:03	X	X				X								
2	2	502	06:04							X	X	X					
3	3	300	06:08	X	X				X								
4	4	300	06:09							X	X	X					
5	5	121	06:13	X	X				X								
6	6	121	06:13							X	X	X					
7	7	76	06:15		X			X	X								
8	8	76	06:16							X	X	X	X			X	
9	9	50	06:17		X		X		X								
10	10	50	06:17							X	X	X	X			X	
11	11	35	06:19		X			X	X								
12	12	35	06:19							X	X	X	X		X	X	
13	13	35	06:20				X										
14	14	35	06:20														
15	15	26	06:21				X		X								
16	16	26	06:22							X	X	X		X	X	X	X
17	17	16	06:23						X								
18	18	16	06:23							X	X	X	X			X	
19	19	12	06:24	X	X			X	X								
20	20	12	06:25							X	X					X	
21	21	12	06:25				X										
22	22	12	06:26									X	X				
23	23	6	06:27	X	X		X	X	X								
24	24	6	06:27							X	X	X	X				
Sampler / Analyst				Helen	Matt	Ian	Frances	Tingting	Tingting	Mario	Mario	Elaine	Ben	Alex	Alex	Jeremy	Jeremy

JR271 – CTD log

Station	38 (continued)	CTD No	060	Date	28/6/12	CTD type: 24 bottles 20 litre Standard
Lat		Event No		Time I/W		
Lon		Depth		Time bottom		
Filename	JR271_CTD_Log_060	Cast Depth		Time O/W		
Weather / Comments	Bottles 14 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Chloro	POC/N/P	HPLC	Photophy	RNA/DNA	N Cycle	Micro Expt	Salinity						
1	1	503	06:03								X						
2	2	502	06:04														
3	3	300	06:08								X						
4	4	300	06:09														
5	5	121	06:13								X						
6	6	121	06:13		X												
7	7	76	06:15														
8	8	76	06:16	X													
9	9	50	06:17														
10	10	50	06:17	X													
11	11	35	06:19														
12	12	35	06:19	X			X										
13	13	35	06:20														
14	14	35	06:20														
15	15	26	06:21														
16	16	26	06:22	X	X												
17	17	16	06:23														
18	18	16	06:23	X													
19	19	12	06:24														
20	20	12	06:25	X	X												
21	21	12	06:25														
22	22	12	06:26				X		X								
23	23	6	06:27														
24	24	6	06:27														
Sampler / Analyst				Sophie	Sophie	Mark	Laura	Cecelia	Darren	Polly	Jeff						

JR271 – CTD log

Station	38	CTD No	061	Date	28/6/12	CTD type: 24 bottles 10 litre Titanium
Lat	71° 45.010	Event No	243	Time I/W	07:03	
Lon	10° 34.530	Depth	2388	Time bottom	07:54	
Filename	JR271_CTD_Log_061	Cast Depth	2330	Time O/W	09:09	
Weather / Comments						

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Nutrients	DOM	Trace Metals	Carbonate Calibr	Oxygen Calibr	Thorium	Salinity							
1	1	2180	07:45	X		X											
2	2	2330	07:54	X		X											
3	3	2300	07:57	X		X		X									
4	4	1900	08:05	X		X											
5	5	1700	08:10	X		X											
6	6	1500	08:16	X		X		X		X							
7	7	1301	08:20	X		X											
8	8	1101	08:25	X		X											
9	9	902	08:30	X		X											
10	10	702	08:35	X		X		X									
11	11	601	08:38	X		X		X									
12	12	502	08:41	X		X		X									
13	13	400	08:46	X		X			X	X							
14	14	301	08:49	X		X											
15	15	201	08:52	X		X				X							
16	16	151	08:54	X		X			X	X							
17	17	101	08:56	X		X			X								
18	18	80	08:58	X		X			X								
19	19	60	08:59	X		X			X	X							
20	20	50	09:00	X		X			X	X							
21	21	40	09:02	X		X			X	X							
22	22	30	09:03	X		X			X	X							
23	23	20	09:04	X		X			X	X							
24	24	10	09:06	X		X			X	X							
Sampler / Analyst				Mario	Mario	Eric	Eithne	Matt	Fred	Jeff							

JR271 – CTD log

Station	39	CTD No	062	Date	28/6/12	CTD type: 24 bottles 20 litre Standard
Lat	70° 30.497 N	Event No	248	Time I/W	19:18	
Lon	10° 06.008 W	Depth	1242	Time bottom	19:29	
Filename	JR271_CTD_Log_062	Cast Depth	500	Time O/W	19:57	
Weather / Comments	All bottles fired					

Fire Seq	*Bot. No.*	*Depth (m)*	*Time (GMT)*	Oxygen	Carbonate pH	N_2O	DMS	TEP	DOC	Nutrients	DOM	Cytometry	Bact Prod	Calc/PP	Lugols	SEM	Psi/PIC
1	1	502	19:30						X								
2	2	502	19:30							X	X	X					
3	3	351	19:34		X				X								
4	4	351	19:34							X	X	X					
5	5	151	19:39		X				X								
6	6	151	19:39							X	X	X					
7	7	82	19:41		X			X	X								
8	8	81	19:42							X	X	X				X	
9	9	51	19:44		X			X	X								
10	10	50	19:44							X	X	X					
11	11	51	19:45														
12	12	50	19:45													X	
13	13	40	19:46						X								
14	14	40	19:47							X	X	X				X	
15	15	32	19:48		X			X	X								
16	16	32	19:48							X	X	X				X	
17	17	20	19:49		X				X								
18	18	20	19:50							X	X	X				X	X
19	19	10	19:51		X			X	X								
20	20	11	19:51							X	X	X			X	X	
21	21	11	19:52														
22	22	11	19:52														
23	23	5	19:53		X			X	X								
24	24	5	19:54							X	X	X					
Sampler / Analyst				Helen	Matt	Ian	Frances	Tingting	Tingting	Mario	Mario	Elaine	Ben	Alex	Alex	Jeremy	Jeremy

JR271 – CTD log

Station	39 (continued)	CTD No	062	Date	28/6/12	CTD type: 24 bottles 20 litre Standard
Lat		Event No		Time I/W		
Lon		Depth		Time bottom		
Filename	JR271_CTD_Log_062	Cast Depth		Time O/W		
Weather / Comments	All bottles fired					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Chloro	POC/N/P	HPLC	Photophy	RNA/DNA	N Cycle	Micro Expt	Salinity						
1	1	502	19:30								X						
2	2	502	19:30														
3	3	351	19:34								X						
4	4	351	19:34														
5	5	151	19:39								X						
6	6	151	19:39														
7	7	82	19:41														
8	8	81	19:42	X													
9	9	51	19:44														
10	10	50	19:44					X									
11	11	51	19:45														
12	12	50	19:45	X	X												
13	13	40	19:46														
14	14	40	19:47	X													
15	15	32	19:48														
16	16	32	19:48	X													
17	17	20	19:49														
18	18	20	19:50	X													
19	19	10	19:51														
20	20	11	19:51	X													
21	21	11	19:52														
22	22	11	19:52														
23	23	5	19:53														
24	24	5	19:54														
Sampler / Analyst				Sophie	Sophie	Mark	Laura	Cecelia	Darren	Polly	Jeff						

JR271 – CTD log

Station	40	CTD No	063	Date	29/6/12	CTD type: 24 bottles 20 litre Standard
Lat	68° 41.703 N	Event No	253	Time I/W	05:56	
Lon	10° 34.570 W	Depth	2193	Time bottom	06:06	
Filename	JR271_CTD_Log_062	Cast Depth	500	Time O/W	06:35	
Weather / Comments	Bottles 17 and 19 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Oxygen	Carbonate pH	N_2O	DMS	TEP	DOC	Nutrients	DOM	Cytometry	Bact Prod	Calc/PP	Lugols	SEM	Psi/PIC
1	1	502	06:07	X	X				X								
2	2	502	06:08							X	X	X					
3	3	350	06:11	X	X	X			X								
4	4	350	06:12							X	X	X					
5	5	151	06:16	X	X	X			X								
6	6	151	06:16							X	X	X					
7	7	76	06:19	X	X	X	X	X	X								
8	8	76	06:19							X	X	X	X			X	
9	9	46	06:21		X	X	X		X								
10	10	46	06:21							X	X	X	X			X	
11	11	30	06:23	X	X	X	X	X	X								
12	12	30	06:24							X	X	X	X			X	
13	13	30	06:24														
14	14	30	06:25														
15	15	21	06:26		X	X	X		X								
16	16	21	06:26							X	X	X	X	X	X	X	X
17	17	21	06:27														
18	18	21	06:27														
19	19	11	06:28														
20	20	11	06:29									X	X				
21	21	11	06:29		X	X	X	X	X								
22	22	11	06:30							X	X					X	
23	23	6	06:31	X	X	X	X	X	X								
24	24	6	06:32							X	X	X	X			X	
Sampler / Analyst				Helen	Matt	Ian	Frances	Tingting	Tingting	Mario	Mario	Elaine	Ben	Alex	Alex	Jeremy	Jeremy

JR271 – CTD log

Station	40 (continued)	CTD No	063	Date	29/6/12	CTD type: 24 bottles 20 litre Standard
Lat		Event No		Time I/W		
Lon		Depth		Time bottom		
Filename	JR271_CTD_Log_063	Cast Depth		Time O/W		
Weather / Comments	Bottles 17 and 19 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Chloro	POC/N/P	HPLC	Photophy	RNA/DNA	N Cycle	Micro Expt	Salinity						
1	1	502	06:07								X						
2	2	502	06:08														
3	3	350	06:11								X						
4	4	350	06:12														
5	5	151	06:16								X						
6	6	151	06:16		X												
7	7	76	06:19														
8	8	76	06:19	X													
9	9	46	06:21														
10	10	46	06:21	X													
11	11	30	06:23														
12	12	30	06:24	X	X												
13	13	30	06:24														
14	14	30	06:25														
15	15	21	06:26														
16	16	21	06:26	X													
17	17	21	06:27														
18	18	21	06:27							X							
19	19	11	06:28														
20	20	11	06:29														
21	21	11	06:29														
22	22	11	06:30	X													
23	23	6	06:31														
24	24	6	06:32	X	X				X								
Sampler / Analyst				Sophie	Sophie	Mark	Laura	Cecelia	Darren	Polly	Jeff						

JR271 – CTD log

Station	41	CTD No	064	Date	29/6/12	CTD type: 24 bottles 20 litre Standard
Lat	67° 50.062 N	Event No	260	Time I/W	18:46	
Lon	12° 10.448 W	Depth	1878	Time bottom	18:57	
Filename	JR271_CTD_Log_064	Cast Depth	500	Time O/W	19:27	
Weather / Comments	Bottles 17, 19, 20 and 22 leaked					

Fire Seq	*Bot. No.*	*Depth (m)*	*Time (GMT)*	Oxygen	Carbonate pH	N_2O	DMS	TEP	DOC	Nutrients	DOM	Cytometry	Bact Prod	Calc/PP	Lugols	SEM	Psi/PIC
1	1	502	18:58		X				X								
2	2	502	18:59									X					
3	3	351	19:02		X				X								
4	4	351	19:03									X					
5	5	101	19:08		X				X								
6	6	101	19:09									X					
7	7	51	19:11		X			X	X								
8	8	51	19:11									X				X	
9	9	39	19:13		X			X	X								
10	10	39	19:14												X	X	
11	11	39	19:14														
12	12	39	19:15									X					
13	13	31	19:16		X				X								
14	14	31	19:17									X				X	
15	15	21	19:18		X			X	X								
16	16	21	19:18									X				X	X
17	17	16	19:19														
18	18	16	19:20									X					
19	19	11	19:21		X										X		
20	20	11	19:21													X	
21	21	11	19:22					X	X			X					
22	22	11	19:22														
23	23	5	19:23		X			X	X								
24	24	5	19:24									X					
Sampler / Analyst				Helen	Matt	Ian	Frances	Tingting	Tingting	Mario	Mario	Elaine	Ben	Alex	Alex	Jeremy	Jeremy

JR271 – CTD log

Station	41 (continued)	CTD No	064	Date	29/6/12	CTD type: 24 bottles 20 litre Standard
Lat		Event No		Time I/W		
Lon		Depth		Time bottom		
Filename	JR271_CTD_Log_064	Cast Depth		Time O/W		
Weather / Comments	Bottles 17, 19, 20 and 22 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Chloro	POC/N/P	HPLC	Photophy	RNA/DNA	N Cycle	Micro Expt	Salinity						
1	1	502	18:58								**X**						
2	2	502	18:59														
3	3	351	19:02								**X**						
4	4	351	19:03														
5	5	101	19:08								**X**						
6	6	101	19:09														
7	7	51	19:11														
8	8	51	19:11														
9	9	39	19:13														
10	10	39	19:14				**X**	**X**									
11	11	39	19:14														
12	12	39	19:15														
13	13	31	19:16														
14	14	31	19:17														
15	15	21	19:18														
16	16	21	19:18														
17	17	16	19:19														
18	18	16	19:20														
19	19	11	19:21														
20	20	11	19:21														
21	21	11	19:22														
22	22	11	19:22														
23	23	5	19:23														
24	24	5	19:24														
Sampler / Analyst				Sophie	Sophie	Mark	Laura	Cecelia	Darren	Polly	Jeff						

JR271 – CTD log

Station	42	CTD No	065	Date	30/6/12	CTD type: 24 bottles 20 litre Standard
Lat	67° 49.830 N	Event No	265	Time I/W	05:57	
Lon	16° 25.300 W	Depth	1061	Time bottom	06:09	
Filename	JR271_CTD_Log_065	Cast Depth	500	Time O/W	06:39	
Weather / Comments	Bottle 3 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Oxygen	Carbonate pH	N_2O	DMS	TEP	DOC	Nutrients	DOM	Cytometry	Bact Prod	Calc/PP	Lugols	SEM	Psi/PIC
1	1	501	06:10		X				X								
2	2	502	06:10									X					
3	3	301	06:15		X												
4	4	301	06:16						X			X					
5	5	151	06:19		X	X			X								
6	6	151	06:20									X				X	
7	7	51	06:23		X	X	X	X	X								
8	8	51	06:23									X					
9	9	33	06:25		X			X	X								
10	10	33	06:25									X					
11	11	33	06:26			X	X										
12	12	33	06:26														
13	13	25	06:27		X	X	X		X								
14	14	25	06:28									X				X	
15	15	20	06:29		X		X	X	X								
16	16	20	06:29									X		X	X	X	X
17	17	15	06:30			X	X		X								
18	18	15	06:31									X				X	
19	19	10	06:32		X			X	X								
20	20	10	06:32									X					
21	21	10	06:33			X	X										
22	22	10	06:33													X	
23	23	5	06:34		X	X	X	X	X							X	
24	24	5	06:35									X					
Sampler / Analyst				Helen	Matt	Ian	Frances	Tingting	Tingting	Mario	Mario	Elaine	Ben	Alex	Alex	Jeremy	Jeremy

JR271 – CTD log

Station	42 (continued)	CTD No	065	Date	30/6/12	CTD type: 24 bottles 20 litre Standard
Lat		Event No		Time I/W		
Lon		Depth		Time bottom		
Filename	JR271_CTD_Log_065	Cast Depth		Time O/W		
Weather / Comments	Bottle 3 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Chloro	POC/N/P	HPLC	Photophy	RNA/DNA	N Cycle	Micro Expt	Salinity						
1	1	501	06:10								X						
2	2	502	06:10														
3	3	301	06:15														
4	4	301	06:16								X						
5	5	151	06:19								X						
6	6	151	06:20														
7	7	51	06:23														
8	8	51	06:23														
9	9	33	06:25														
10	10	33	06:25				X	X									
11	11	33	06:26														
12	12	33	06:26														
13	13	25	06:27														
14	14	25	06:28														
15	15	20	06:29														
16	16	20	06:29														
17	17	15	06:30														
18	18	15	06:31														
19	19	10	06:32														
20	20	10	06:32														
21	21	10	06:33														
22	22	10	06:33														
23	23	5	06:34							X							
24	24	5	06:35						X								
Sampler / Analyst				Sophie	Sophie	Mark	Laura	Cecelia	Darren	Polly	Jeff						

JR271 – CTD log

Station	42	CTD No	066	Date	30/6/12	CTD type: 24 bottles 10 litre Titanium
Lat	67° 49.829	Event No	267	Time I/W	07:11	
Lon	16° 25.301	Depth	1062	Time bottom	07:31	
Filename	JR271_CTD_Log_066	Cast Depth	1026	Time O/W	08:10	
Weather / Comments						

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Nutrients	DOM	Trace Metals	Carbonate Calibr	Oxygen Calibr	Thorium	Salinity							
1	1	1026	07:32	X		X				X							
2																	
3	2	900	07:36	X		X											
4	3	800	07:39	X		X											
5																	
6	4	700	07:42	X		X				X							
7																	
8	5	500	07:47	X		X			X								
9																	
10	6	399	07:50	X		X											
11																	
12	7	300	07:53	X		X				X							
13																	
14	8	200	07:56	X		X			X	X							
15																	
16	9	151	07:59	X		X			X	X							
17	10	101	08:01	X		X			X	X							
18																	
19	11	80	08:03	X		X			X								
20																	
21	12	60	08:04	X		X			X								
22	13	41	08:06	X		X			X	X							
23																	
24	14	21	08:07	X		X			X	X							
Sampler / Analyst				Mario	Mario	Eric	Eithne	Matt	Fred	Jeff							

JR271 – CTD log

Station	43	CTD No	067	Date	30/6/12	CTD type: 24 bottles 20 litre Standard
Lat	67° 49.890 N	Event No	272	Time I/W	18:49	
Lon	20° 03.860 W	Depth	855	Time bottom	19:01	
Filename	JR271_CTD_Log_067	Cast Depth	500	Time O/W	19:32	
Weather / Comments	Bottle 18 and 23 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Oxygen	Carbonate pH	N_2O	DMS	TEP	DOC	Nutrients	DOM	Cytometry	Bact Prod	Calc/PP	Lugols	SEM	Psi/PIC
1	1	501	19:02						X								
2	2	501	19:03														
3	3	350	19:07						X								
4	4	350	19:08														
5	5	176	19:12						X								
6	6	176	19:12														
7	7	100	19:14						X								
8	8	101	19:15														
9	9	50	19:17					X	X								
10	10	50	19:17														
11	11	31	19:19						X								
12	12	31	19:20														
13	13	22	19:21					X	X								
14	14	22	19:22														
15	15	22	19:22														
16	16	22	19:23														
17	17	16	19:24						X								
18	18	16	19:24														
19	19	11	19:25					X	X								
20	20	10	19:25														
21	21	10	19:26														
22	22	11	19:26														
23	23	5	19:27														
24	24	5	19:28					X	X								
Sampler / Analyst				Helen	Matt	Ian	Frances	Tingting	Tingting	Mario	Mario	Elaine	Ben	Alex	Alex	Jeremy	Jeremy

JR271 – CTD log

Station	43 (continued)	CTD No	067	Date	30/6/12	CTD type: 24 bottles 20 litre Standard
Lat		Event No		Time I/W		
Lon		Depth		Time bottom		
Filename	JR271_CTD_Log_067	Cast Depth		Time O/W		
Weather / Comments	Bottle 18 and 23 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Chloro	POC/N/P	HPLC	Photophy	RNA/DNA	N Cycle	Micro Expt	Salinity						
1	1	501	19:02								**X**						
2	2	501	19:03														
3	3	350	19:07								**X**						
4	4	350	19:08														
5	5	176	19:12								**X**						
6	6	176	19:12														
7	7	100	19:14														
8	8	101	19:15														
9	9	50	19:17														
10	10	50	19:17														
11	11	31	19:19														
12	12	31	19:20														
13	13	22	19:21														
14	14	22	19:22														
15	15	22	19:22														
16	16	22	19:23														
17	17	16	19:24														
18	18	16	19:24														
19	19	11	19:25														
20	20	10	19:25														
21	21	10	19:26														
22	22	11	19:26														
23	23	5	19:27														
24	24	5	19:28														
Sampler / Analyst				Sophie	Sophie	Mark	Laura	Cecelia	Darren	Polly	Jeff						

JR271 – CTD log

Station	44	CTD No	068	Date	1/7/12	CTD type: 24 bottles 20 litre Standard
Lat	67° 15.820 N	Event No	277	Time I/W	06:15	
Lon	24° 02.410 W	Depth	662	Time bottom	06:26	
Filename	JR271_CTD_Log_068	Cast Depth	500	Time O/W	06:59	
Weather / Comments	Bottle 20 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Oxygen	Carbonate pH	N_2O	DMS	TEP	DOC	Nutrients	DOM	Cytometry	Bact Prod	Calc/PP	Lugols	SEM	Psi/PIC
1	1	499	06:27						X								
2	2	499	06:28														
3	3	302	06:32						X								
4	4	302	06:33														
5	5	150	06:37						X								
6	6	150	06:37														
7	7	76	06:40					X	X								
8	8	76	06:40														
9	9	41	06:42						X								
10	10	41	06:42														
11	11	34	06:46					X	X								
12	12	34	06:46														
13	13	34	06:47														
14	14	34	06:47														
15	15	26	06:48						X								
16	16	26	06:49														
17	17	16	06:50						X								
18	18	16	06:51														
19	19	11	06:52					X	X								
20	20	11	06:52														
21	21	11	06:53														
22	22	11	06:53														
23	23	6	06:55					X	X								
24	24	6	06:55														
Sampler / Analyst				Helen	Matt	Ian	Frances	Tingting	Tingting	Mario	Mario	Elaine	Ben	Alex	Alex	Jeremy	Jeremy

JR271 – CTD log

Station	44 (continued)	CTD No	068	Date	1/7/12	CTD type: 24 bottles 20 litre Standard
Lat		Event No		Time I/W		
Lon		Depth		Time bottom		
Filename	JR271_CTD_Log_068	Cast Depth		Time O/W		
Weather / Comments	Bottle 20 leaked					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Chloro	POC/N/P	HPLC	Photophy	RNA/DNA	N Cycle	Micro Expt	Salinity						
1	1	499	06:27								**X**						
2	2	499	06:28														
3	3	302	06:32								**X**						
4	4	302	06:33														
5	5	150	06:37								**X**						
6	6	150	06:37														
7	7	76	06:40														
8	8	76	06:40														
9	9	41	06:42														
10	10	41	06:42														
11	11	34	06:46														
12	12	34	06:46														
13	13	34	06:47														
14	14	34	06:47														
15	15	26	06:48														
16	16	26	06:49														
17	17	16	06:50														
18	18	16	06:51														
19	19	11	06:52														
20	20	11	06:52														
21	21	11	06:53														
22	22	11	06:53														
23	23	6	06:55														
24	24	6	06:55														
Sampler / Analyst				Sophie	Sophie	Mark	Laura	Cecelia	Darren	Polly	Jeff						

JR271 – CTD log

Station	44	CTD No	069	Date	1/7/12	CTD type: 24 bottles 10 litre Titanium
Lat	67° 16.234	Event No	279	Time I/W	07:18	
Lon	24° 03.422	Depth	684	Time bottom	07:32	
Filename	JR271_CTD_Log_069	Cast Depth	661	Time O/W	08:00	
Weather / Comments						

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Nutrients	DOM	Trace Metals	Carbonate Calibr	Oxygen Calibr	Thorium	Salinity							
1	1	661	07:33	X		X				X							
2																	
3	2	600	07:35	X		X											
4																	
5	3	500	07:38	X		X			X	X							
6																	
7	4	400	07:41	X		X											
8																	
9	5	300	07:44	X		X				X							
10																	
11	6	200	07:47	X		X			X								
12																	
13	7	150	07:49	X		X			X	X							
14																	
15	8	101	07:51	X		X			X								
16																	
17	9	81	07:53	X		X			X								
18																	
19	10	61	07:55	X		X			X								
20																	
21	11	41	07:56	X		X			X	X							
22																	
23	12	21	07:58	X		X			X	X							
24																	
Sampler / Analyst				Mario	Mario	Eric	Eithne	Matt	Fred	Jeff							

JR271 – CTD log

Station	45	CTD No	070	Date	1/7/12	CTD type: 24 bottles 20 litre Standard
Lat	66° 47.548 N	Event No	283	Time I/W	15:41	
Lon	25° 08.448 W	Depth	822	Time bottom	15:53	
Filename	JR271_CTD_Log_070	Cast Depth	500	Time O/W	16:24	
Weather / Comments	All bottles fired					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Oxygen	Carbonate pH	N_2O	DMS	TEP	DOC	Nutrients	DOM	Cytometry	Bact Prod	Calc/PP	Lugols	SEM	Psi/PIC
1	1	499	15:53														
2	2	500	15:54														
3	3	351	15:58														
4	4	351	15:58														
5	5	201	16:02														
6	6	201	16:02														
7	7	117	16:05														
8	8	117	16:06														
9	9	76	16:08														
10	10	76	16:08														
11	11	49	16:10														
12	12	49	16:11														
13	13	41	16:12														
14	14	41	16:12														
15	15	26	16:14														
16	16	26	16:14														
17	17	21	16:15														
18	18	21	16:16														
19	19	16	16:17														
20	20	16	16:17														
21	21	11	16:18														
22	22	11	16:18														
23	23	5	16:20														
24	24	5	16:20														
Sampler / Analyst				Helen	Matt	Ian	Frances	Tingting	Tingting	Mario	Mario	Elaine	Ben	Alex	Alex	Jeremy	Jeremy

JR271 – CTD log

Station	45 (continued)	CTD No	070	Date	1/7/12	CTD type: 24 bottles 20 litre Standard
Lat		Event No		Time I/W		
Lon		Depth		Time bottom		
Filename	JR271_CTD_Log_070	Cast Depth		Time O/W		
Weather / Comments	All bottles fired					

Fire Seq	***Bot. No.***	***Depth (m)***	***Time (GMT)***	Chloro	POC/N/P	HPLC	Photophy	RNA/DNA	N Cycle	Micro Expt	Salinity						
1	1	499	15:53								**X**						
2	2	500	15:54														
3	3	351	15:58								**X**						
4	4	351	15:58														
5	5	201	16:02								**X**						
6	6	201	16:02														
7	7	117	16:05														
8	8	117	16:06														
9	9	76	16:08														
10	10	76	16:08														
11	11	49	16:10														
12	12	49	16:11														
13	13	41	16:12														
14	14	41	16:12														
15	15	26	16:14														
16	16	26	16:14														
17	17	21	16:15														
18	18	21	16:16														
19	19	16	16:17														
20	20	16	16:17														
21	21	11	16:18														
22	22	11	16:18														
23	23	5	16:20														
24	24	5	16:20														
Sampler / Analyst				Sophie	Sophie	Mark	Laura	Cecelia	Darren	Polly	Jeff						

JR271 – GOFLO log

APPENDIX 6

GOFLO No	001	Bot. No.	Depth (m)	Nutrients	DOM	Trace Metals	Thorium
Event No	090	1	400	X	X	X	X
Date	14/6/12	2	300	X	X	X	X
Station	11	3	200	X	X	X	X
Lat	78.71806 N	4	150	X	X	X	X
Lon	0.00010 W	5	100	X	X	X	X
Max Depth	2729 m	6	60	X	X	X	X
Time I/W	08:00	7	40	X	X	X	X
Time O/W	09:22	8	20	X	X	X	X
		Sampler / Analyst		Mario	Mario	Eric	Fred

GOFLO No	002	Bot. No.	Depth (m)	Nutrients	DOM	Trace Metals	Thorium
Event No	099	1	320	X	X	X	
Date	15/6/12	2	280	X	X	X	
Station	12	3	230	X	X	X	
Lat	78.23377 N	4	180	X	X	X	
Lon	5.56322 W	5	100	X	X	X	
Max Depth	362 m	6	40	X	X	X	
Time I/W	07:33	7	15	X	X	X	
Time O/W	09:04						
		Sampler / Analyst		Mario	Mario	Eric	Fred

JR271 – GOFLO log

GOFLO No	003	Bot. No.	Depth (m)	Nutrients	DOM	Trace Metals	Thorium
Event No	106	1	330	X		X	X
Date	16/6/12	2	230	X		X	X
Station	14	3	130	X		X	X
Lat	78.20889 N	4	80	X		X	X
Lon	5.99663 W	5	60	X		X	X
Max Depth	350 m	6	40	X		X	X
Time I/W	07:35	7	25	X		X	X
Time O/W	08:28						
		Sampler / Analyst		Mario	Mario	Eric	Fred

GOFLO No	004	Bot. No.	Depth (m)	Nutrients	DOM	Trace Metals	Thorium
Event No	114	1	500	X	X	X	
Date	17/6/12	2	400	X	X	X	
Station	15	3	300	X	X	X	
Lat	78.80667 N	4	200	X	X	X	
Lon	4.93323 W	5	100	X	X	X	
Max Depth	1167 m	6	80	X	X	X	
Time I/W	07:04	7	50	X	X	X	
Time O/W	08:14	8	35	X	X	X	
		9	25	X	X	X	
		Sampler / Analyst		Mario	Mario	Eric	Fred

JR271 – GOFLO log

GOFLO No	005	Bot. No.	Depth (m)	Nutrients	DOM	Trace Metals	Thorium
Event No	127	1	500	X	X	X	X
Date	18/6/12	2	400	X	X	X	
Station	18	3	300	X	X	X	
Lat	78.26295 N	4	200	X	X	X	X
Lon	4.34280 W	5	150	X	X	X	X
Max Depth	~1700 m	6	100	X	X	X	X
Time I/W	12:39	7	60	X	X	X	X
Time O/W	13:52	8	40	X	X	X	X
		9	25	X	X	X	X
		Sampler / Analyst		Mario	Mario	Eric	Fred

GOFLO No	006	Bot. No.	Depth (m)	Nutrients	DOM	Trace Metals	Thorium
Event No	135	1	500	X	X	X	X
Date	19/6/12	2	400	X	X	X	
Station	19	3	300	X	X	X	
Lat	78.85295 N	4	200	X	X	X	X
Lon	1.26999 W	5	150	X	X	X	X
Max Depth	3051 m	6	100	X	X	X	X
Time I/W	07:52	7	60	X	X	X	X
Time O/W	08:46	8	40	X	X	X	X
		9	25	X	X	X	X
		Sampler / Analyst		Mario	Mario	Eric	Fred

JR271 – GOFLO log

GOFLO No	007	Bot. No.	Depth (m)	Nutrients	DOM	Trace Metals	Thorium
Event No	148	1	500	X	X	X	
Date	20/6/12	2	400	X	X	X	
Station	21	3	300	X	X	X	
Lat	78.99276 N	4	200	X	X	X	
Lon	7.97375 E	5	150	X	X	X	
Max Depth	1104 m	6	100	X	X	X	
Time I/W	07:00	7	60	X	X	X	
Time O/W	08:11	8	40	X	X	X	
		9	20	X	X	X	
		Sampler / Analyst		Mario	Mario	Eric	Fred

GOFLO No	008	Bot. No.	Depth (m)	Nutrients	DOM	Trace Metals	Thorium
Event No	170	1	500			X	X
Date	22/6/12	2	400			X	
Station	26	3	300			X	
Lat	76.26200 N	4	200			X	X
Lon	12.54163 E	5	120			X	X
Max Depth	1714 m	6	60			X	X
Time I/W	07:03	7	40			X	X
Time O/W	08:08	8	25			X	X
		Sampler / Analyst		Mario	Mario	Eric	Fred

JR271 – GOFLO log

GOFLO No	009	Bot. No.	Depth (m)	Nutrients	DOM	Trace Metals	Thorium
Event No	182	1	110	X	X	X	
Date	23/6/12	2	90	X	X	X	
Station	28	3	70	X	X	X	
Lat	76.15638 N	4	50	X	X	X	
Lon	26.07028 E	5	30	X	X	X	
Max Depth	133	6	15	X	X	X	
Time I/W	06:44						
Time O/W	07:13						
		Sampler / Analyst		Mario	Mario	Eric	Fred

GOFLO No	010	Bot. No.	Depth (m)	Nutrients	DOM	Trace Metals	Thorium
Event No	197	1	350	X		X	
Date	24/6/12	2	300	X		X	
Station	30	3	250	X		X	
Lat	72.88871 N	4	200	X		X	
Lon	26:00531 E	5	150	X		X	
Max Depth	361 m	6	100	X		X	
Time I/W	07:41	7	60	X		X	
Time O/W	08:32	8	40	X		X	
		9	25	X		X	
		Sampler / Analyst		Mario	Mario	Eric	Fred

JR271 – GOFLO log

GOFLO No	011	Bot. No.	Depth (m)	Nutrients	DOM	Trace Metals	Thorium
Event No	206	1	260	X		X	X
Date	25/6/12	2	200	X		X	X
Station	32	3	150	X		X	X
Lat	71.75197 N	4	100	X		X	X
Lon	17.90070 E	5	80	X		X	X
Max Depth	284 m	6	60	X		X	X
Time I/W	06:48	7	40	X		X	X
Time O/W	07:47	8	20	X		X	X
		Sampler / Analyst		Mario	Mario	Eric	Fred

GOFLO No	012	Bot. No.	Depth (m)	Nutrients	DOM	Trace Metals	Thorium
Event No	218	1	500	X		X	X
Date	26/6/12	2	400	X		X	
Station	34	3	300	X		X	
Lat	71.74754 N	4	200	X		X	X
Lon	8.44273 E	5	150	X		X	X
Max Depth	2736 m	6	100	X		X	X
Time I/W	06:48	7	60	X		X	X
Time O/W	07:56	8	40	X		X	X
		9	20	X		X	X
		Sampler / Analyst		Mario	Mario	Eric	Fred

JR271 – GOFLO log

GOFLO No	013	Bot. No.	Depth (m)	Nutrients	DOM	Trace Metals	Thorium
Event No	230	1	500	X		X	X
Date	27/6/12	2	400	X		X	
Station	36	3	300	X		X	
Lat	71.74529 N	4	200	X		X	X
Lon	1.26729 W	5	150	X		X	X
Max Depth	1784 m	6	100	X		X	X
Time I/W	06:54	7	60	X		X	X
Time O/W	07:59	8	40	X		X	X
		9	20	X		X	X
		Sampler / Analyst		Mario	Mario	Eric	Fred

GOFLO No	014	Bot. No.	Depth (m)	Nutrients	DOM	Trace Metals	Thorium
Event No	254	1	400	X		X	
Date	29/6/12	2	300	X		X	
Station	40	3	200	X		X	
Lat	68.69511 N	4	150	X		X	
Lon	10.57605 W	5	100	X		X	
Max Depth	2193 m	6	60	X		X	
Time I/W	06:49	7	40	X		X	
Time O/W	07:56	8	20	X		X	
		Sampler / Analyst		Mario	Mario	Eric	Fred