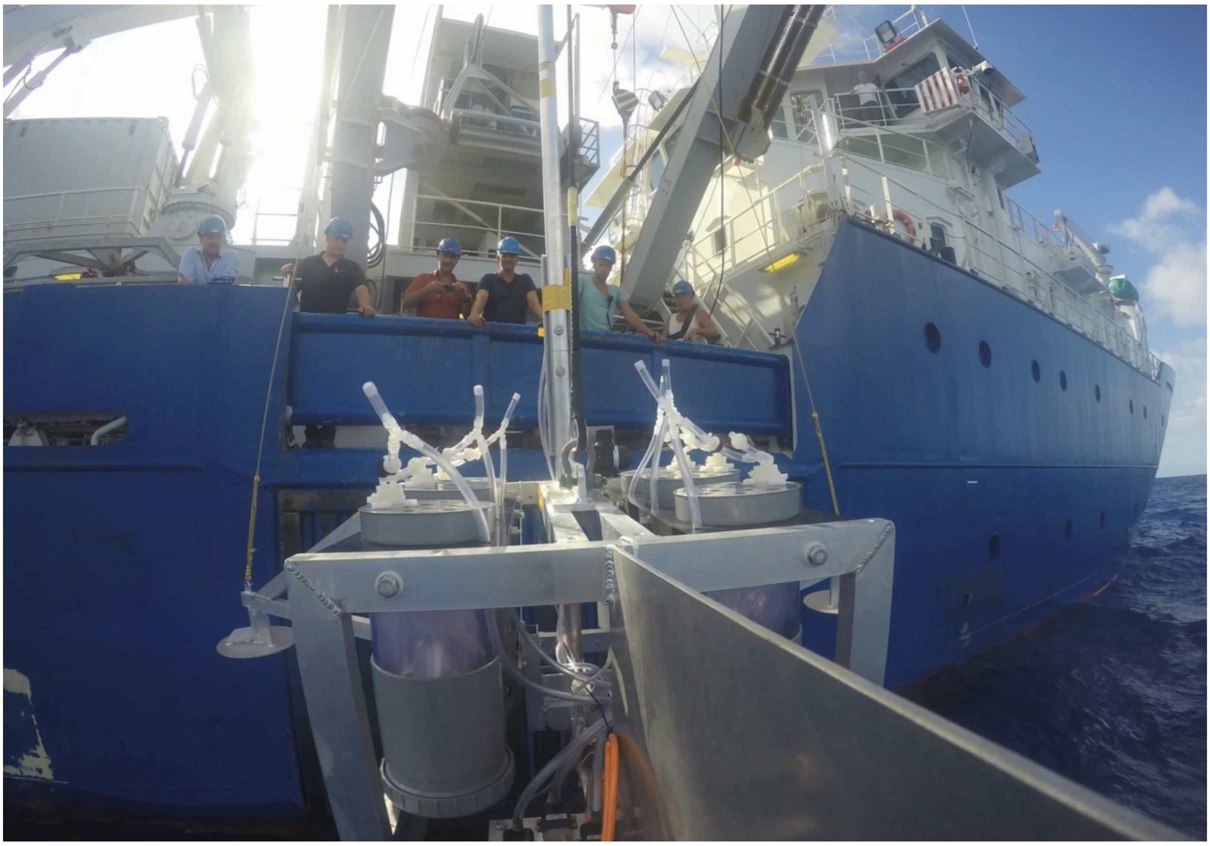
Cruise report *RV Pelagia* 64PE414

Saba Bank

19th of August – 8th of September 2016

Guadeloupe – Curaçao



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1 Introduction

1.1 Aim and Background

This research expedition is part of the project "Caribbean Coral Reef Ecosystems", funded within NWO's Caribbean Research Program. This project consist of three parts: one is devoted to the physiological basis of aragonite dissolution by excavating sponges, one focusses on the field-validation of the impact of environmental conditions on the net accumulation or dissolution of coral reefs. The research expedition completes these efforts by aiming to quantify the large-scale interaction between coral reefs and seawater chemistry. The Saba Bank (figure 1) is an excellent study site, since it is a large shallow carbonate platform (approximately 1800 km^2), harboring coral reefs, various benthic algal communities and large amounts of sponges and gorgonians. Besides a series of previous surveys on the bank, most of the bank area is still a terra incognita as are the characteristics of the water overlying the bank. The various benthic communities on the bank as well as the various water masses that envelop the bank are expected to develop a typical bank signature in the overlying water, while flowing over the bank. Horizontal and vertical gradients of dissolved and suspended organic matter (phytopigments and particulate organic matter, POM) concentrations and pico-and nanoplankton are assessed during this cruise to shed light upon this benthic-pelagic coupling of the bank. Considering the large abundance of sponges and gorgonians on the bank that retain and/or filter huge amounts of water we expect depletion of pelagic plankton by zones in which such organisms dominate the benthic community of the bank. Depletion of pelagic plankton has been found previously on reefs elsewhere and may explain that certain reef zones might be net heterotrophic and may enhance acidification of the overlying water.

Depth is undoubtedly the most important variable as it regulates the amount of light that penetrates the water column and is used for photosynthesis of corals and algae. Depth also is related to the shear stress that is exerted on the organisms living attached to the bottom. Wave energy determines if organisms can survive (stay attached) under extreme conditions such as storms and hurricanes. Furthermore, depth will have an influence on the composition and fate of the sediment that is generated on a coral reef. The sediment will be very fine in less exposed environments and virtually absent in exposed forereef conditions. Grain size of the sediment determines to a large degree the animals that can live in, on, and near it. Sediment transport on the bank may also influence settlement success of larvae of benthic species. Next to depth the exact position on the Saba Bank in relation to both incoming waves and currents and the edge of the bank will also influence the availability and concentration of food and nutrients. Closer to the edge of the bank an organism is closer to the incoming water with fresh nutrients and plankton.

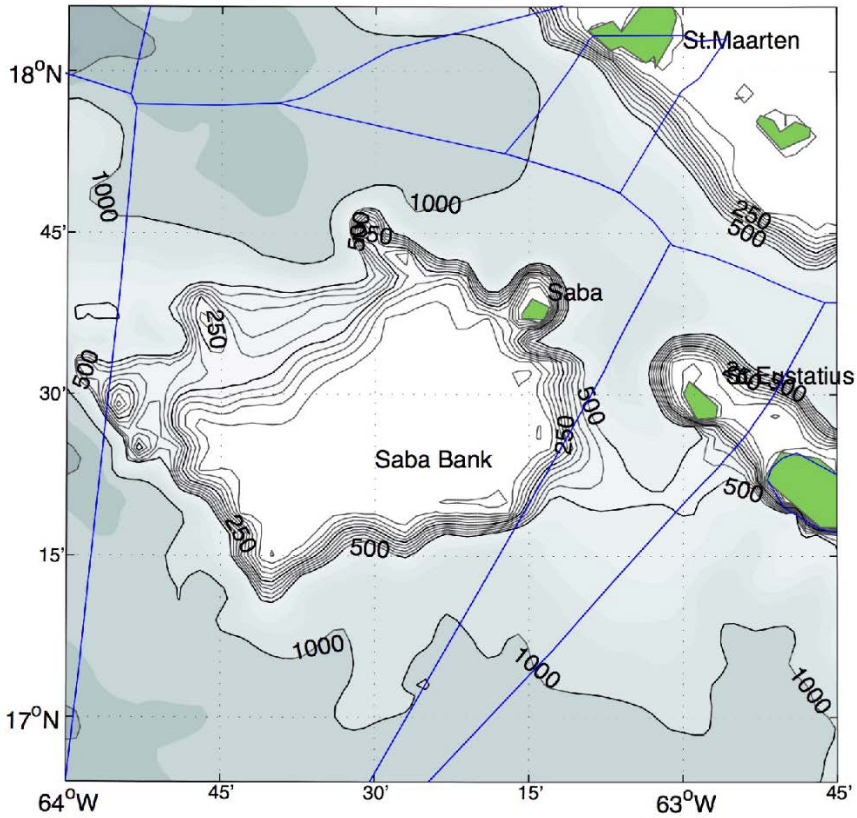


Figure 1: The location of the Saba Bank, a large carbonate platform located south and west of the island of Saba. Most of the coral reefs are located on the eastern and southern rim of the platform, where water depths are around 15-20 meters. The northern and western slopes of the bank descend more gradually downward. Blue lines indicate EEZ's of the various countries.

To understand the interaction between the environment and coral reef functioning, this research expedition will integrate ecological mapping, (carbonate) chemistry and physical oceanography. Spatial coverage of corals and other calcifying organisms will be mapped and linked to transects along which seawater will be analyzed for chemical constitution. Changes in total alkalinity, pH, DIC and nutrients will indicate what the net calcium carbonate production and dissolution, as well as release and uptake of nutrients over the Saba Bank are. Additional near-bottom seawater sampling by a custom-designed 'gradient sampler' may provide a local, instantaneous estimate of these processes. In combination with (micro-) turbulence estimates, the fluxes of CaCO3 accretion (or loss), nutrient dynamics et cetera may be inferred.

1.2 Participating scientists

Lennart de Nooijer	NIOZ	Chief Scientist
Steven van Heuven	NIOZ	Carbonate chemistry
Fleur van Duyl	NIOZ	Pigments, DOC
Eric Meesters	IMARES	Coral reef ecology
Adam Candy	TU Delft	ADCP, turbulence/ flow modelling
Alice Webb	NIOZ	Carbonate chemistry
Didier de Bakker	IMARES/ NIOZ	Coral reef ecology, carbonate chemistry
Rene van Westen	Utrecht University	Microturbulence
Avila Lindgren	UVA	Pigments
Barry Boersen	NIOZ	Technician
Bob Koster	NIOZ	Technician
Jan van Ooijen	NIOZ	Nutrients
Sharyn Ossebaar	NIOZ	Carbonate chemistry, dissolved oxygen

1.3 Acknowledgements

Execution of the scientific program would not have been possible without the commitment of the crew of the R/V pelagia. Pieter, Bert, Alle, Wijnand, Inno, Iwan, Alex, Sjaak, Roel, Martin and Rick have made this expedition not only a pleasant experience, but also allowed the scientific team to operate at its best. Together with various members of the scientific crew, GJ Reichart has been important in preparing and planning this expedition.

2 Scientific program

2.1 Transit and Transect 1

Transit started on the evening of the August 20th, 00:21 (UTC) by leaving the port of Point-á-Pitre. It ended at 11:35 (UTC) the next morning by arrival at the first station.
From Saturday Aug 21st, 11:56, until the 23rd, 22:19, eleven stations (st1-st11) were sampled using the bottles on the ultraclean (UC) CTD frame (see figure 2 for an overview of all stations sampled). After every CTD cast, one or multiple deployments with the SCAMP were performed. At stations 5 and 7, the hopper videoframe was tested. UC CTD bottles were closed according to the CTD sample list (12.1). After placement in the UC container, subsamples were taken for determination of O_2, pH, $[CO_3^{2-}]$, DIC and TA, nutrients, TN and TP, in that order. Dedicated bottles were then subsampled for filtration and DOC analyses. Finally, from the former bottles, samples were taken for trace metals and isotopes thereof (TEIs), according to an established protocol (section 6).

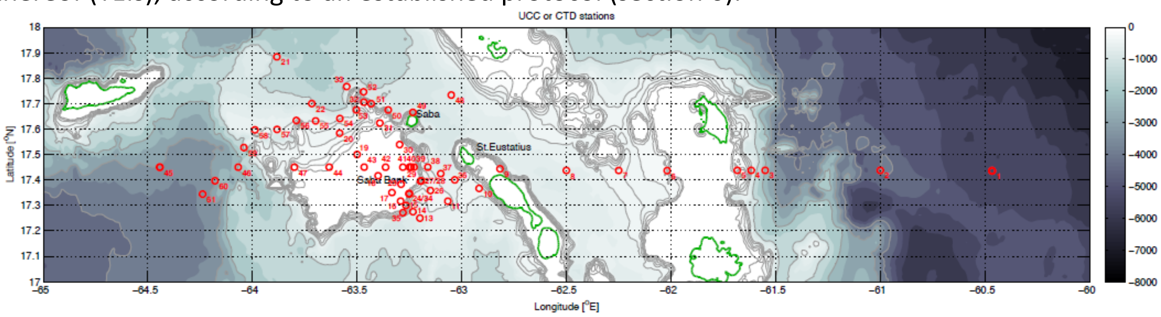


Figure 2: all stations that were (UC) CTD sampled during expedition 64PE414.

2.2 Transect 2

On the 24th (12:46 UTC), at station 12, a small frame was deployed carrying an Nortek AWAC 1MHz ADCP, recording current velocity and direction for the largest part of the expedition (figure 3).

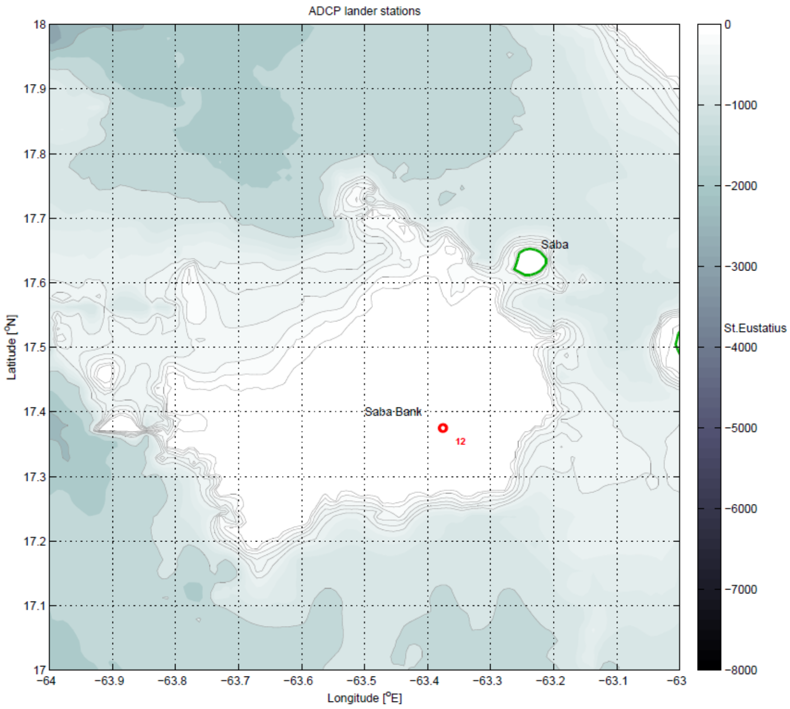


Figure 3: Location of the deployed AWAC ADCP.

The afternoon of the 24th was devoted to videorecording the bottom coverage of selected stations on the bank (figure 4).

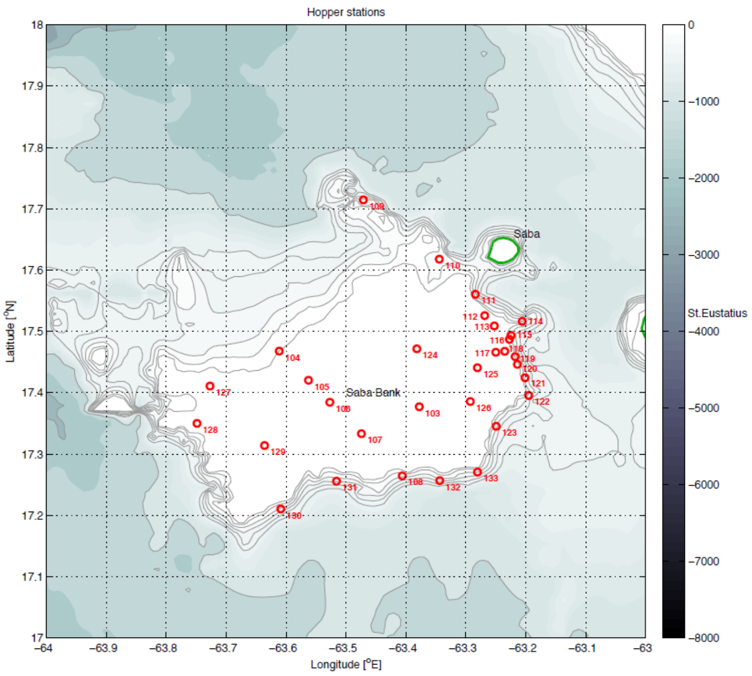


Figure 4: All stations covered by the hopper videorecordings.

In the morning of the 25th, the aquaflow was switched on. On the 25th and 26th, stations 13-22 were sampled. These stations form transect 2 (figure 5) and together span the Saba Bank in a SE-NW direction. At each of the 10 stations, both the CTD frame was and measurements for the microturbulence (using the SCAMP) were performed. In the afternoon of the 26th, a 5 more stations were video-ed.

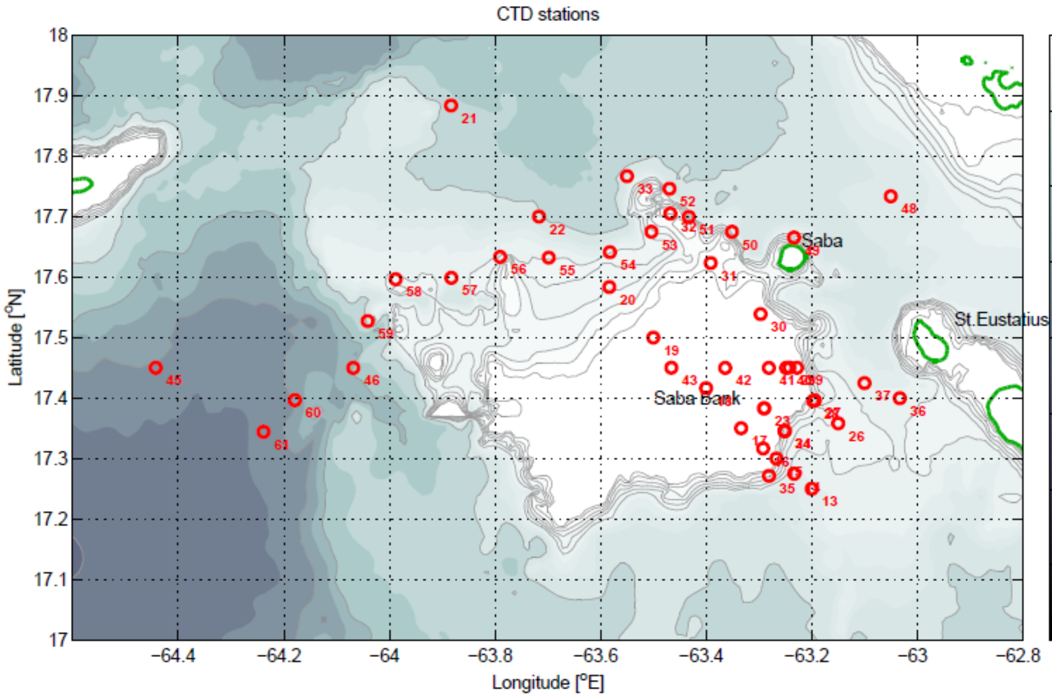


Figure 5: all stations encompassing the four CTD bottle-sampled transects.

2.3 Transect 3

On the 27th of August, the gradient sampler was deployed for the first time. One CTD cast (station 23, depth 30 meters) was performed to sample the water column above the gradient sampler. The sampler was positioned close to this position and was programmed to start pumping seawater (depths 0, 0.1, 0.3, 1, 2 and 3 meters above seafloor) 45 minutes after the start of the deployment. Pumping time was set to 30 minutes and closely after that, the sampler was retrieved. During these 1 hour and 45 minutes, the CTD was lowered and hauled 8 consecutive times without closing any of the Niskin bottles. After retrieval of the sampler, this procedure was repeated with 10 CTD casts during the deployment. During the second deployment, the SCAMP was deployed once. The complete procedure was repeated in the afternoon at a different station (no 24: see figure 6).

The 28th of August was devoted to the videoframe and on the 29th, transect 3 (stations 26-33; figure 4) was sampled using the CTD, with additional SCAMP deployment at most of the stations along this transect.

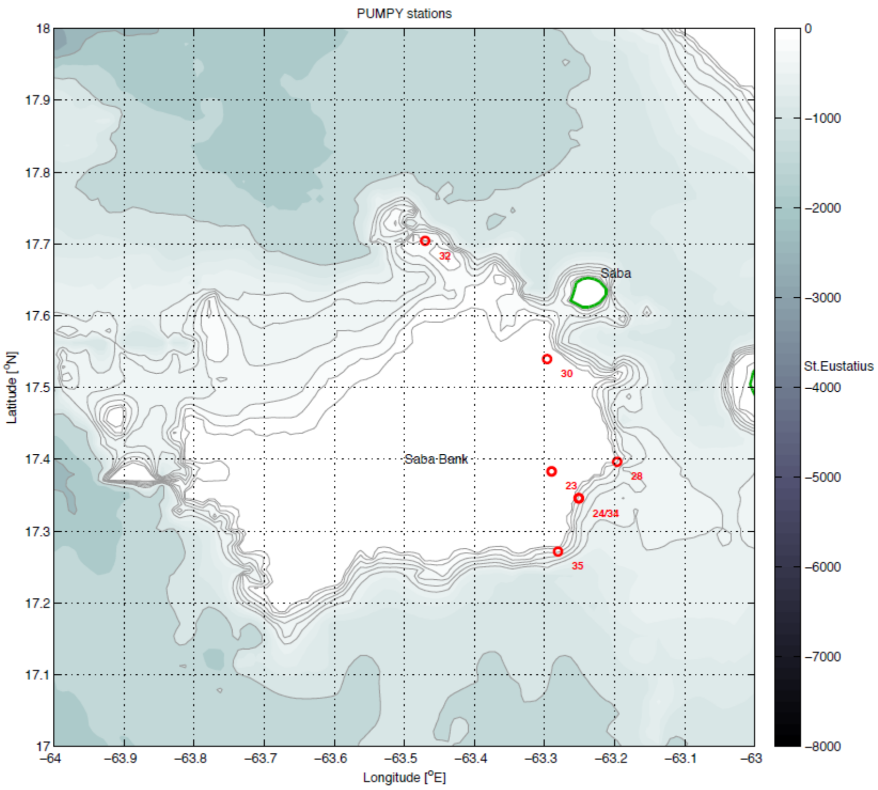


Figure 6: stations where the Gradient sampler was deployed.

2.4 Transect 4

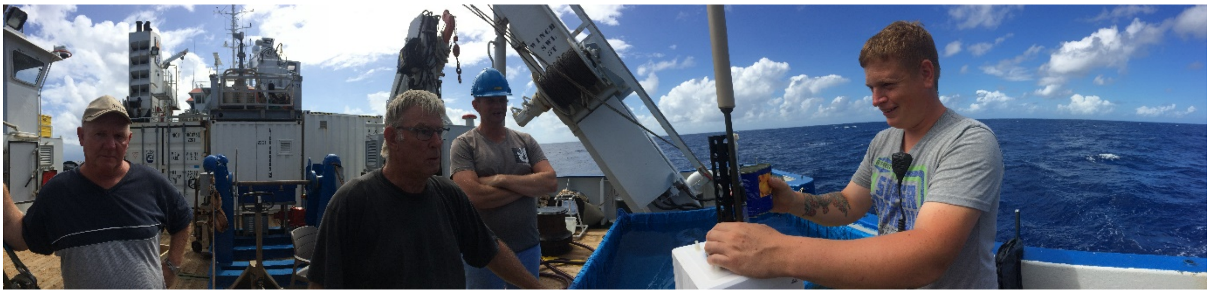
The morning of the 30th was used for 3 videostations (figure 3). Stations 34 and 35 were CTD-sampled in the afternoon. After both CTD casts, the gradient sampler was lowered to the seafloor as described before. During the deployments, the SCAMP was used for profiling the water column. During the second deployment (at 17°16.35132' N, 63°17.12718' W) the SCAMP was lost. The assessment of Rene van Westen and the technicians present during the deployment, the frame protecting the sensors of the SCAMP likely got stuck in the seafloor cover (e.g. coral) and due to the drift of the ship, the end of the rope was lost. It is recommended that for such deployments in the future, the end of the rope is equipped with a small buoy to facilitate retrieval. Four crew members used the man-overboard boat to find the loose rope quickly after the end of it was lost. After 30-45 minutes this operation was stopped since the rope was unlikely to be found if it had floated on the surface of the water. Rene has contacted local authorities to discuss future retrieval by SCUBA diving.

Stations 36-44 (on the 31st) and stations 45-47 (on the 1st of September) were sampled alternately with the standard CTD and with the UC CTD. The shallowest stations could not be sampled with the UC CTD. Together these stations make up transect 4 (figure 4). Within this transect, at 14:22 UTC, the first of the three Argofloats was deployed. At the end of the 1st, one more station was visited for videorecordings.

2.5 Transect 5 and transit

On the 2nd of Sept, the final 6 stations for the ecological monitoring were visited. The small lander with the AWAC 14705 ADCP was retrieved in the evening. On the 3rd (6 stations), 4th (5 stations) and 5th (2 stations) were CTD bottle-sampled to complete the final transect (no 5; figure 4). At the final station (no 61) the second ArgoFloat was deployed after the CTD cast. On Monday the 5th of September, at 16:19 UCT, transit to Curacao started. During transit, the morning of the 6th of September, the third

Argofloat was deployed from the back of the ship. On the evening of the 7th, we entered the port of Willemstad.



Throughout the expedition from Guadeloupe to Curaçao continuous measurements were recorded on position, speed over ground, course, water depth, sea surface salinity and temperature, and local meteorology. Water depth was continuously monitored and recorded from a Kongsberg EA600 3010 12kHz echo sounder. Longitude and latitude positions were recorded from Seapath GPS, with course from the ship's Gyro compass. Surface salinity and temperature were measured by a Seabird SBE21, and calibrated to 4m depth CTD measurements made on the downcast. KNMI instruments recorded local meteorology, including surface air temperature, pressure and humidity, relative wind speed and direction, and incident solar radiation.

Records of these continuous measurements were logged in an Ifremer CASINO+ data acquisition system (see 14.3 for a summary of the events), and stored for further reference and processing. The VMADCP acquisition system also logged time and position from the Seapath GPS and heading and tilt (pitch and roll) from the ships Gyro, over NMEA communication protocols. These raw NMEA streams accompany the VMADCP dataset.

3 Dissolved Oxygen Sharyn Ossebaar, Alice Webb, Steven van Heuven

At every station water samples were taken from the CTD or UCCTD for the determination of concentrations of dissolved oxygen in order to calibrate the in-situ CTD sensors. Samples were drawn into volume-calibrated ~120 ml Pyrex glass bottles using Tygon tubing, flushing the bottle with at least 3 times its volume. Addition of chemicals was performed immediately afterward, after which glass stoppers were secured in place with an elastic band. The samples were stored underwater and in the dark at 24-25ºC. Analysis of series of 30-50 collected samples at a time took place every few days, at the same temperature. Over 5 runs, a total of some 250 analyses were performed of 159 unique water samples.

The determination of the volumetric dissolved oxygen concentration of water samples was performed colourimetrically by measuring the absorbance of iodine at 460nm on an Agilent CARY 8454 Spectrophotometer (see Su-Chen Pai et al., Marine Chemistry 41 (1993), 343-351). The spectrophotometer was calibrated using standards of seawater spiked with known amounts of KIO_3 (a stock solution of KIO_3 of concentration 73.58M was used), relying on the built-in software routines (Agilent ChemStation). The R^2 value of the calibration line was never less than 0.999, with an average standard deviation of the residuals between the calibration line and the calibration standards of ±0.5 μmol l^{-1}. Oxygen concentrations reported by the spectrophotometer were corrected for the volumetric dilution of addition of reagent and the oxygen inadvertently added with those reagent. Conversion to μmol kg^{-1} was performed using salinity values reported by the CTD instrument, and a tapping temperature that is assumed to be equal to the in-situ temperature (likely slightly invalid for the deepest, coldest samples). At each station at least one sample was taken in duplicate. The average of the differences between replicates of circa 30 samples was approximately 0.9 µmol l^{-1}, after discarding 9 pairs of samples with unacceptable replicate differences of >2 µmol l^{-1}. With appropriate correction for instrument drift (based on measurements of drift standards), which has not currently been performed, these metrics may improve slightly.

No reference standard exists for the measurement of dissolved oxygen and it is thus difficult to ascertain the accuracy of the analyses, despite the care taken in the preparation of the stock solution of KIO_3. To alleviate this shortcoming, subsamples of a 10 l sample of deep-ocean water, brought to equilibrium with the atmosphere, were analyzed interspersed in our measurement series. In runs 2, 3 and 4, these runs yielded an average concentration of approximately 205 µmol/kg. Post-cruise processing will indicate if this is accurate, considering sample salinity, mean air pressure and temperature of equilibration and tapping.

Use of the bottle oxygen measurements for the calibration of the CTD frames' oxygen sensors will be performed post-cruise by means of a single, nonlinear multiparametric fit through station number, depth and temperature. A detailed assessment of correction quality and estimated final accuracy will follow after the cruise. A preliminary application of that method appreciably reduces bias between CTDoxy and BOToxy, for both the UCC frame (from -2.7±5.3 to +0.0±1.1 µmol/kg, n=59) and the regular CTD frame (from -5.7±1.3 to +0.0±1.1 µmol/kg, n=100), as illustrated in figures 7 and 8.

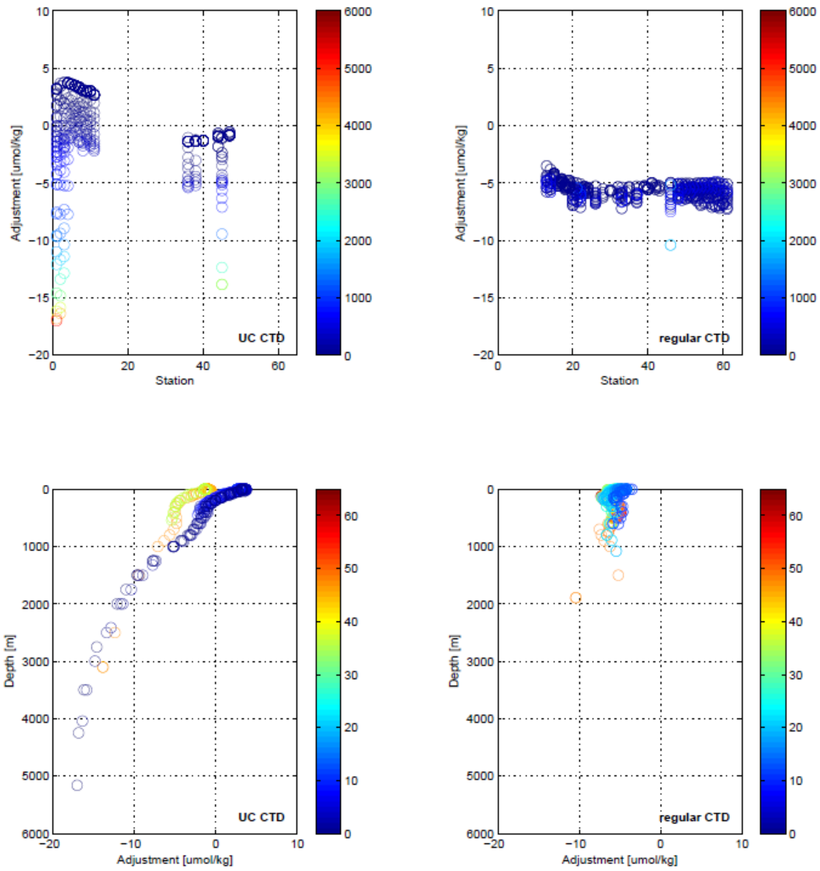


Figure 7: Adjustments applied to the raw CTDoxy measurements (here shown only for depths at which bottles were closed). Left column: UC-CTD; right column: regular CTD. Top row: adjustments over time (or rather, station number); bottom row: adjustments vs. depth. The deep casts of the UC-CTD show large adjustments, implying the presence of appreciable bias of the CTDoxygen sensor at high pressure and/or low temperature.

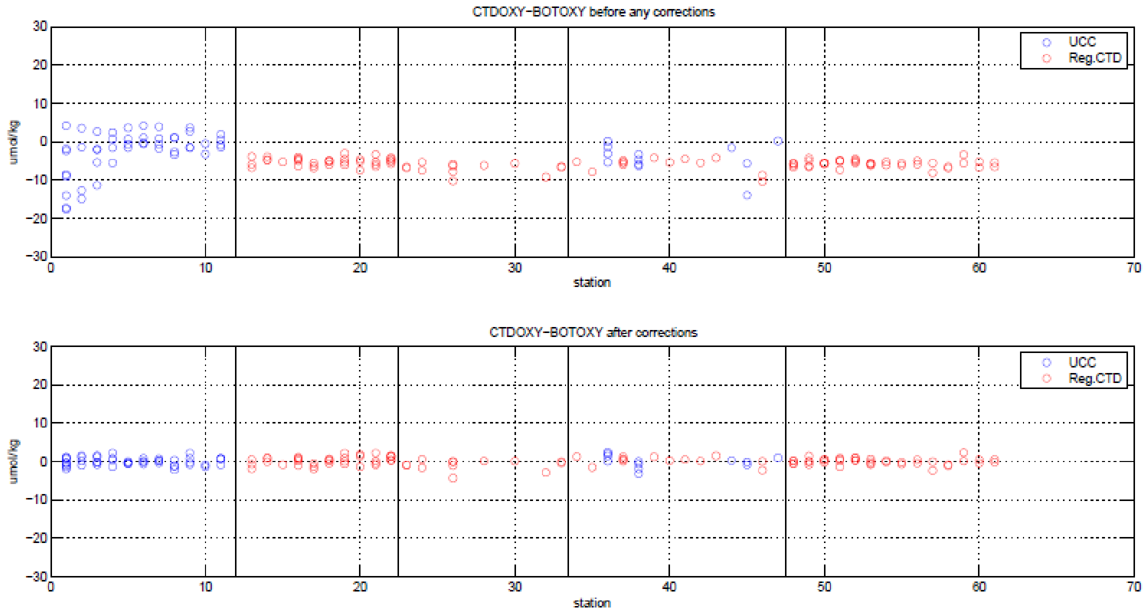


Figure 8: Uncorrected (upper panel) and corrected (bottom panel) CTD oxygen results.

4 Inorganic carbon chemistry

Steven van Heuven, Alice Webb
Sharyn Ossebaar, Didier de Bakker

Sampling and analysis for carbonate system parameters broadly followed the standard operating procedures outlined by Dickson *et al.*, 2007. Specifically, water samples of 0.5l were collected from CTD units into borosilicate sample bottles with plastic caps, using Tygon tubing. In each profile, two or three duplicate samples were collected, generally at shallow, intermediate and deep parts of the profile. Samples analysis generally commenced immediately after collection. When the wait time of the samples of a station was expected to exceed 4 hours, sampled were kept in a fridge 4ºC. Analysis of profiles was in all cases completed within 20 hours after sampling. Analyses were performed on two VINDTA 3C's (Versatile INstrument for the Determination of Total Alkalinity, designed and built by Dr. L. Mintrop, Marine Analytics and Data, Kiel, Germany), referred to as A and B (VINDTA #15 and #14 respectively). These instruments were slightly modified. The peristaltic sample pump was replaced with an overpressure system (~0.5 bar overpressure) and a 1 meter long coiled 1/8" stainless steel counterflow heat exchanger that was placed between the sampling line and the circulation circuit. This setup allows for the rapid, convenient and bubble-free loading of the pipettes with sample of 25ºC (±0.1ºC), irrespective of the samples' initial temperature. Rinsing of A_T titration cell was performed by automated showering with distilled water, rather than repeated filling with distilled salt water. The new procedure is markedly faster, and precision is equal if not better. Certified reference material (CRM, Batch #154) obtained from dr. Andrew Dickson at Scripps Institute of Oceanography (San Diego, California) was used for quality control.

4.1 Dissolved inorganic carbon (DIC)

DIC was determined by coulometric titration. An automated extraction line takes a 20ml subsample which is subsequently purged of CO_2 in an acidified stripping chamber. A nitrogen carries gas transports the CO_2 gas into a coulometric titration cell via a condensor and acid trap, to strip the gas flow of any water. The CO_2 reacts with the cathode solution in the cell to form hydroxyethylcarbamic acid, which is then titrated with hydroxide ions (OH-) electrolytically generated by the coulometer.

The current of the coulometer is then integrated over the duration of the titration to obtain the total amount of carbon titrated. A rather puzzling discrepancy was observed between the DIC results obtained on instruments A and B, that was not resolved by first order adjustments (i.e., to CRM results). A more thorough assessment of measurement will likely result in small offset adjustment to one of the datasets prior to their merging into a single product.

4.2 Total Alkalinity (TA)

Determinations of TA were performed by acid titration that combines aspects from both the commonly used 'closed cell' method and the 'open cell' method, following the VINDTAs standard settings (initial HCl addition of 0.6ml, subsequent additions of 0.15ml). A single 20L batch of ~0.1M HCl (salinity 35) was prepared to be used by both VINDTAs, of which about 16 litres remained after the cruise. A samples of the acid was collected for post-cruise determination of acid strength.

4.3 pH

At most stations, up to 8 depths were sampled for measurement of pH. Samples were tapped from niskins immediately after O_2 samples has been tapped. Seawater was carefully flushed directly into 100mm cuvettes, which were then closed with minimal air contact. Filled cuvettes were carefully equilibrated to 25.00±0.05 ºC prior to analysis. Analysis of samples was performed per the spectrophotometric method of Clayton and Byrne, 1994, following the SOP6B of Dickson et al., (2007) on an Agilent CARY 8454 diode array spectrophotometer. Occasional temperature checks (using a 1/8" diameter high accuracy PRT probe) of samples after analysis indicated that during handling samples generally stayed within 0.05ºC of the desired temperature of 25.00ºC.

The indicator meta-cresol purple (2 mM, Merck, non-purified, R-ratio ~1.7) was added to the sample and the absorbances of the mixture at 730, 578 and 434nm are determined. The pH is then calculated as:

$$pH = pK_2 + \log10[(A_1/A_2 - \varepsilon_1(HI^-)/\varepsilon_2(HI^-)) / \varepsilon_1(I^{2-})/\varepsilon_2(HI^-)-(A_1/A_2)\ \varepsilon_2(I^{2-})/\varepsilon_2(HI^-)]$$

Where pK_2 is the acid dissociation constant for the species HI–, ε represents the extinction coefficient ratios for m-cresol purple, A the measured absorbances, and I is the indicator dye. Results of repeat analysis of individual cuvettes had a standard deviation ~0.0004. Field replicates generally were well within 0.005 pH units. This metric is skewed upwards by occasional poor reproducibility of near-sediment samples, which contained particles interfering with the spectrophotometry.

4.4 pCO_2

Continuous measurements have been performed of the pCO_2 of the ocean surface water, pumped in from the Aquaflow system. Analysis was performed with a General Oceanics model 8050 instrument, mounted temporarily in the wet lab, and in general accordance with standard operating procedures for this measurement (Pierrot et al., 2009 or SOP5 of Dickson et al., 2007). Cleaning of the coarse particle filter was performed weekly, by hand (rather than using the automated backflushing option). Data of in-situ S and T are not available for the first several days of the expedition (Aquaflow logging was disabled). Using estimates of in-situ T based on equilibrator temperature, and with approximated

S, high-accuracy pCO_2 values can nonetheless be obtained. The LICOR reference cell was continuously flushed with N_2 (at a flow rate of ca. 10 ml/min). Calibration against standard gasses was performed every few hours. Standard gasses are commerically obtained premixes of CO_2 in artificial air, containing nominally 200, 400 and 600 ppm CO_2. These were calibrated several weeks before the cruise, using a newly obtained LICOR 7000 that was calibrated against N_2 and a dry reference gas (borrowed at the Centre for Isotope Research, University of Groningen) of 488.80 ppm (itself calibrated directly against NOAA standards). Resulting values were 201.3, 382.0 and 598.0 ppm. Arbitrarily, an uncertainty of ±1ppm is assigned to these standard gas concentrations. Measurements of the xCO_2 of atmospheric air were performed, but no dedicated tubing to the crow's nest was realized, and the air was simply sampled from the wet lab. During daytime, strong spiking due to human presence is observed. At nighttime, values rapidly settled towards ambient values. By comparison of those nighttime values with (for example) GlobalVIEW modelled xCO_2 fields, the accurate calibration of the LICOR may be corroborated.

References

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5 Nutrients — Jan van Ooijen

Summary

On this cruise, approximately 650 samples were analysed for Phosphate, Ammonium, Nitrate and Nitrite. The samples were measured on a Seal Analytical QuAAtro Autoanalyser connected with an autosampler. The different nutrients were determined colorimetrical.

Methods

Samples were obtained from an Ultra Clean CTD, from a normal CTD rosette sampler and from the gradient sampler. All CTD-samples were taken in polypropylene bottles. The samples were filtered through a 0.20 µm acrodisc and sub-sampled in a 5 ml polyethylene vial. These vials were all stored dark at 4 °C before analysed. Samples for DN and DP analysis were frozen at -20°C immediately after filtering and samples for Silicate were stored at 4°C, both for measuring at the NIOZ laboratory. All samples from the CTD and gradient sampler were analysed within 24 hours on a QuAAtro autoanalyser. As a light source the QuAAtro uses a LED instead of a lamp to avoid the noise effect of the movements of the ship on the light source and therefore on the baseline.

Standards were prepared fresh every day by diluting the stock solutions of the different nutrients in nutrient depleted surface ocean water. This water is also used as baseline water. Each run of the system had a correlation coefficient for 11 calibrant points of at least 0.9999. The samples were measured from the lowest to the highest concentration to minimize carry over effects.

In every run a mixed nutrient standard containing phosphate and nitrate in a constant and well known concentration was measured as a triplicate. Also a Nutrient Reference Standard (lot BU) was measured as a duplicate. This reference standard made by Kanso (Japan) was ready to use and contained known concentrations of phosphate, silicate, nitrate and nitrite.

Analytical Methods

The colorimetric methods used are as follows:

Ortho-Phosphate (PO_4) reacts with ammonium molybdate at pH 1.0, and potassium antimonyltartrate is used as a catalyst. The yellow phosphate-molybdenum complex is reduced by ascorbic acid and forms a blue reduced molybdophosphate-complex which is measured at 880nm (Murphy and Riley, 1962).

Ammonium (NH_4) reacts with phenol and sodiumhypochlorite at pH 10.5 to form an indo-phenolblue complex. Citrate is used as a buffer and complexant for calcium and magnesium at this pH. The blue color is measured at 630nm (Koroleff, 1969 and optimized by Helder and De Vries, 1979).

Nitrate plus Nitrite (NO_3+NO_2) is mixed with an imidazol buffer at pH 7.5 and reduced by a copperized cadmium column to Nitrite. This is diazotated with sulphanylamide and naphtylethylene-diamine to a pink colored complex and measured at 550 nm. Nitrate is calculated by subtracting the Nitrite value of the Nitrite channel from the 'NO_3+NO_2' value (Grasshoff et al., 1983).

Nitrite (NO_2) is diazotated with sulphanylamide and naphtylethylene-diamine to form a pink colored complex and measured at 550nm (Grasshoff et al., 1983).

Statistics of the analysis of this cruise:

The standard deviation of the 3rd calibrant (n=10) in the same run:

PO_4	:	0.005 µmol/L
NH_4	:	0.011 µmol/L
NO_3+NO_2	:	0.041 µmol/L
NO_2	:	0.002 µmol/L

The standard deviation of mixed nutrient standard (n=30) between different runs:

PO_4	:	0.009 µmol/L
NH_4	:	0.018 µmol/L
NO_3+NO_2	:	0.059 µmol/L
NO_2	:	0.005 µmol/L

Limit of detection:

PO_4	:	0.011 µmol/L
NH_4	:	0.030 µmol/L
NO_3+NO_2	:	0.005 µmol/L
NO_2	:	0.004 µmol/L

Measured average of the Kanso Reference Material Lot BU:

PO_4	:	0.364 µmol/L

NH_4	:	1.705 µmol/L
NO_3+NO_2	:	4.101 µmol/L
NO_2	:	0.086 µmol/L

6 Phytopigment, pico-, nanoplankton and TOC Fleur van Duyl, Avila Lindgren

We sampled water at 54 CTD, UCC and gradient sampler stations at 3-6 depths (see supplementary material for stations and depths sampled). Water samples were obtained of the following variables:

1. Phytopigments
2. Particulate organic matter (not done for PUMPY, insufficient water)
3. Total organic matter
4. Bacterioplankton/virus abundance
5. Phytoplankton abundance

Focus was on phytopigments, pico-and nanoplankton and organic matter in water masses shallower than 200-250m outside and on the bank. In deeper waters we sampled mostly from the deep chl-a maximum (based on fluorescence) towards the surface. On the bank we will compare plankton and organic matter (OM) concentrations at the bottom with those at the surface and follow the changes in these differences over the bank and try to relate patterns with different water masses and benthic communities on the bank. Benthic communities on the Bank were documented with a series of underwater camera/video transects with the NIOZ-hopper video camera and GoPro. In addition we will take account of the different water masses flowing over the Bank as characterized by temperature, salinity and inorganic nutrients among others.

Methods

Water samples were obtained from CTD niskin bottles, UC-CTD bottles and plastic bags of the bottom water gradient sampler. With 2 filtration set-ups (see photo) water was filtered over GF75 filters of 47 mm diameter for phytopigments and over 25 mm diameter GF75 filters for particulate organic matter. For phytopigments up to 10 L water was filtered and for particulate organic matter (POM) approximately 2 L per depth. POM was not sampled from the gradient sampler (insufficient water). The volume of filtered water was measured for each filter to be able to assess the concentration of the variable e.g. phytopigments per unit volume. After filtering filters were folded, packed in aluminium foil and shock frozen before storage in the -80°C freezer. In addition 30 ml water samples were taken for TOM (TOC and TN) which were fixed with 200 µL concentrated HCl. Samples for bacterioplankton and viral abundance (1 ml) were fixed with 20 µl glutaraldehyde solution. Phytoplankton in 3.5 ml water was fixed with a formaldehyde/hexamine solution. After cooling in a refrigerator for 15-30 mins, samples of bacterio/virioplankton and phytoplankton were also shock frozen in liquid nitrogen and stored in a -80 °C freezer. These latter biological samples will be analysed by flowcytometry.

Results

No results are available yet. We did see however clear differences in material collected on filters between samples taken on the Saba Bank and the water masses around the Bank. Also vertical gradients were found on most deep stations (>250m deep) between 0 and 200/250m.

7 Trace elements and their isotopes (TEI's) Sharyn Ossebaar

Since seawater samples are easily contaminated with e.g. Zn, sampling from the UC CTD bottles was performed using cleanroom clothing, rubber booths and gloves throughout the complete procedure. Prior to UC sampling, all other samples were taken from the bottles without the use of cleanroom clothing. After all sampling was done, the container floor was cleaned with tap water while in the meantime the air in the container is refreshed/ cleaned. Measurements have shown that the air is clean within minutes and ready for trace metal sampling.

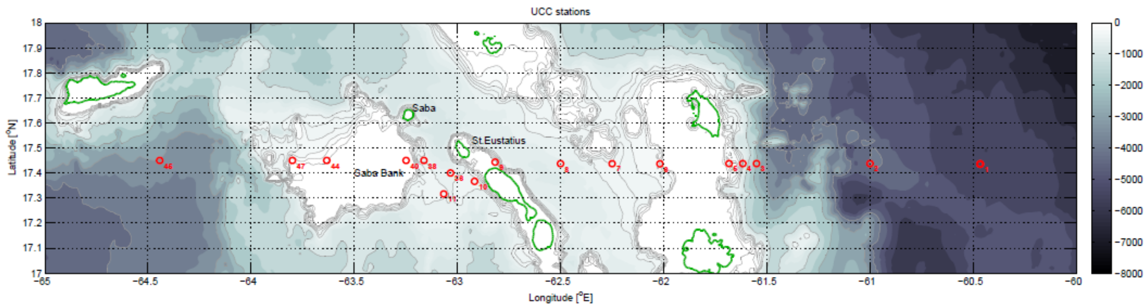


Figure 9: all stations where UC CTD samples were taken during 64PE414.

Per sample depth, 2 bottles were filled with 0.2 µm-filtered seawater. For this we use the pressurized filter system inside the cleanroom container. A normal working pressure is ~0.7 bar N_2 pressure, allowing a filtered water flow of approximately 1L per minute. In case the flow was significantly lower, the pressure was adjusted.

One filter was used for all depth sampling after discarding the first 1L of seawater. All sample bottles (one of 1000 ml and one of 250 ml) were filled with ~0.35M nitric acid. All sample bottles were therefore emptied and rinsed 5 times with seawater before they were filled until the shoulder. After filling, all bottles were acidified with 1 ‰ (1ml/1000ml or 250µL/250ml) of ~14M Nitric acid Quartz distilled grade. Pipet tips that were used for the samples were first rinsed with MQ and those for the acidification were rinsed with the acid.

After sampling and acidification of the samples, the container floor, but not the frame and bottles, were cleaned by rinsing with fresh water. After filtering, the filters were stored double bagged in the fridge. All samples were double bagged and stored within boxes in a separate container.

8 Microscale turbulence measurements Rene van Westen, Adam Candy

The Self Contained Autonomous Microstructure Profiler (SCAMP) is a free falling instrument, capable of measuring high-resolution profiles of temperature, salinity and fluorescence in the upper 100m. The falling velocity is controlled by moderating the buoyancy of the SCAMP with drifters or weights, in this case, pieces of lead. In order to obtain an approximate depth resolution of 1mm, during the expedition the velocity of the SCAMP was adjusted to 10 cm s^{-1}, and verified after each cast. This high resolution allows us to resolve quantities related to the turbulence of the water column.

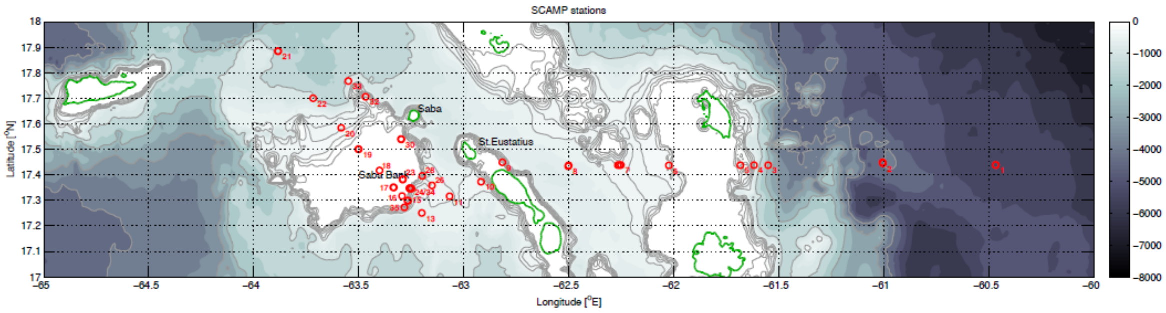


Figure 10: all stations where the SCAMP was deployed.

There are six different sensors mounted on the SCAMP: two fast temperature sensors, one fast conductivity sensor, one (combined) accurate temperature and conductivity sensor, a fluorometer and a pressure sensor. During the expedition, the SCAMP was deployed 36 times at 25 different stations. It is lowered into the water from the end of the ship with the ship's engines turned off to protect the propeller from potential entanglement with the line. The overall wind conditions in the area of interest were moderate (4 – 5Bft), causing the ship to drift away from the SCAMP. To compensate for this effect, the retrieval line of length 200m was fully unwound and resulted in a maximum achievable depth of approximately 50m, depending on ocean and wind conditions. On top of that, waves influence the falling velocity of the SCAMP, leading to a 'yoyo' in some profiles. We found the ocean to be a challenging environment for a lightweight instrument such as the SCAMP.

During the first few days, the SCAMP measurements were set to begin after reaching a depth of 2m. However, from different down casts profiles, the conductivity (and therefore salinity) showed a significant offset compared to the expected values (when compared to the CTD casts at the same locations). After investigating several potential causes for the discrepancy we concluded this was due to the high sensitivity to open air of the accurate conductivity sensor. This is inevitable and difficult to avoid while lowering the SCAMP from the ship deck. The best solution we found was to activate the SCAMP out of water with a 180s delay, lower it into the ocean and a further 12m down and then once it is again back close to the surface the true cast and measurements begin.

The data for each profile is stored on the SCAMP which can be downloaded over a serial USB connection to a computer. The profiles can directly be displayed and analysed. Some routines are provided on processing the raw data of the SCAMP. However, these routines are slightly adapted to overcome the 'yoyo' in the profiles, which affects the quality of the analysis and turbulence related quantities. The data output of the fluorometer mounted on top of the SCAMP has been compared to the data of the CTD. Generally, the SCAMP measures the same profiles as the CTD with depth, but more analysis will be made once off ship to convert the values of the SCAMP's fluoremeter (Volt) to chlorophyll-a concentrations. Additionally, the temperature and salinity profiles of the SCAMP and CTD will be analysed and compared in more detail. In particular, a closer inspection of the falling velocities throughout depth will be made to ensure the turbulence measurements are accurate.

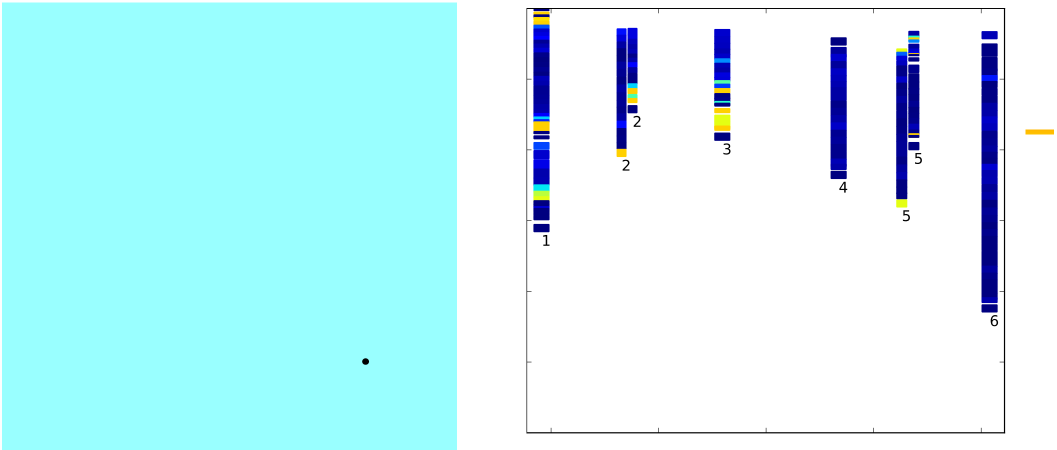


Figure 11: Left panel: Position of six stations along a transect over Saba Bank during 25 August 2016. Right panel: Dissipation rate (m^2s^{-3}) due to turbulence in depth for each station. Note that some stations have multiple casts.

The dissipation due to turbulence in the water column can be determined from the high-resolution temperature measurements made by the SCAMP. In figure 11, eight of the profiles made on 25 August 2016 are presented. Station 1 and 6 are located in relative deep water, while the other four stations are on the bank in shallow water (< 40m). From these profiles (figure 11) it is possible to determine a coefficient of vertical, which will be related to the redistribution of nutrients or chlorophyll-a in the water column.

Unfortunately, during one of the SCAMP deployments, the instrument became stuck on the seabed while the ship drifted away. This took place inbetween the two relatively deep (20m) sills on the southern edge of Saba Bank. The retrieval line broke and the SCAMP was lost. The crew was not able to find the SCAMP nor the remainder of the retrieval line. Divers from Saba will look for the SCAMP in the upcoming days. There is a significant challenge in ship deployments into the open ocean, where the ship can move vertically many meters over surface wave periods, and additionally currents and winds can push (unpowered) large ships relatively large distances during the time it takes to down and upcast the SCAMP.

9 Photographic survey of the benthic community — Erik Meesters, Didier de Bakker

By analyzing the pictures and determining approximate cover of important benthic categories a classification of the pictures will be made. Furthermore this classification can then be analyzed by statistical models to increase our understanding of the Saba Bank and to predict the distribution of the different communities over the bank using as well the chemical and oceanographic data that have been collected during the cruise.

Material and Methods

To study and understand the distribution of the different communities of the Saba Bank we collected video and photos from 31 places on the bank. The data were collected with the NIOZ hopper frame which is equipped with two video cameras and, on this trip, with additionally a GoPro Hero 4 Black camera with an adapted housing as well as a number of lights. The frame had two cameras pointing at the bottom and one camera pointing forward. One of the downward looking cameras is a HD camera of which also frame grabs were made during recording. Camera signals, with the exception of the GoPro photos, were collected in real time on board of the ship through an optical cable running through the winch cable, which also allowed for control of the cameras. On board the images from the forward and downward looking camera could be viewed and if the bottom came too close to the hopper frame the winch operator, who can also view the images, would rise the frame in small increments. The frame grabber and the GoPro recorded at an interval of 5 seconds. The time of the different recording devices was synchronized with GPS time to allow for exact positioning of the pictures. Photo resolutions were 4000 x3000 for the GoPro and 1920 x 1080 for the other downward looking camera.

Each transect started at a chosen position on the Bank and after the image capturing was started the ship would start and head to the finishing point which was mostly within 1nm at a speed over the ground of approximately 0.3 knts. During deployment the hopper frame was lowered to 1-2m above the bottom and the collection of images started as soon as the bottom was visible on the screens on board (the GoPro started collecting pictures already on board. The pictures that were not part of the transect were later removed from the data set). The ship's captain knew beforehand the exact course he had to steer the vessel and was in constant communication with the scientists in the camera control room.

An algorithm was written to calculate the exact position of each photo and its distance to the next photo. Pictures separated by less than 10 meters were not be selected for the analysis. If a selected picture was not clear enough for analysis the next closest photo was chosen.

The pictures will be analyzed to estimate the cover or density of important benthic categories over the bank. These measurements will be used to define different communities on the bank (most likely communities will be deep fore reef community, fore reef community, back reef community, shallow gorgonian community, Sargassum community, seaweed community, sand flat). Then we will link the biological communities to the oceanographic and physical data that are also collected during the cruise. We will attempt to generate statistical models which can be used to predict the occurrence of different communities over the bank and to understand the physical and biological processes that govern them.

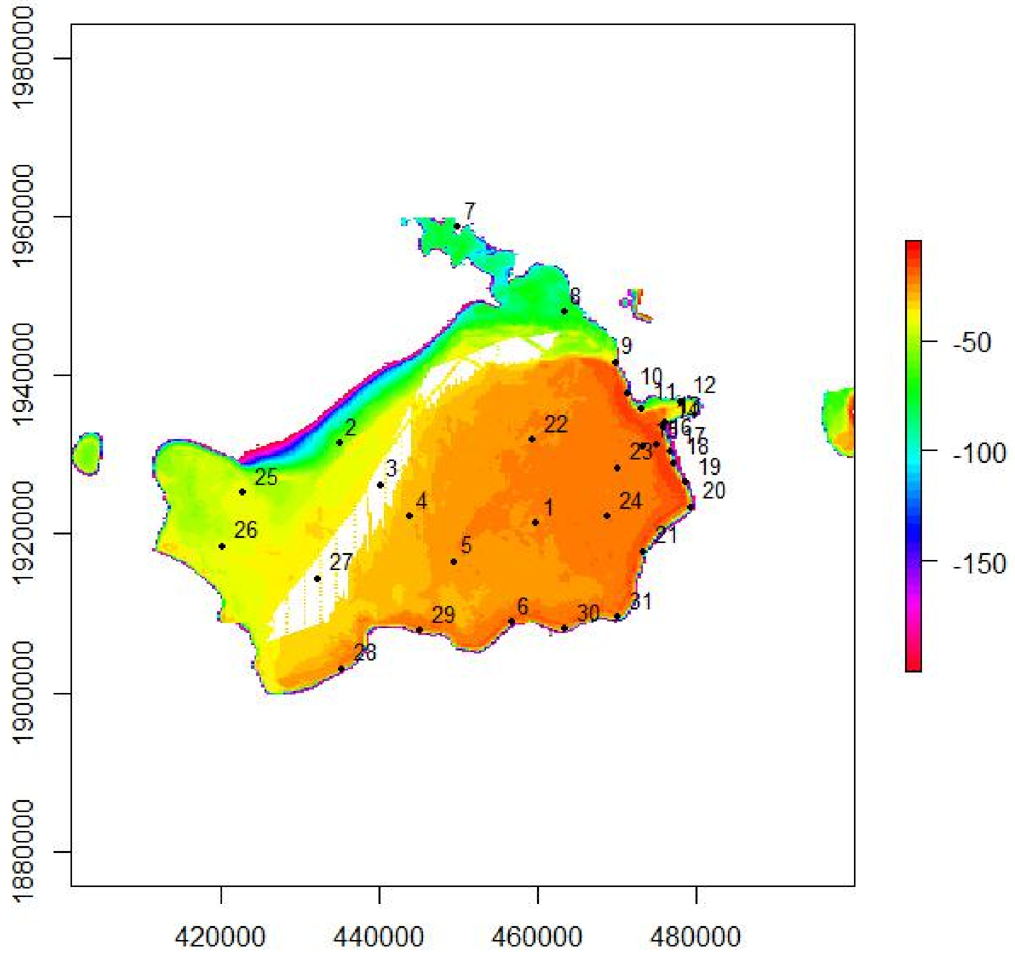


Figure 12: Bathymetric map of the bank with the different locations that were investigated by the NIOZ hopper frame. The white area has no bathymetric data. Number refer to the hopper stations.

Preliminary Results (4 Sept. 2016)

In total more than 32.000 pictures were collected. An example of a track with the position of the pictures and the position of the pictures that were selected for analysis is shown below. In total the 31 tracks resulted in approximately 1800 pictures that were each 10m separated from the next picture. The analysis of these pictures in ongoing but will be relatively quick.

A first inventory of the photos indicate that large changes can occur within 1000m even on relatively flat bottom. While on the edge of the bank there are clear differences that were expected and which resulted in relatively easy to predict communities we found also that differences in depth of only a few meters further ‘in land’ of the Bank can have large consequences for the organisms living in such an area. Furthermore, hydrodynamic measurements and modelling indicated that water currents around the bank are very different than we first assumed which may have a profound influence on our understanding of the coral communities on the bank and their growth during the Holocene.

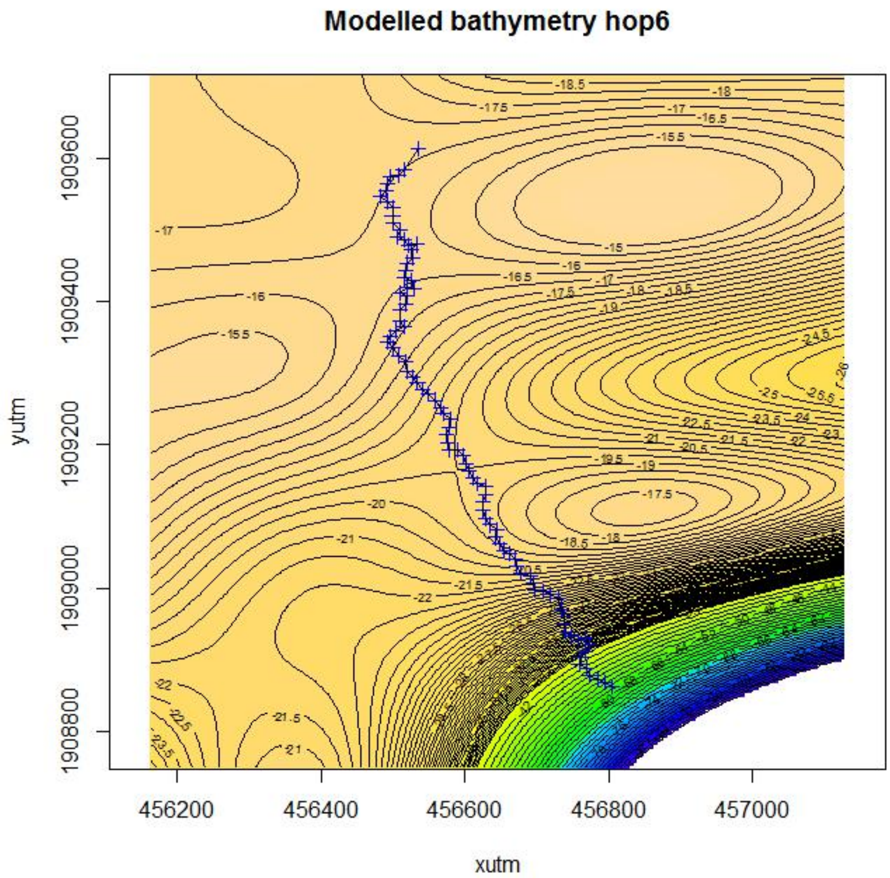


Figure 13: Hopper frame location 6 covers approximately 800m of bottom. During the track 733 pictures were taken of which ultimately 91 were selected for analysis. The + signs denote the final pictures and their distribution along the transect. Bathymetric lines are modelled from data from the Royal Hydrographic Survey, The Netherlands Navy.

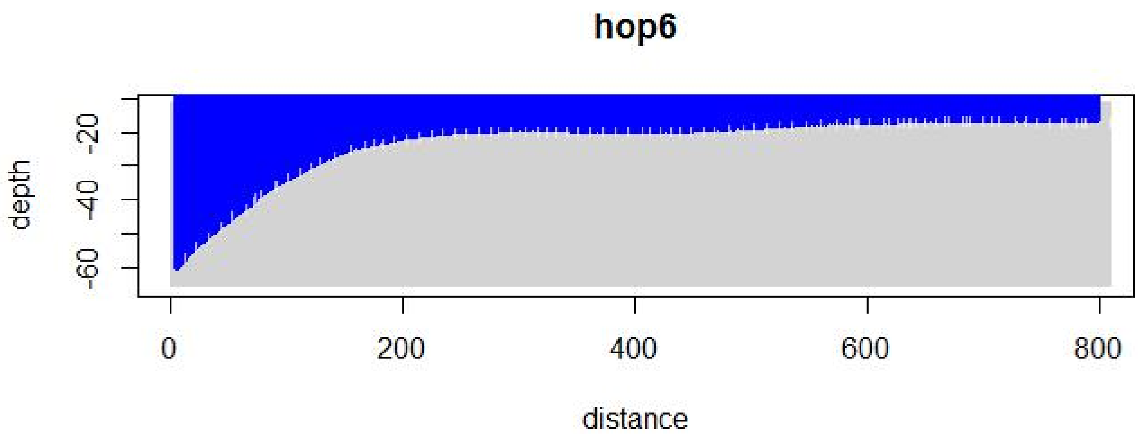


Figure 14: Depth profile of the same transect which started at 60 m depth and continued for 800m. White dashes indicate the depth at which the selected pictures were taken.

10 Vessel-mounted ADCP — Adam Candy, René van Westen

Vessel Mounted Acoustic Doppler Current Profiler (vmADCP) data were collected from a hull-mounted RDI 75 kHz instrument with a range of approximately 30 – 600m. The instantaneous current field and depth were continuously monitored by a VmDas acquisition system and collected on a dedicated service computer, together with navigation data (time, position, heading and tilt), for the determination of the alignment of the vmADCP relative to the Seapath GPS antenna. Note external sources were used in preference to the internally-available ADCP compass and tilt sensor, for both increased accuracy and consistency with other measurements made onboard. This data was collected in files up to 15MB in size, and regularly transferred to the appropriate directory of the ship's computer network.

Processing in combination with the navigational information was done at time of acquisition. The raw and processed data have been stored alongside the two raw NMEA streams from Seapath GPS and onboard Gyro.

Final data processing will take place at the home institute after the cruise, possibly including post-processing calibration with data from the ADCPs on the deployed gradient sampler and lander placed at the centre of the bank. The water current profile was determined in 60 bins, each with a size of 1m. Further details of the configuration during the expedition can be found alongside the saved dataset.

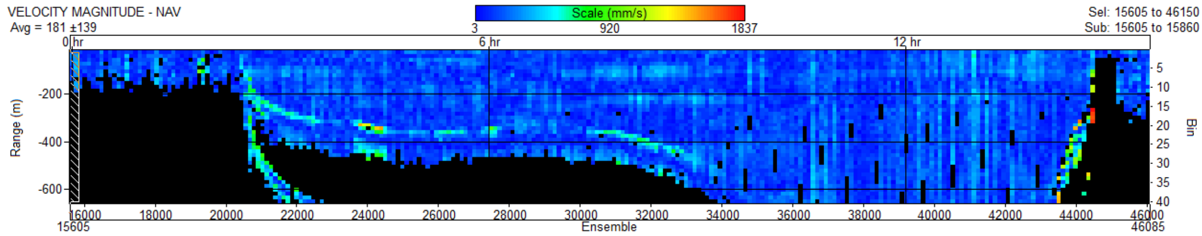


Figure 15: An example of one of the velocity profile sections recorded by the VMADCP, indicating higher observed velocities around the slopes of the bank.

11 Mercator ocean forecast — Adam Candy

During the expedition a process for generating seven-day forecasts of ocean conditions, both in the Saba Bank area (1° about a centre position of 17.5°N 63.5°W) and in a wider Caribbean region (4° about a centre position of 16°N 64°W) was developed, where it was important that this function over the ship satellite link.

The Mercator Ocean product with data assimilation was selected. This contains a seven day forecast, is updated daily and at the native model grid resolution of 1/12°. It uses a Kalman filter assimilation scheme to include sea surface temperature from Reynolds AVHRR-AMSR 1/4°; sea surface height from remote-sensed satellite data from Jason2, Cryosat and Saral; in-situ temperature and salinity vertical profiles from the Coriolis Cente; hourly ECMWF operational forcings; and bulk CORE Formulation forcings.

Mercator Ocean provide an OPeNDAP interface so that a limited subset of the full model output can be downloaded, which makes it suitable for use over the ship's satellite link. The daily mean dataset (containing velocity, salinity and temperature over depths) is 26.5MB, whilst the 2-hourly mean dataset (containing only surface fields) is 6.3MB. With the time difference, the new forecasts could be downloaded and processed overnight, ready for analysis the following day.

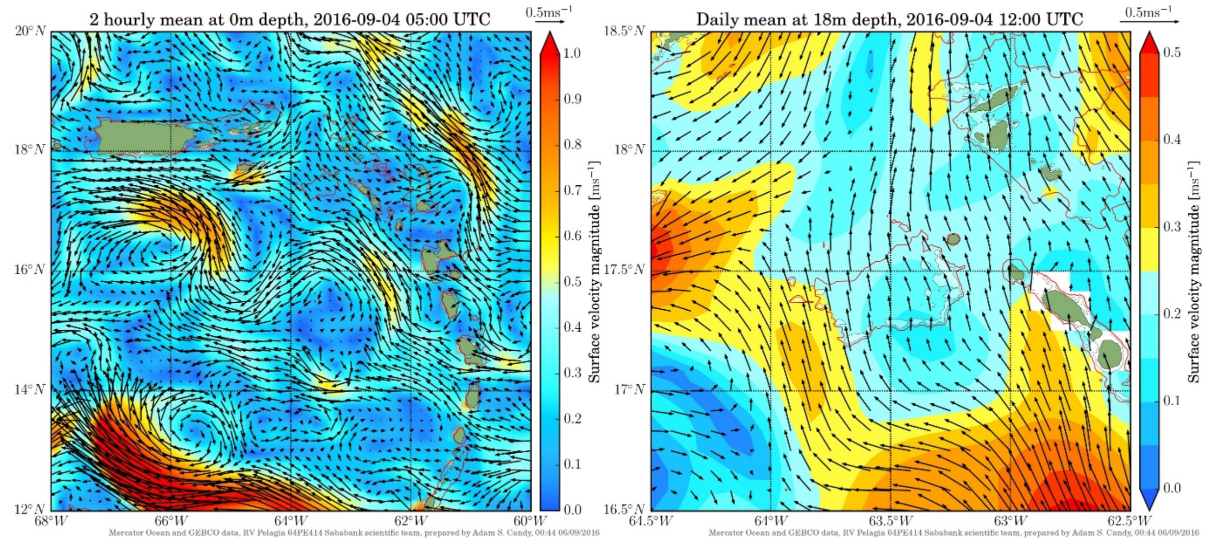


Figure 16: (Left) Two-hourly mean surface velocity forecast for 5/9/2016 over the Caribbean Sea region. (Right) Daily mean horizontal velocity at 18m depth over the Saba Bank region.

Additionally this data was used to a generate 3D visualisations of the flow over the bank in combination with high-resolution bathymetry data from the GEBCO 30 arc-second 2014 dataset and a recent survey by the Dutch Royal Hydrographic Survey.

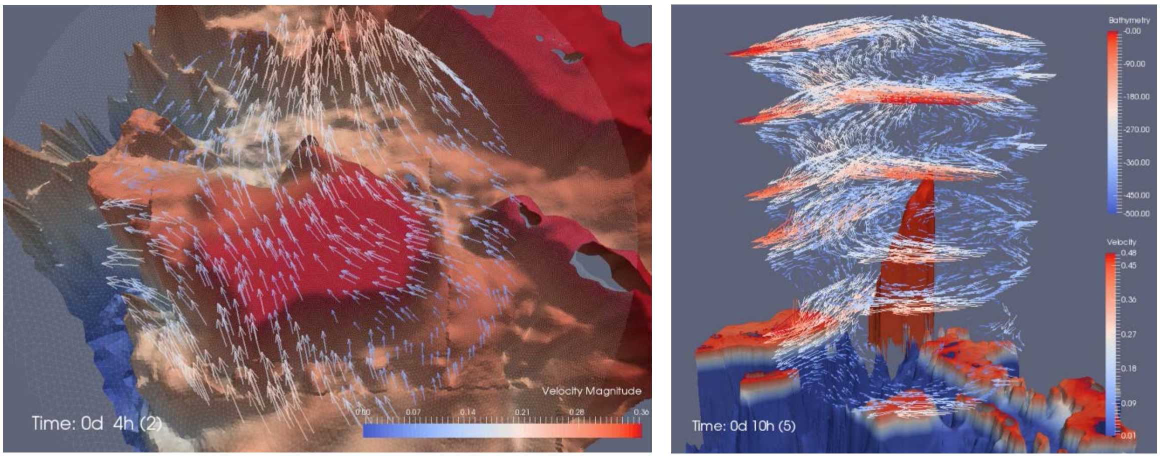


Figure 17: (Left) Surface flow over Saba Bank embedded into an unstructured 3D mesh model of the bathymetry in the Caribbean Sea. (Right) Velocities at 1m, 10m, 22m, 30m and 48m below the surface shown around a vertically-exaggerated bathymetry of Saba Bank, together with the bathymetry in the wider region shown below.

These were used to inform and guide the cruise path and focus, and in initial efforts to analyse the effect of the local hydrodynamics on the chemical and biological processes on the bank.

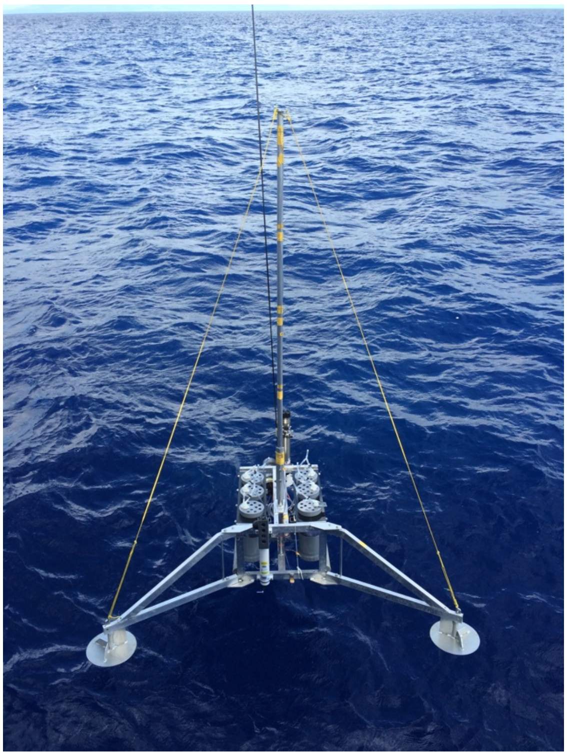
12 deployments

12.1 ADCP Adam Candy

The frame deployed on Saba Bank contained a Nortek AWAC ADCP mounted in an upward-facing position. Frequency of this device is 1MHz and a total range of 20m, with 20 bins, each of a 1 m size. From the resultant dataset, orientation of the frame and instrument was determined to be almost exactly horizontal (<1º offset from vertical)

12.2 Gradient sampler Steven van Heuven, Bob Koster, Lennart de Nooijer, Adam Candy

12.2.1 Gradient sampler



A gradient sampler was developed at the NIOZ in 2016. It consists of an aluminum frame (dimensions approximately 2x2x1m) in which six sampling units are mounted. These units each contain a small pump that fills a gas-impermeable bag (~6 L). The samples are collected through tubes that can be adjusted in height: here the samples were all taken at 0.1, 0.3, 0.6, 1.0, 2.0, 3.0 meters from the bottom of the lander frame (figure 18). The pumps were fed by a mounted battery pack and programmed so that they started pumping 45 minutes after deployment. This is to avoid any disturbed and suspended sediment from entering the sample bags. Pumping was automatically stopped after 30 minutes, close to the time of retrieval. One deployment was made at station 33, where water depth was 75 meters, all other deployments were considerably shallower (<30 meters). Sampling of the filled bags was done on deck, following similar procedures as were employed for sampling the CTD bottles. Sampling for oxygen was performed on one of the early gradient sampling stations. Due to small amounts of residual air in the bags, measured oxygen concentrations were determined to not be representative of in-situ conditions. Sampling from the gradient sampler for oxygen was therefore not performed on subsequent stations.

Figure 18: two GoPro recordings from a deployment of the gradient sampler.

12.2.2 Gradient Sampler Acoustic Doppler Current Profiler

The gradient sampler contained a Nortek AquaDopp 2 MHz ADCP mounted in an upward-facing position. For each of the seven locations the gradient sampler was deployed, with nine deployments in total, velocity profiles were recorded over approximately a one and half hour period over a range of 1.0 – 11.0 m above the seafloor. Initial processing of the velocity profiles indicate a good match in relative magnitude to observations made by the VMADCP and those predicted by the assimilated model forecast product in the region from Mercator Ocean.

Water column profiles were measured and averaged over a one minute period, and this took place every five minutes during the deployment.

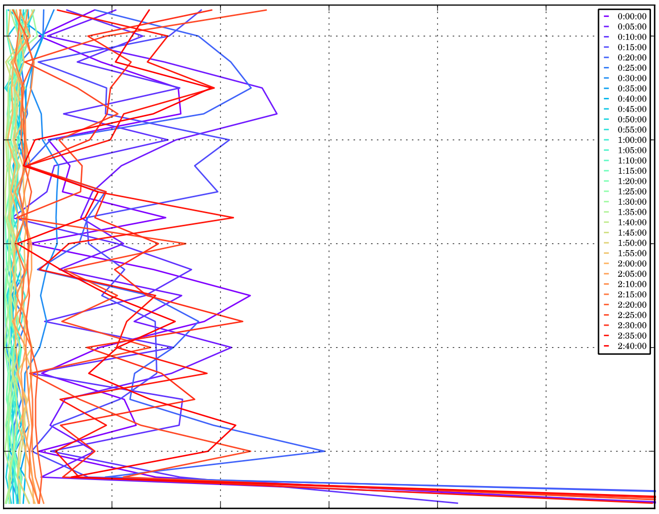


Figure 19: Initial analysis of velocity profiles recorded by the upward-facing ADCP mounted on the gradient sampler. The strongly spiking blue and red lines represent the measurements taken during deployment and recovery.

13 Multibeam   Adam Candy

Throughout the expedition, bathymetric data was collected from the Kongsberg EM302 Swath Multibeam system. The primary role of this instrument during this expedition was to guide and inform deployment of the CTD and SCAMP, and to help with positioning of the hopper.

The device is mounted in a gondola underneath the R.V. Pelagia. This operates at 30kHz, with ping and chirp mode and operates in combination with the Seapath GPS and motion sensors. Typically at 5km water depth this instrument has a swath of approximately 4200m. For measurements over Saba Bank at significantly shallower depths, the swath is much reduced.

The data was recorded using the Kongsberg SIS (Seafloor Information System) software. Raw data will be archived at NIOZ for conceivable future processing.

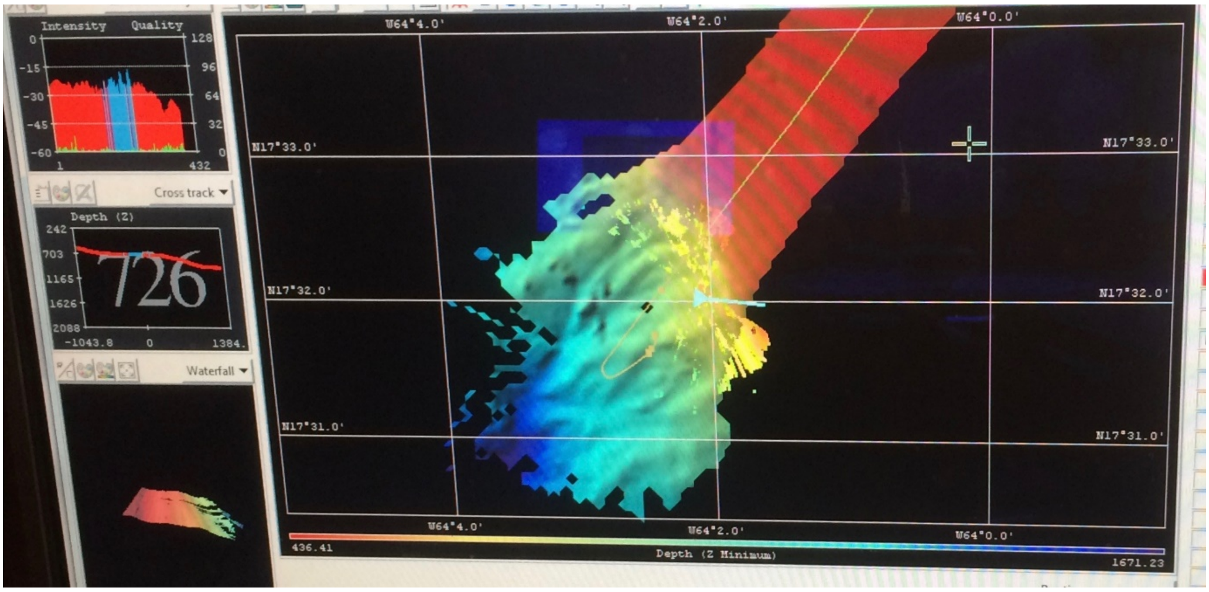


Figure 20: Output from the multibeam sea floor imager on the approach to Saba Bank.

14 Appendices

14.1 UC CTD sample depths

Station				01								
Cast				01								
Time in (UTC)				19:00								
Multibeam depth				5167								
Operator				LdN								
bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto	TEIs
1	5158		X	XX	X	XX	X					X
2	4250			X			X					
3	3499		X	X	X	X	X					X
4	2749			X			X					
5	2000	XX	XX	X	X	XX	X					X
6	1749			X			X					
7	1500			X			X					X
8	1250			X			X					
9	1000			X	X	X	X					X
10	5											

11	5											
12	5											
13	5											
14	5											
15	5											
16	5											
17	5											
18	5											
19	5											
20	5											
21	5											
22	5											
23	5											
24	5											

Station	01
Cast	03
Time in (UTC)	19:00
Multibeam depth	5167
Operator	LdN

bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto	TEIs
1	1501	X	XX	X	X	X	X					X
2	1247			X			X					
3	1002			X	X	X	X					X
4	900			X			X					
5	804		X	X	X	XX	X					X
6	700			X			X					
7	601			X	X	X	X					X
8	501			X			X					
9	403		X	X			X					X
10	305			X	X	X	X					
11	250			X			X					X
12	201			X			X					
13	149	X		X	X	X	X					X
14	149						X	X	X	X	X	
15	101			X	X	X	X					X
16	101						X	X	X	X	X	
17	50			X	X	X	X					X
18	50						X	X	X	X	X	
19	20			X	X	X	X					X
20	20						X	X	X	X	X	
21	10	BOTTLE EMPTY										
22	10			X			X	X	X	X	X	
23	4		XX	X	X	X	X					X
24	4						X	X	X	X	X	

Station	02
Cast	01
Time in (UTC)	9:15

Multibeam depth	5130
Operator	LdN

bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto	TEIs
1	4040		X	XX	X	XX	X					X
2	3499			X			X					
3	2997			X	X	X	X					X
4	2500			X			X					
5	2001	XX	XX	X	X	XX	X					X
6	1503			X			X					
7	1251			X			X					X
8	1004			X	X	X	X					
9	903			X			X					X
10	802			X			X					
11	702		XX	XX	X	XX	X					X
12	603			X			X					
13	501			X	X	X	X					X
14	401			X			X					
15	300			X			X					X
16	251			X			X					
17	200			X			X					
18	149			X	X	X	X	X	X	X	X	X
19	100			X	X	X	X	X	X	X	X	
20	75			X	X	X	X	X	X	X	X	X
21	75			X								
22	49		X	XX	X	X	X	X	X	X	X	
23	19			X			X	X	X	X	X	X
24	5			X			X	X	X	X	X	

Station	03
Cast	01
Time in (UTC)	17:00
Multibeam depth	2430
Operator	LdN

bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto	TEIs
1	2415		X	XX	X	X	X					
2	2001	XX		X			X					X
3	1750			X	X	X	X					
4	1501			X			X					X
5	1251			X			X					
6	1000		X	XX	X	XX	X					X
7	900			X			X					
8	800			X	X	X	X					X
9	700			X			X					
10	600		X	X	X	X	X					X
11	500			X			X					
12	450			X			X					X
13	400		X	XX	X	XX	X					
14	349						X					X

15	300			X			X					
16	250						X					X
17	200			X	X	X	X					
18	150						X	X	X	X	X	X
19	100		X	X	X	X	X	X	X	X	X	
20	75				X	X	X	X	X	X	X	X
21	75											
22	50			X			X	X	X	X	X	X
23	21				X	X	X	X	X	X	X	
24	5			X			X	X	X	X	X	X

Station	04
Cast	02
Time in (UTC)	20:15
Multibeam depth	1360
Operator	LdN

bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto	TEIs
1	1325	X	X	XX	X	XX	X					
2	1000			X			X					X
3	800			X			X					
4	601		X	X	X	X	X					X
5	401			X			X					
6	301			X			X					X
7	200		X	X	X	XX	X	X	X	X	X	
8	125			X			X	X	X	X	X	X
9	75			X	X	X	X	X	X	X	X	
10	50			X			X	X	X	X	X	X
11	19		X	X	X	X	X	X	X	X	X	
12	5			X			X	X	X	X	X	X
13	5											
14	5											
15	5											
16	5											
17	5											
18	5											
19	5											
20	5											
21	5											
22	5											
23	5											
24	5											

Station	05
Cast	01
Time in (UTC)	11:00
Multibeam depth	360
Operator	BK

bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto	TEIs
1	352	X	X	XX	X	XX	X					
2	301			X			X					X
3	250			X			X					
4	200		X	X	X	X	X					X
5	175			X			X					
6	150			X			X					X
7	124		X	X	X	XX	X	X	X	X	X	
8	100			X			X	X	X	X	X	X
9	75			X	X	X	X	X	X	X	X	
10	50			X			X	X	X	X	X	X
11	25		X	X	X	X	X	X	X	X	X	
12	5			X			X	X	X	X	X	X
13	5											
14	5											
15	5											
16	5											
17	5											
18	5											
19	5											
20	5											
21	5											
22	5											
23	5											
24	5											

Station	06
Cast	01
Time in (UTC)	16:10
Multibeam depth	250
Operator	RvW

bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto	TEIs
1	251	X	X	XX	X	XX	X					
2	226			X			X					X
3	199			X			X					
4	175		X	X	X	X	X					X
5	150			X			X					
6	125			X			X	X	X	X	X	X
7	100		X	X	X	XX	X					
8	80			X			X	X	X	X	X	X
9	60			X	X	X	X	X	X	X	X	
10	41			X			X	X	X	X	X	X
11	30		X	X	X	X	X	X	X	X	X	
12	5			X			X	X	X	X	X	X
13	5											
14	5											
15	5											
16	5											
17	5											

18	5											
19	5											
20	5											
21	5											
22	5											
23	5											
24	5											

Station	07
Cast	01
Time in (UTC)	19:15
Multibeam depth	420
Operator	AC

bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto	TEIs
1	400	X	X	XX	X	XX	X					
2	350			X			X					X
3	300			X			X					
4	251		X	X	X	X	X					X
5	200			X			X					
6	151			X			X					X
7	100		X	X	X	XX	X	X	X	X	X	
8	75			X			X	X	X	X	X	X
9	50			X	X	X	X	X	X	X	X	
10	25			X			X	X	X	X	X	X
11	5		X	X	X	X	X	X	X	X	X	
12	5			X			X	X	X	X	X	X
13	5											
14	5											
15	5											
16	5											
17	5											
18	5											
19	5											
20	5											
21	5											
22	5											
23	5											
24	5											

Station	08
Cast	01
Time in (UTC)	11:15
Multibeam depth	625
Operator	LdN

bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto	TEIs
1	601	X	X	XX	X	XX	X					
2	500			X			X					X

3	400			X			X					
4	301		X	X	X	X	X					X
5	200			X			X	X	X	X	X	
6	151			X			X					X
7	125			X	X	XX	X					
8	100			X			X	X	X	X	X	X
9	69			X	X	X	X	X	X	X	X	
10	50			X			X	X	X	X	X	X
11	26		X	X	X	X	X	X	X	X	X	
12	4			X			X	X	X	X	X	X
13	4											
14	4											
15	4											
16	4											
17	4											
18	4											
19	4											
20	4											
21	4											
22	4											
23	4											
24	4											

Station	09
Cast	01
Time in (UTC)	14:45
Multibeam depth	300
Operator	AC

bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto	TEIs
1	275	X	X	XX	X	XX	X					
2	250			X			X					X
3	225			X			X					
4	200		X	X	X	X	X	X	X	X	X	X
5	174			X			X					
6	150			X			X	X	X	X	X	X
7	125		X	X	X	XX	X					
8	101			X			X	X	X	X	X	X
9	76			X	X	X	X					
10	51			X			X	X	X	X	X	X
11	25		X	X	X	X	X	X	X	X	X	
12	5			X			X	X	X	X	X	X
13	5											
14	5											
15	5											
16	5											
17	5											
18	5											
19	5											
20	5											
21	5											
22	5											

23	5											
24	5											

Station	10
Cast	02
Time in (UTC)	17:45
Multibeam depth	420
Operator	RvW

bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto	TEIs
1	400	X	X	XX	X	XX	X					
2	350			X			X					X
3	300			X			X					
4	250		X	X	X	X	X					X
5	200			X			X					
6	150			X			X	X	X	X	X	X
7	126		X	X	X	XX	X					
8	100			X			X	X	X	X	X	X
9	75			X	X	X	X	X	X	X	X	
10	50			X			X	X	X	X	X	X
11	25		X	X	X	X	X	X	X	X	X	
12	5			X			X	X	X	X	X	X
13	5											
14	5											
15	5											
16	5											
17	5											
18	5											
19	5											
20	5											
21	5											
22	5											
23	5											
24	5											

Station	11
Cast	02
Time in (UTC)	21:45
Multibeam depth	484
Operator	LdN

bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto	TEIs
1	450	X	X	XX	X	XX	X					
2	402			X			X					X
3	350			X			X					
4	300		X	X	X	X	X					X
5	250			X			X					
6	200			X			X	X	X	X	X	X
7	150		X	X	X	XX	X					

8	101			X			X	X	X	X	X	X
9	75			X	X	X	X	X	X	X	X	
10	50			X			X	X	X	X	X	X
11	24		X	X	X	X	X	X	X	X	X	
12	5			X			X	X	X	X	X	X
13	5											
14	5											
15	5											
16	5											
17	5											
18	5											
19	5											
20	5											
21	5											
22	5											
23	5											
24	5											

Station	36
Cast	01
Time in (UTC)	11:15
Multibeam depth	550
Operator	LdN

bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto	TEIs
1	542		X	X	XX		X					
2	500			X			X					X
3	400		X	X	X		X					
4	301			X			X					X
5	250			X	X		X					
6	201			X			X					X
7	150	X	X	X			X					
8	98			X	XX		X					X
9	76			X			X					
10	50			X	X		X					X
11	24			X			X					
12	5		X	X	XX		X					X
13	5											
14	5											
15	5											
16	5											
17	5											
18	5											
19	5											
20	5											
21	5											
22	5											
23	5											
24	5											

Station	38

Cast	01
Time in (UTC)	14:45
Multibeam depth	440
Operator	RvW

bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto	TEIs
1	418		X	XX	XX		X					
2	300			X	XX		X					X
3	250		X	X			X					
4	201			X	XX		X					X
5	151	X		X			X					
6	100		X	X	XX		X					X
7	25			X			X					
8	5		X	X	X		X					X
9	5											
10	5											
11	5											
12	5											
13	5											
14	5											
15	5											
16	5											
17	5											
18	5											
19	5											
20	5											
21	5											
22	5											
23	5											
24	5											

Station	40
Cast	02
Time in (UTC)	17:30
Multibeam depth	20
Operator	RvW

bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto	TEIs
1	17	X	X	XX	XX		X	X				
2	17								X	X	X	
3	17											X
4	12			X	XX		X	X				X
5	12								X	X	X	
6	12											
7	9			X	XX		X					X
8	9											
9	9											
10	5			X	XX		X	X				X

11	5								X	X	X	
12	5											
13	5											
14	5											
15	5											
16	5											
17	5											
18	5											
19	5											
20	5											
21	5											
22	5											
23	5											
24	5											

Station					44							
Cast					01							
Time in (UTC)					22:00							
Multibeam depth					62							
Operator					AC							
bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto	TEIs
1	57											
2	57	X	X	XX	XX		X	X				X
3	57								X	X	X	
4	40											
5	40			X	XX		X	X				X
6	40								X	X	X`	
7	25											
8	25			X	XX		X	X				X
9	25											
10	5											
11	5			X	XX		X	X				X
12	5								X	X	X	
13	5											
14	5											
15	5											
16	5											
17	5											
18	5											
19	5											
20	5											
21	5											
22	5											
23	5											
24	5											

Station	45
Cast	02
Time in (UTC)	11:05

Multibeam depth	3210
Operator	AC

bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto	TEIs
1	3102		XX	XX	XX							
2	3102											X
3	2500			X								
4	1500			X								X
5	1000			X	X							
6	900			X								X
7	800			X								
8	700			X								X
9	600		XX	X	XX							
10	500			X								X
11	400			X								
12	299			X								X
13	250			X			X	X	X	X	X	
14	200			X	X							X
15	148			X			X	X	X	X	X	
16	125	X		X								X
17	100								X	X	X	
18	100			X	X		X	X				X
19	84								X	X	X	
20	84			X			X	X				X
21	50				X							
22	50			X			X	X	X	X	X	X
23	5				X				X	X	X	
24	5			X			X	X				X

Station	47
Cast	01
Time in (UTC)	20:30
Multibeam depth	50
Operator	AC

bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto	TEIs
1	43								X	X	X	
2	43	X	X	X	XX		X	X				X
3	38								X	X	X	
4	38			X	XX		X	X				X
5	30											
6	30			X	X							X
7	20											
8	20			X	XX							X
9	5								X	X	X	
10	5			X	XX		X	X				X
11												
12												
13												
14												

15												
16												
17												
18												
19												
20												
21												
22												
23												
24												

14.2 CTD sample depths

Station	13
Cast	01
Time in (UTC)	11:30
Multibeam depth	610
Operator	LdN

bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto
1	606	X	XX	XX	X		X				
2	606										
3	500			X			X				
4	500										
5	400			X			X				
6	300		X	X	XX		X				
7	300										
8	200			X			X	X			
9	200								X	X	X
10	150			X	X		X				
11	150										
12	125										
13	125	X		X	X		X	X			
14	125								X	X	X
15	100			X	X		X	X			
16	100								X	X	X
17	76			X	X		X				
18	76										
19	50			X			X	X			
20	50								X	X	X
21	26		X	X	XX		X	X			
22	26								X	X	X
23	5			X	X		X	X			
24	5								X	X	X

Station	14
Cast	01
Time in (UTC)	13:00
Multibeam depth	605
Operator	LdN

bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto
1	599	X	XX	X	X		X				
2	599										
3	502			X			X				
4	502										
5	401			X			X				
6	401										
7	301		X	X	XX		X				
8	301										
9	200			X			X	X			
10	200								X	X	X
11	150			X	X		X				
12	150										
13	125	X		X	X		X	X			
14	125								X	X	X
15	101			X	X		X	X			
16	101								X	X	X
17	75			X	X		X				
18	75										
19	50			X			X	X			
20	50								X	X	X
21	26		X	X	XX		X	X			
22	26								X	X	X
23	5			X	X		X	X			
24	5								X	X	X

Station	15
Cast	03
Time in (UTC)	14:30
Multibeam depth	16
Operator	LdN

bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto
1	13			XX	XX		X	X			
2	13								X	X	X
3	12.5			X	X		X	X			
4	12.5								X	X	X
5	12			X	X		X	X			
6	12										
7	11	X	XX	X	X		X				
8	11										
9	8			X	X		X				
10	8										
11	6			X	X		X				
12	6										
13	4			X	X		X				
14	4										
15	2			X	XX		X	X			
16	2								X	X	X
17	2										
18	2										

19	2										
20	2										
21	2										
22	2										
23	2										
24	2										

Station	16										
Cast	01										
Time in (UTC)	16:30										
Multibeam depth	24										
Operator	RvW										
bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto
1	22	X	XX	XX	XX		X	X			
2	22								X	X	X
3	22										
4	21		XX	XX	XX		X	X			
5	21								X	X	X
6	21										
7	18		XX	X	XX		X				
8	18										
9	18										
10	16		X								
11	16										
12	16										
13	12		X	X	XX		X				
14	12										
15	12										
16	9										
17	9										
18	9										
19	7										
20	7										
21	7										
22	3			X	XX		X	X			
23	3								X	X	X
24	3										

Station	17										
Cast	03										
Time in (UTC)	17:30										
Multibeam depth	23										
Operator	LdN										
bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto
1	21	X	XX	XX	xx		X	X			
2	21								X	X	X
3	21										
4	18		XX	XX	XX		X	X			
5	18								X	X	X

6	18										
7	15		XX	X	XX		X				
8	15										
9	15										
10	12		X	X	XX		X				
11	12										
12	12										
13	9										
14	9										
15	9										
16	6										
17	6										
18	6										
19	3			X	XX		X	X			
20	3								X	X	X
21	3										
22	3										
23	3										
24	3										

Station					18						
Cast					01						
Time in (UTC)					18:40						
Multibeam depth					23						
Operator					RvW						
bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto
1	21	X	XX	XX	XX		X	X			
2	21								X	X	X
3	21										
4	18		XX	XX	XX		X	X			
5	18								X	X	X
6	18										
7	15		XX	X	XX		X				
8	15										
9	15										
10	12		X	X	XX		X				
11	12										
12	12										
13	9										
14	9										
15	9										
16	6										
17	6										
18	6										
19	3			X	XX		X	X			
20	3								X	X	X
21	3										
22	3										
23	3										
24	3										

Station	19
Cast	01
Time in (UTC)	20:0 0
Multibeam depth	32
Operator	LdN

bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto
1	30	X	XX	XX	XX		X	X			
2	30								X	X	X
3	30										
4	28		XX	XX	XX		X	X			
5	28								X	X	X
6	28										
7	25		XX	X	XX		X				
8	25										
9	25										
10	20		X	X	XX		X				
11	20										
12	20										
13	15										
14	15										
15	15										
16	10										
17	10										
18	10										
19	5			X	XX		X	X			
20	5								X	X	X
21	5										
22	5										
23	5										
24	5										

Station	20
Cast	01
Time in (UTC)	11:30
Multibeam depth	316
Operator	RvW

bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto
1	300	X	XX	XX	XX		X				
2	300										
3	251										
4	251										
5	224										
6	224										
7	200		XX	XX	XX		X	X			
8	200								X	X	X
9	175										
10	175										
11	150	X		X	XX						
12	150										
13	126										

14	126						X	X	X	X	X
15	100		XX	X	XX						
16	100										
17	75						X	X	X	X	X
18	75										
19	50						X	X			
20	50								X	X	X
21	25	X	X	X	XX						
22	25						X	X	X	X	X
23	5						X	X			
24	5								X	X	X

Station	21
Cast	01
Time in (UTC)	11:00
Multibeam depth	1090
Operator	LdN

bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto
1	1080	X	XX	XX	XX	X	X				
2	1080										
3	798			X							
4	798										
5	600			X							
6	600										
7	401	X	XX	X	X	XX	X				
8	401										
9	301			X							
10	301										
11	201			X			X	X			
12	201								X	X	X
13	150			X	XX	X					
14	150										
15	100			X			X	X			
16	100								X	X	X
17	75		XX	X	XX	X	X	X			
18	75								X	X	X
19	50			X			X	X			
20	50								X	X	X
21	25	X	X	XX	XX	X	X	X			
22	25								X	X	X
23	5			X			X	X			
24	5								X	X	X

Station	22
Cast	01
Time in (UTC)	14:18
Multibeam depth	902
Operator	RvW

bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto

1	890	X	XX	XX	XX	X	X				
2	890										
3	600		XX	X	X	X					
4	600										
5	400	X	X	X	X	XX	X				
6	400										
7	300			X	X						
8	300										
9	200			X	X	X	X	X			
10	200								X	X	X
11	150			X							
12	150										
13	126			X	X		X	X			
14	126								X	X	X
15	100			X							
16	100										
17	75		XX	X	X	X	X	X			
18	75								X	X	X
19	50			X			X	X			
20	50								X	X	X
21	25	X	X	XX	X	X	X	X			
22	25								X	X	X
23	5			X			X	X			
24	5								X	X	X

Station	23
Cast	01
Time in (UTC)	11:25
Multibeam depth	16
Operator	RvW

bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto
1	13		X	X	X		X	X			
2	13								X	X	X
3	11			X	X		X	X			
4	11								X	X	X
5	8			X	X		X				
6	8										
7	5			X	X		X	X			
8	5								X	X	X
9	5										
10	5										
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											
21											

22											
23											
24											

Station	23										
Cast	06										
Time in (UTC)	14:05										
Multibeam depth	16										
Operator	AC										
bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto
1	14		X	X	X		X	X			
2	14								X	X	X
3	10			X	X		X	X			
4	10								X	X	X
5	7			X	X		X				
6	7										
7	4			X	X		X	X			
8	4								X	X	X
9	4										
10	4										
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											
21											
22											
23											
24											

Station	24										
Cast	01										
Time in (UTC)	17:30										
Multibeam depth	23										
Operator	AC										
bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto
1	13		X	X	X		X	X			
2	13								X	X	X
3	11			X	X		X	X			
4	11								X	X	X
5	8			X	X		X				
6	8										
7	5			X	X		X	X			
8	5								X	X	X

9	5										
10	5										
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											
21											
22											
23											
24											

Station	24
Cast	06
Time in (UTC)	20:00
Multibeam depth	24
Operator	AC

bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto
1	22		X	X	X		X	X			
2	22								X	X	X
3	18			X	X		X	X			
4	18								X	X	X
5	10			X	X		X				
6	10										
7	4			X	X		X	X			
8	4								X	X	X
9											
10											
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											
21											
22											
23											
24											

Station	26
Cast	01
Time in (UTC)	8:15

Multibeam depth				419							
Operator				LdN							
bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto
1	399	X	XX	XX	XX		X				
2	399										
3	300			X	X						
4	300										
5	249										
6	249										
7	200		XX	XX	X		X	X			
8	200								X	X	X
9	175										
10	175	X		X	X		X				
11	150						X	X			
12	150								X	X	X
13	125										
14	125										
15	100		XX	X	X		X	X			
16	100								X	X	X
17	73						X	X			
18	73								X	X	X
19	50						X	X			
20	50								X	X	X
21	25	X	X	X	XX		X				
22	25										
23	4			X	X		X	X			
24	4								X	X	X

Station				28							
Cast				02							
Time in (UTC)				13:15							
Multibeam depth				27							
Operator				RvW							
bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto
1	25	X	X	XX	XX		X	X			
2	25								X	X	X
3	20			X	XX		X	X			
4	20								X	X	X
5	15			X	XX		X				
6	15										
7	5			X	XX		X	X			
8	5								X	X	X
9											
10											
11											
12											
13											
14											
15											
16											

17											
18											
19											
20											
21											
22											
23											
24											

Station	30										
Cast	02										
Time in (UTC)	16:45										
Multibeam depth	18										
Operator	RvW										
bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto
1	16	X	X	XX	XX		X	X			
2	16							X	X	X	X
3	11			X	XX		X	X			
4	11								X	X	X
5	8			X	XX		X				
6	8										
7	5			X	XX		X	X			
8	5								X	X	X
9											
10											
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											
21											
22											
23											
24											

Station	32										
Cast	02										
Time in (UTC)	20:35										
Multibeam depth	80										
Operator	RvW										
bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto
1	77	X	X	XX	XX		X	X			
2	77								X	X	X
3	65			X	XX		X	X			

4	65								X	X	X
5	40			X	XX		X				
6	40										
7	5			X	XX		X	X			
8	5								X	X	X
9											
10											
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											
21											
22											
23											
24											

Station	33
Cast	01
Time in (UTC)	11:00
Multibeam depth	800
Operator	LdN

bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto
1	800	X	XX	XX	XX		X				
2	800										
3	600			X	X						
4	600										
5	401										
6	401										
7	301			XX	X		X	X			
8	301										
9	251										
10	251			X	X						
11	200						X	X			
12	200								X	X	X
13	150	X									
14	150								X	X	X
15	101		XX	X	X		X	X			
16	101								X	X	X
17	75						X	X			
18	75								X	X	X
19	50						X	X			
20	50								X	X	X
21	25			X	XX		X				
22	25										
23	5			X	X		X	X			
24	5								X	X	X

Station	34										
Cast	01										
Time in (UTC)	16:20										
Multibeam depth	21										
Operator	AC										
bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto
1	20	X	XX	XX	XX		X	X			
2	20								X	X	X
3	15			X	XX		X	X			
4	15								X	X	X
5	11			X	XX		X				
6	11										
7	5			X	XX		X	X			
8	5								X	X	X
9											
10											
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											
21											
22											
23											
24											

Station	35										
Cast	01										
Time in (UTC)	19:05										
Multibeam depth	25										
Operator	RvW										
bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto
1	23	X	XX	XX	XX		X	X			
2	23								X	X	X
3	15			X	XX		X	X			
4	15								X	X	X
5	10			X	XX		X				
6	10										
7	5			X	XX		X	X			
8	5								X	X	X
9											
10											
11											

12											
13											
14											
15											
16											
17											
18											
19											
20											
21											
22											
23											
24											

Station	37										
Cast	01										
Time in (UTC)	13:15										
Multibeam depth	580										
Operator	AC										
bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto
1	577	X	X	XX	XX		X				
2	577										
3	500			X			X				
4	500										
5	400		X	X	X		X				
6	400										
7	300			X			X				
8	300										
9	250			X	X		X				
10	250										
11	199			XX			X	X			
12	199								X	X	X
13	150		X	X			X				
14	150										
15	100			X	XX		X	X			
16	100								X	X	X
17	75			X			X	X			
18	75								X	X	X
19	50			X	X		X	X			
20	50								X	X	X
21	24			X			X	X			
22	24								X	X	X
23	5		X	X	XX		X	X			
24	5								X	X	X

Station	39
Cast	01
Time in (UTC)	16:10
Multibeam depth	15
Operator	LdN

bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto
1	13	X	X	XX	XX		X	X			
2	13								X	X	X
3	12			X	XX		X	X			
4	12								X	X	X
5	9			X	XX		X				
6	9										
7	5			X	XX		X	X			
8	5								X	X	X
9											
10											
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											
21											
22											
23											
24											

Station	41
Cast	01
Time in (UTC)	18:30
Multibeam depth	21
Operator	AC

bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto
1	18	X	XX	XX	X		X	X			
2	18								X	X	X
3	14			X	X		X	X			
4	14								X	X	X
5	10			X	X		X	X			
6	10										
7	5			X	X		X	X			
8	5								X	X	X
9											
10											
11											
12											
13											
14											
15											
16											
17											
18											

19											
20											
21											
22											
23											
24											

Station					42						
Cast					01						
Time in (UTC)					14:20						
Multibeam depth					22						
Operator					RvW						
bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto
1	20	X	X	XX	XX		X	X			
2	20								X	X	X
3	15			X	XX		X	X			
4	15								X	X	X
5	10			X	XX		X				
6	10										
7	5			X	XX		X	X			
8	5								X	X	X
9											
10											
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											
21											
22											
23											
24											

Station					43						
Cast					01						
Time in (UTC)					20:30						
Multibeam depth					27						
Operator					RvW						
bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto
1	25	X	X	XX	XX		X	X			
2	25								X	X	X
3	17			X	XX		X	X			
4	17								X	X	X
5	10			X	XX		X				

6	10										
7	5			X	XX		X	X			
8	5								X	X	X
9											
10											
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											
21											
22											
23											
24											

Station					46						
Cast					01						
Time in (UTC)					16:35						
Multibeam depth					3961						
Operator					AC						
bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto
1	1892		XX	XX	XX		X				
2	1892										
3	1500			X			X				
4	1000			X	X		X				
5	900			X			X				
6	801			X			X				
7	700			X			X				
8	600		X	X	X		X				
9	500			X			X				
10	398			X			X				
11	300			X			X				
12	200			X			X				
13	150	X		X	XX		X				
14	125			X			X				
15	100			X			X				
16	75			X	X		X				
17	75			X					X	X	X
18	49			X					X	X	X
19	49			X	XX		X				
20											
21	4										
22	4			X	XX		X				
23									X	X	X
24											

Station					48						
Cast					01						
Time in (UTC)					11:10						
Multibeam depth					765						
Operator					RvW						
bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto
1	750	X	X	X	XX		X	X			
2	750										
3	649			X			X	X			
4	649										
5	500		X	X			X	X			
6	500										
7	400			X	X		X	X			
8	400										
9	301			X			X	X			
10	301										
11	250			X			X	X			
12	250										
13	200		X	X	XX		X	X			
14	200										
15	150			X			X	X			
16	150										
17	100			X	X		X	X			
18	100								X	X	X
19	76			X			X	X			
20	76										
21	25			X			X	X			
22	25								X	X	X
23	5		X	X	X		X	X			
24	5								X	X	X

Station					49						
Cast					01						
Time in (UTC)					13:25						
Multibeam depth					500						
Operator					RvW						
bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto
1	492	X	X	XX	XX		X	X			
2	492										
3	400			X	X		X	X			
4	400										
5	300			X	X		X	X			
6	300										
7	250			X			X	X			
8	250										
9	200		X	X	XX		X	X			
10	200										
11	150			XX			X	X			
12	150										
13	126			X			X	X			

14	126										
15	101		X	X	X		X	X			
16	101								X	X	X
17	75			X			X	X			
18	75										
19	50			X	X		X	X			
20	50										
21	25			X			X	X			
22	25								X	X	X
23	5		X	X	X		X	X			
24	5								X	X	X

Station	50
Cast	01
Time in (UTC)	16:00
Multibeam depth	526
Operator	RvW

bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto
1	509	X	X	XX	XX		X	X			
2	509										
3	399			X	X		X	X			
4	399										
5	300			X	X		X	X			
6	300										
7	250			X			X	X			
8	250										
9	200		X	X	XX		X	X			
10	200										
11	150			X			X	X			
12	150										
13	125			X			X	X			
14	125										
15	100		X	X	X		X	X			
16	100								X	X	X
17	75			X			X	X			
18	75										
19	51			X	X		X	X			
20	51										
21	25			X			X	X			
22	25								X	X	X
23	5		X	X	X		X	X			
24	5								X	X	X

Station	51
Cast	01
Time in (UTC)	17:45
Multibeam depth	600
Operator	RvW

bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto

1	575	X	X	XX	XX		X	X			
2	575										
3	500			X			X	X			
4	500										
5	399			X	X		X	X			
6	399										
7	300			X	X		X	X			
8	300										
9	250			X			X	X			
10	250										
11	200		X	X	XX		X	X			
12	200										
13	150			X			X	X			
14	150										
15	100		X	X	X		X	X			
16	100								X	X	X
17	76			X			X	X			
18	76										
19	50			X	X		X	X			
20	50										
21	25			X			X	X			
22	25								X	X	X
23	5		X	X	X		X	X			
24	5								X	X	X

Station	52
Cast	01
Time in (UTC)	17:20
Multibeam depth	510
Operator	RvW

bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto
1	490	X	X	XX	XX		X	X			
2	490										
3	400			X	X		X	X			
4	400										
5	300			X	X		X	X			
6	300										
7	250			X			X	X			
8	250										
9	200		X	X	XX		X	X			
10	200										
11	150			X			X	X			
12	150										
13	125			X			X	X			
14	125										
15	101		X	X	X		X	X			
16	101								X	X	X
17	75			X			X	X			
18	75										
19	50			X	X		X	X			
20	50										
21	26			X			X	X			

22	26								X	X	X
23	5		X	X	X		X	X			
24	5								X	X	X

Station	53
Cast	01
Time in (UTC)	20:50
Multibeam depth	500
Operator	LdN

bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto
1	502	X	X	XX	XX		X	X			
2	502										
3	400			X	X		X	X			
4	400										
5	300			X	X		X	X			
6	300										
7	250			X			X	X			
8	250										
9	200		X	X	XX		X	X			
10	200										
11	150			X			X	X			
12	150										
13	124			X			X	X			
14	124										
15	101		X	X	X		X	X			
16	101								X	X	X
17	75			X			X	X			
18	75										
19	50			X	X		X	X			
20	50										
21	25			X			X	X			
22	25								X	X	X
23	5		X	X	X		X	X			
24	5								X	X	X

Station	54
Cast	01
Time in (UTC)	22:25
Multibeam depth	510
Operator	RvW

bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto
1	500	X	X	XX	XX		X	X			
2	500										
3	400			X	X		X	X			
4	400										
5	300			X	X		X	X			
6	300										
7	250			X			X	X			
8	250										

9	200			X	XX		X	X			
10	200										
11	150			X			X	X			
12	150										
13	125			X			X	X			
14	125										
15	100			X	X		X	X			
16	100										
17	76			X			X	X			
18	76								X	X	X
19	51		X	X	X		X	X			
20	51										
21	25			X			X	X			
22	25								X	X	X
23	5			X	X		X	X			
24	5								X	X	X

Station	55
Cast	01
Time in (UTC)	11:00
Multibeam depth	505
Operator	LdN

bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto
1	500	X	X	XX	XX		X	X			
2	500										
3	400			X	X		X	X			
4	400										
5	300			X	X		X	X			
6	300										
7	249			X			X	X			
8	249										
9	200			X	XX		X	X			
10	200										
11	150			X			X	X			
12	150										
13	125			X			X	X			
14	125										
15	100			X	X		X	X			
16	100								X	X	X
17	75		X	X			X	X			
18	75										
19	51			X	X		X	X			
20	51										
21	25			X			X	X			
22	25								X	X	X
23	5			X	X		X	X			
24	5								X	X	X

Station	56
Cast	01
Time in (UTC)	13:00

Multibeam depth	508										
Operator	RvW										
bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto
1	500		X	XX	XX		X	X			
2	500										
3	400			X	X		X	X			
4	400										
5	300		X	X	X		X	X			
6	300										
7	250			X			X	X			
8	250										
9	200			X	XX		X	X			
10	200										
11	150			X			X	X			
12	150										
13	124			X			X	X			
14	124										
15	100			X	X		X	X			
16	100								X	X	X
17	75		X	X			X	X			
18	75										
19	50			X	X		X	X			
20	50										
21	25			X	X		X	X			
22	5								X	X	X
23	5			X	X		X	X			
24	5								X	X	X

Station	57										
Cast	01										
Time in (UTC)	15:15										
Multibeam depth	504										
Operator	LdN										
bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto
1	499		X	XX	XX		X	X			
2	499										
3	401			X	X		X	X			
4	401										
5	301			X	X		X	X			
6	301										
7	250			X			X	X			
8	250										
9	199			X	XX		X	X			
10	199										
11	151			X			X	X			
12	151										
13	125			X			X	X			
14	125										
15	100			X	X		X	X			
16	100								X	X	X

17	75		X	X			X	X			
18	75										
19	50			X	X		X	X			
20	50								X	X	X
21	6										
22	6										
23	6			X	X		X	X			
24	6								X	X	X

Station	58
Cast	01
Time in (UTC)	17:05
Multibeam depth	500
Operator	RvW

bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto
1	493	X	X	XX	XX		X	X			
2	493										
3	400			X	X		X	X			
4	400										
5	300			X	X		X	X			
6	300										
7	250			X			X	X			
8	250										
9	200			X	XX		X	X			
10	200										
11	150			X			X	X			
12	150										
13	125			X			X	X			
14	125										
15	100			X	X		X	X			
16	100								X	X	X
17	75		X	X			X	X			
18	75										
19	50			X	X		X	X			
20	50										
21	25			X			X	X			
22	25								X	X	X
23	5			X	X		X	X			
24	5								X	X	X

Station	59
Cast	01
Time in (UTC)	19:00
Multibeam depth	1035
Operator	LdN

bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto
1	501		X	XX	XX		X	X			
2	501										
3	401			X	X		X	X			

4	401										
5	301			X	X		X	X			
6	301										
7	251			X			X	X			
8	251										
9	201			X	XX		X	X			
10	201										
11	151			X			X	X			
12	151										
13	127			X	X		X	X			
14	127										
15	101			X			X	X			
16	101										
17	76		X	X			X	X			
18	76								X	X	X
19	52			X	X		X	X			
20	52										
21	26			X			X	X			
22	26								X	X	X
23	6			X	X		X	X			
24	6								X	X	X

Station	60
Cast	01
Time in (UTC)	11:00
Multibeam depth	2800-3300?
Operator	RvW

bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	[CO_3^{2-}]	nuts	TN/TP	filters	TOC	Flow cyto
1	498	X	X	XX	XX		X	X			
2	498										
3	400			X	X		X	X			
4	400										
5	298			X	X		X	X			
6	298										
7	250			X			X	X			
8	250								X	X	X
9	200			X	XX		X	X			
10	200										
11	150			X			X	X			
12	150										
13	125			X			X	X			
14	125										
15	100			X	X		X	X			
16	100								X	X	X
17	75		X	X			X	X			
18	75								X	X	X
19	50			X	X		X	X			
20	50								X	X	X
21	25			X			X	X			
22	25								X	X	X
23	5			X	X		X	X			
24	5								X	X	X

Station		61									
Cast		01									
Time in (UTC)		13:00									
Multibeam depth		3300									
Operator		LdN									
bottle	Tripped depth (m)	sal	O_2	DIC/TA	pH	$[CO_3^{2-}]$	nuts	TN/TP	filters	TOC	Flow cyto
1	500	X	X	XX	XX		X	X			
2	500										
3	400			X	X		X	X			
4	400										
5	300			X	X		X	X			
6	300										
7	250			X			X	X			
8	250										
9	200			X	XX		X	X			
10	200										
11	148			X			X	X			
12	148										
13	126			X			X	X			
14	126										
15	100			X	X		X	X			
16	100								X	X	X
17	75		X	X			X	X			
18	75										
19	50			X	X		X	X			
20	50										
21	25			X			X	X			
22	25								X	X	X
23	5			X	X		X	X			
24	5								X	X	X

14.3 Activity list

Date	Time (UTC)	Lat (deg. min.milli)	Lon (deg. min.milli)	Device	Action	Station	Cast
20/08/2016	11:55:32	N 17° 26.1741'	W 60° 27.94122'	UC CTD	Begin	1	1
20/08/2016	13:31:11	N 17° 26.23848'	W 60° 27.9549'	UC CTD	Bottom	1	1
20/08/2016	15:43:51	N 17° 26.15178'	W 60° 27.93804'	UC CTD	End	1	1
20/08/2016	17:48:07	N 17° 26.32332'	W 60° 28.01712'	SCAMP	Begin	1	2
20/08/2016	17:51:47	N 17° 26.33766'	W 60° 28.03914'	SCAMP	Start Heave	1	2
20/08/2016	17:58:22	N 17° 26.35674'	W 60° 28.08006'	SCAMP	End	1	2
20/08/2016	18:52:29	N 17° 26.1312'	W 60° 27.9966'	UC CTD	Begin	1	3
20/08/2016	19:27:05	N 17° 26.18406'	W 60° 27.96558'	UC CTD	Bottom	1	3
20/08/2016	20:33:06	N 17° 26.17116'	W 60° 27.99198'	UC CTD	End	1	3
21/08/2016	09:14:56	N 17° 26.25024'	W 60° 59.99934'	UC CTD	Begin	2	1
21/08/2016	10:26:29	N 17° 26.2518'	W 60° 59.99736'	UC CTD	Bottom	2	1
21/08/2016	12:20:19	N 17° 26.247'	W 61° 0.01116'	UC CTD	End	2	1
21/08/2016	12:51:00	N 17° 26.71638'	W 61° 0.23526'	SCAMP	Begin	2	2

21/08/2016	13:03:52	N 17° 26.95278'	W 61° 0.35184'	SCAMP	Begin	2	2
21/08/2016	13:08:11	N 17° 27.024'	W 61° 0.39384'	SCAMP	Start Heave	2	2
21/08/2016	13:14:36	N 17° 27.11892'	W 61° 0.4446'	SCAMP	End	2	2
21/08/2016	17:02:32	N 17° 26.24754'	W 61° 33.01248'	UC CTD	Begin	3	1
21/08/2016	17:50:47	N 17° 26.2509'	W 61° 32.99412'	UC CTD	Bottom	3	1
21/08/2016	19:19:52	N 17° 26.25384'	W 61° 33.00054'	UC CTD	End	3	1
21/08/2016	19:30:24	N 17° 26.24808'	W 61° 33.02868'	SCAMP	Begin	3	2
21/08/2016	19:35:41	N 17° 26.2644'	W 61° 33.07956'	SCAMP	Start Heave	3	2
21/08/2016	19:45:36	N 17° 26.27058'	W 61° 33.18012'	SCAMP	End	3	2
21/08/2016	20:25:06	N 17° 26.26596'	W 61° 37.05204'	SCAMP	Begin	4	1
21/08/2016	20:34:46	N 17° 26.2878'	W 61° 37.14888'	SCAMP	Start Heave	4	1
21/08/2016	20:43:13	N 17° 26.31318'	W 61° 37.24026'	SCAMP	End	4	1
21/08/2016	22:10:31	N 17° 26.25558'	W 61° 37.00134'	UC CTD	Begin	4	2
21/08/2016	22:39:46	N 17° 26.24928'	W 61° 37.00578'	UC CTD	Bottom	4	2
21/08/2016	23:25:19	N 17° 26.2566'	W 61° 37.03098'	UC CTD	End	4	2
22/08/2016	11:12:43	N 17° 26.2551'	W 61° 41.00316'	UC CTD	Begin	5	1
22/08/2016	11:19:16	N 17° 26.25498'	W 61° 41.00514'	UC CTD	Bottom	5	1
22/08/2016	11:49:35	N 17° 26.25948'	W 61° 40.99872'	UC CTD	End	5	1
22/08/2016	11:59:16	N 17° 26.25'	W 61° 40.96548'	SCAMP	Begin	5	2
22/08/2016	12:06:40	N 17° 26.23572'	W 61° 41.08758'	SCAMP	Start Heave	5	2
22/08/2016	12:16:57	N 17° 26.27556'	W 61° 41.2722'	SCAMP	End	5	2
22/08/2016	12:49:48	N 17° 26.3103'	W 61° 38.92854'	Hopper frame	Begin	101	1
22/08/2016	13:26:16	N 17° 26.30502'	W 61° 39.13368'	Hopper frame	End	101	1
22/08/2016	16:16:01	N 17° 26.19252'	W 62° 1.10442'	UC CTD	Begin	6	1
22/08/2016	16:26:37	N 17° 26.21142'	W 62° 1.11276'	UC CTD	Bottom	6	1
22/08/2016	16:55:17	N 17° 26.22222'	W 62° 1.12572'	UC CTD	End	6	1
22/08/2016	17:10:36	N 17° 26.20518'	W 62° 1.40034'	SCAMP	Begin	6	2
22/08/2016	17:20:21	N 17° 26.1792'	W 62° 1.4958'	SCAMP	Start Heave	6	2
22/08/2016	17:28:18	N 17° 26.14548'	W 62° 1.57266'	SCAMP	End	6	2
22/08/2016	19:09:02	N 17° 26.24634'	W 62° 15.00762'	UC CTD	Begin	7	1
22/08/2016	19:21:11	N 17° 26.24802'	W 62° 15.0072'	UC CTD	Bottom	7	1
22/08/2016	19:59:10	N 17° 26.25174'	W 62° 15.0051'	UC CTD	End	7	1
22/08/2016	20:07:51	N 17° 26.31438'	W 62° 15.11304'	SCAMP	Begin	7	2
22/08/2016	20:17:17	N 17° 26.31504'	W 62° 15.30804'	SCAMP	Start Heave	7	2
22/08/2016	20:28:01	N 17° 26.3013'	W 62° 15.54678'	SCAMP	End	7	2
22/08/2016	20:28:38	N 17° 26.3004'	W 62° 15.56058'	SCAMP	Begin	7	3
22/08/2016	20:35:51	N 17° 26.2902'	W 62° 15.7272'	SCAMP	Start Heave	7	3
22/08/2016	20:44:56	N 17° 26.27718'	W 62° 15.93438'	SCAMP	End	7	3
22/08/2016	20:45:40	N 17° 26.27688'	W 62° 15.95136'	SCAMP	Begin	7	4
22/08/2016	20:55:48	N 17° 26.26992'	W 62° 16.18338'	SCAMP	Start Heave	7	4
22/08/2016	21:05:46	N 17° 26.27628'	W 62° 16.41828'	SCAMP	End	7	4
22/08/2016	22:18:57	N 17° 28.93224'	W 62° 17.24472'	Hopper frame	Begin	102	1
22/08/2016	22:52:03	N 17° 28.79346'	W 62° 17.36328'	Hopper frame	End	102	1
23/08/2016	11:11:21	N 17° 26.2407'	W 62° 30.01488'	UC CTD	Begin	8	1
23/08/2016	11:22:04	N 17° 26.24322'	W 62° 30.0057'	UC CTD	Bottom	8	1
23/08/2016	11:57:39	N 17° 26.2464'	W 62° 29.99382'	UC CTD	End	8	1

23/08/2016	12:06:00	N 17° 26.22336'	W 62° 30.04818'	SCAMP	Begin	8	2
23/08/2016	12:17:02	N 17° 26.12838'	W 62° 30.10386'	SCAMP	Start Heave	8	2
23/08/2016	12:25:12	N 17° 26.0538'	W 62° 30.13278'	SCAMP	End	8	2
23/08/2016	12:29:48	N 17° 26.01762'	W 62° 30.15078'	SCAMP	Begin	8	3
23/08/2016	12:41:19	N 17° 25.9206'	W 62° 30.1983'	SCAMP	Start Heave	8	3
23/08/2016	12:49:07	N 17° 25.8567'	W 62° 30.23118'	SCAMP	End	8	3
23/08/2016	14:57:18	N 17° 26.62566'	W 62° 49.03746'	UC CTD	Begin	9	1
23/08/2016	15:03:58	N 17° 26.6262'	W 62° 49.04484'	UC CTD	Bottom	9	1
23/08/2016	15:45:04	N 17° 26.93976'	W 62° 48.95832'	UC CTD	End	9	1
23/08/2016	15:45:23	N 17° 26.94054'	W 62° 48.96258'	SCAMP	Begin	9	2
23/08/2016	15:56:49	N 17° 26.88012'	W 62° 49.05192'	SCAMP	Start Heave	9	2
23/08/2016	16:02:01	N 17° 26.8287'	W 62° 49.07622'	SCAMP	End	9	2
23/08/2016	17:07:29	N 17° 22.36098'	W 62° 55.05276'	SCAMP	Begin	10	1
23/08/2016	17:18:00	N 17° 22.28862'	W 62° 55.2132'	SCAMP	Start Heave	10	1
23/08/2016	17:24:17	N 17° 22.23444'	W 62° 55.29384'	SCAMP	End	10	1
23/08/2016	17:40:49	N 17° 22.00338'	W 62° 55.02672'	UC CTD	Begin	10	2
23/08/2016	17:53:42	N 17° 22.0032'	W 62° 55.00062'	UC CTD	Bottom	10	2
23/08/2016	18:25:59	N 17° 22.00368'	W 62° 54.99282'	UC CTD	End	10	2
23/08/2016	20:26:03	N 17° 18.96498'	W 63° 4.0416'	SCAMP	Begin	11	1
23/08/2016	20:36:33	N 17° 18.8211'	W 63° 4.08714'	SCAMP	Start Heave	11	1
23/08/2016	20:42:37	N 17° 18.72294'	W 63° 4.09368'	SCAMP	End	11	1
23/08/2016	21:35:37	N 17° 18.99522'	W 63° 3.99726'	UC CTD	Begin	11	2
23/08/2016	21:47:37	N 17° 18.99804'	W 63° 3.99786'	UC CTD	Bottom	11	2
23/08/2016	22:19:28	N 17° 18.9993'	W 63° 3.996'	UC CTD	End	11	2
24/08/2016	11:40:25	N 17° 22.5'	W 63° 22.58172'	Lander	Deployment	12	1
24/08/2016	12:10:53	N 17° 22.50744'	W 63° 22.5198'	Lander	Recovery	12	1
24/08/2016	12:46:14	N 17° 22.5123'	W 63° 22.5102'	Lander	Deployment	12	2
24/08/2016	13:33:33	N 17° 22.63488'	W 63° 22.66992'	Hopper frame	Begin	103	1
24/08/2016	14:54:08	N 17° 22.0281'	W 63° 22.48014'	Hopper frame	End	103	1
24/08/2016	16:57:46	N 17° 28.08528'	W 63° 36.68904'	Hopper frame	Begin	104	1
24/08/2016	17:11:20	N 17° 28.02168'	W 63° 36.69876'	Hopper frame	End	104	1
24/08/2016	17:52:56	N 17° 25.22922'	W 63° 33.75654'	Hopper frame	Begin	105	1
24/08/2016	18:22:20	N 17° 24.62448'	W 63° 33.20598'	Hopper frame	End	105	1
24/08/2016	18:44:38	N 17° 23.07528'	W 63° 31.62606'	Hopper frame	Begin	106	1
24/08/2016	19:03:30	N 17° 22.98288'	W 63° 31.58622'	Hopper frame	End	106	1
24/08/2016	19:50:10	N 17° 19.99332'	W 63° 28.4559'	Hopper frame	Begin	107	1
24/08/2016	20:09:57	N 17° 19.9161'	W 63° 28.40742'	Hopper frame	End	107	1
24/08/2016	21:37:05	N 17° 15.86214'	W 63° 24.38034'	Hopper frame	Begin	108	1
24/08/2016	22:37:53	N 17° 16.25466'	W 63° 24.54546'	Hopper frame	End	108	1
25/08/2016	11:26:01	N 17° 15.0132'	W 63° 12.01038'	CTD	Begin	13	1
25/08/2016	12:07:58	N 17° 15.01464'	W 63° 12.00138'	CTD	Bottom	13	1
25/08/2016	12:17:08	N 17° 15.00396'	W 63° 12.00228'	CTD	End	13	1
25/08/2016	12:23:52	N 17° 15.04278'	W 63° 11.98878'	SCAMP	Begin	13	2
25/08/2016	12:30:04	N 17° 15.1143'	W 63° 12.07356'	SCAMP	Start Heave	13	2
25/08/2016	12:38:51	N 17° 15.2136'	W 63° 12.19878'	SCAMP	End	13	2
25/08/2016	13:05:56	N 17° 16.5036'	W 63° 13.99356'	CTD	Begin	14	1

25/08/2016	13:14:57	N 17° 16.50018'	W 63° 14.00178'	CTD	Bottom	14	1
25/08/2016	13:48:43	N 17° 16.50486'	W 63° 13.9929'	CTD	End	14	1
25/08/2016	14:12:21	N 17° 17.9109'	W 63° 15.93558'	SCAMP	Begin	15	1
25/08/2016	14:14:54	N 17° 17.92176'	W 63° 15.9789'	SCAMP	Start Heave	15	1
25/08/2016	14:18:24	N 17° 17.94354'	W 63° 16.0371'	SCAMP	End	15	1
25/08/2016	14:20:54	N 17° 17.96436'	W 63° 16.06842'	SCAMP	Begin	15	2
25/08/2016	14:23:18	N 17° 17.97498'	W 63° 16.10448'	SCAMP	Start Heave	15	2
25/08/2016	14:25:12	N 17° 17.98248'	W 63° 16.13184'	SCAMP	End	15	2
25/08/2016	14:42:20	N 17° 18.01356'	W 63° 16.01136'	CTD	Begin	15	3
25/08/2016	14:43:08	N 17° 18.01302'	W 63° 16.00878'	CTD	Bottom	15	3
25/08/2016	14:43:40	N 17° 18.012'	W 63° 16.00782'	CTD	Bottom	15	3
25/08/2016	14:45:33	N 17° 18.00882'	W 63° 16.00818'	CTD	Bottom	15	3
25/08/2016	15:02:01	N 17° 18.0168'	W 63° 16.00224'	CTD	End	15	3
25/08/2016	16:06:43	N 17° 19.01022'	W 63° 17.5311'	CTD	Begin	16	1
25/08/2016	16:20:13	N 17° 19.01532'	W 63° 17.5353'	CTD	Bottom	16	1
25/08/2016	16:20:28	N 17° 19.01544'	W 63° 17.53728'	CTD	End	16	1
25/08/2016	16:25:08	N 17° 19.0308'	W 63° 17.61324'	SCAMP	Begin	16	2
25/08/2016	16:28:31	N 17° 19.01802'	W 63° 17.67864'	SCAMP	Start Heave	16	2
25/08/2016	16:31:54	N 17° 19.03056'	W 63° 17.73588'	SCAMP	End	16	2
25/08/2016	17:00:18	N 17° 21.05082'	W 63° 19.9686'	SCAMP	Begin	17	1
25/08/2016	17:02:10	N 17° 21.05874'	W 63° 19.99944'	SCAMP	Start Heave	17	1
25/08/2016	17:02:51	N 17° 21.06006'	W 63° 20.01162'	SCAMP	End	17	1
25/08/2016	17:09:50	N 17° 21.0747'	W 63° 20.13876'	SCAMP	Begin	17	2
25/08/2016	17:13:05	N 17° 21.0816'	W 63° 20.1999'	SCAMP	Start Heave	17	2
25/08/2016	17:16:34	N 17° 21.0942'	W 63° 20.26482'	SCAMP	End	17	2
25/08/2016	17:29:48	N 17° 21.0156'	W 63° 20.02914'	CTD	Begin	17	3
25/08/2016	17:34:40	N 17° 21.00546'	W 63° 20.02308'	CTD	Bottom	17	3
25/08/2016	17:50:46	N 17° 20.988'	W 63° 20.00178'	CTD	End	17	3
25/08/2016	18:40:47	N 17° 24.99102'	W 63° 24.00576'	CTD	Begin	18	1
25/08/2016	18:45:14	N 17° 24.98928'	W 63° 24.00252'	CTD	Bottom	18	1
25/08/2016	18:56:33	N 17° 24.99846'	W 63° 24.01242'	CTD	End	18	1
25/08/2016	19:00:59	N 17° 25.02258'	W 63° 24.04224'	SCAMP	Begin	18	2
25/08/2016	19:04:46	N 17° 25.03296'	W 63° 24.0951'	SCAMP	Start Heave	18	2
25/08/2016	19:06:53	N 17° 25.0353'	W 63° 24.12678'	SCAMP	End	18	2
25/08/2016	20:08:10	N 17° 29.99184'	W 63° 30.01332'	CTD	Begin	19	1
25/08/2016	20:11:19	N 17° 30.00084'	W 63° 30.00816'	CTD	Bottom	19	1
25/08/2016	20:22:27	N 17° 30.00168'	W 63° 30.00246'	CTD	End	19	1
25/08/2016	20:26:03	N 17° 30.01848'	W 63° 30.0039'	SCAMP	Begin	19	2
25/08/2016	20:31:05	N 17° 30.03594'	W 63° 30.05418'	SCAMP	Start Heave	19	2
25/08/2016	20:34:19	N 17° 30.03978'	W 63° 30.09378'	SCAMP	End	19	2
25/08/2016	20:38:01	N 17° 30.04314'	W 63° 30.1383'	SCAMP	Begin	19	3
25/08/2016	20:42:44	N 17° 30.04848'	W 63° 30.19674'	SCAMP	Start Heave	19	3
25/08/2016	20:45:26	N 17° 30.04704'	W 63° 30.23328'	SCAMP	End	19	3
25/08/2016	21:40:09	N 17° 35.01882'	W 63° 35.00904'	CTD	Begin	20	1
25/08/2016	21:49:55	N 17° 34.99728'	W 63° 35.00442'	CTD	Bottom	20	1
25/08/2016	22:17:58	N 17° 34.99938'	W 63° 35.0019'	CTD	End	20	1

25/08/2016	22:23:10	N 17° 35.03364'	W 63° 35.00922'	SCAMP	Begin	20	2
25/08/2016	22:31:12	N 17° 35.05824'	W 63° 35.14434'	SCAMP	Start Heave	20	2
25/08/2016	22:37:03	N 17° 35.05716'	W 63° 35.24082'	SCAMP	End	20	2
26/08/2016	11:01:53	N 17° 53.004'	W 63° 52.99812'	CTD	Begin	21	1
26/08/2016	11:26:26	N 17° 53.00976'	W 63° 53.00874'	CTD	Bottom	21	1
26/08/2016	12:08:29	N 17° 53.00892'	W 63° 53.00466'	CTD	End	21	1
26/08/2016	12:14:25	N 17° 53.03706'	W 63° 53.04156'	SCAMP	Begin	21	2
26/08/2016	12:16:40	N 17° 53.05266'	W 63° 53.06118'	SCAMP	Start Heave	21	2
26/08/2016	12:17:27	N 17° 53.0592'	W 63° 53.0679'	SCAMP	End	21	2
26/08/2016	12:19:14	N 17° 53.0748'	W 63° 53.08494'	SCAMP	Begin	21	3
26/08/2016	12:27:37	N 17° 53.14758'	W 63° 53.166'	SCAMP	Start Heave	21	3
26/08/2016	12:33:54	N 17° 53.19378'	W 63° 53.23032'	SCAMP	End	21	3
26/08/2016	14:21:07	N 17° 42.00516'	W 63° 43.0047'	CTD	Begin	22	1
26/08/2016	14:36:39	N 17° 41.99874'	W 63° 42.99894'	CTD	Bottom	22	1
26/08/2016	15:12:06	N 17° 41.98818'	W 63° 43.0032'	CTD	End	22	1
26/08/2016	15:17:09	N 17° 41.99586'	W 63° 43.01784'	SCAMP	Begin	22	2
26/08/2016	15:26:30	N 17° 42.00918'	W 63° 43.05444'	SCAMP	Start Heave	22	2
26/08/2016	15:32:54	N 17° 42.01536'	W 63° 43.0845'	SCAMP	End	22	2
26/08/2016	17:18:04	N 17° 42.87858'	W 63° 28.26582'	Hopper frame	Begin	109	1
26/08/2016	19:01:07	N 17° 42.21072'	W 63° 28.2327'	Hopper frame	End	109	1
26/08/2016	20:31:30	N 17° 37.0728'	W 63° 20.66592'	Hopper frame	Begin		
26/08/2016	20:52:36	N 17° 37.01154'	W 63° 20.55216'	Hopper frame	End	110	1
26/08/2016	21:38:56	N 17° 33.63864'	W 63° 17.0496'	Hopper frame	Begin		
26/08/2016	22:06:18	N 17° 33.5727'	W 63° 17.1792'	Hopper frame	End	111	1
26/08/2016	22:40:06	N 17° 31.55322'	W 63° 16.11804'	Hopper frame	Begin		
26/08/2016	22:59:24	N 17° 31.53618'	W 63° 16.23942'	Hopper frame	End	112	1
26/08/2016	23:35:58	N 17° 30.53856'	W 63° 15.15648'	Hopper frame	Begin	113	1
27/08/2016	00:21:57	N 17° 30.2424'	W 63° 15.2913'	Hopper frame	End	113	1
27/08/2016	11:27:45	N 17° 22.99596'	W 63° 17.409'	CTD	Begin	23	1
27/08/2016	11:28:06	N 17° 22.99518'	W 63° 17.41002'	CTD	Bottom	23	1
27/08/2016	11:34:43	N 17° 22.99248'	W 63° 17.40594'	CTD	End	23	1
27/08/2016	12:23:20	N 17° 22.99746'	W 63° 17.4045'	Gradient sampler	Deployment	23	2
27/08/2016	12:53:05	N 17° 22.91256'	W 63° 17.4603'	CTD jojo	Begin	23	3
27/08/2016	12:54:03	N 17° 22.91226'	W 63° 17.45994'	CTD jojo	Bottom	23	3
27/08/2016	12:57:36	N 17° 22.90824'	W 63° 17.45628'	CTD jojo	Bottom	23	3
27/08/2016	13:00:26	N 17° 22.9056'	W 63° 17.466'	CTD jojo	Bottom	23	3
27/08/2016	13:03:15	N 17° 22.90752'	W 63° 17.4675'	CTD jojo	Bottom	23	3
27/08/2016	13:05:49	N 17° 22.91082'	W 63° 17.46534'	CTD jojo	Bottom	23	3
27/08/2016	13:09:13	N 17° 22.90812'	W 63° 17.46594'	CTD jojo	Bottom	23	3
27/08/2016	13:13:15	N 17° 22.89864'	W 63° 17.46714'	CTD jojo	Bottom	23	3
27/08/2016	13:17:20	N 17° 22.9011'	W 63° 17.45658'	CTD jojo	Bottom	23	3
27/08/2016	13:19:09	N 17° 22.9074'	W 63° 17.44938'	CTD jojo	End	23	3
27/08/2016	13:24:33	N 17° 22.90608'	W 63° 17.4072'	SCAMP	Begin		
27/08/2016	13:32:49	N 17° 22.87836'	W 63° 17.45928'	SCAMP	Start Heave	23	4
27/08/2016	13:33:37	N 17° 22.87884'	W 63° 17.466'	SCAMP	End	23	4

27/08/2016	13:53:40	N 17° 22.9947'	W 63° 17.40408'	Gradient sampler	Recovery	23	5
27/08/2016	14:09:33	N 17° 22.98672'	W 63° 17.4042'	CTD	Begin	23	6
27/08/2016	14:10:56	N 17° 22.98546'	W 63° 17.40456'	CTD	Bottom	23	6
27/08/2016	14:19:59	N 17° 22.98834'	W 63° 17.40552'	CTD	End	23	6
27/08/2016	14:59:37	N 17° 22.99086'	W 63° 17.39592'	Gradient sampler	Deployment	23	7
27/08/2016	15:26:11	N 17° 22.93038'	W 63° 17.46366'	CTD jojo	Begin	23	8
27/08/2016	15:29:11	N 17° 22.93314'	W 63° 17.45406'	CTD jojo	Bottom	23	8
27/08/2016	15:33:34	N 17° 22.93254'	W 63° 17.45592'	CTD jojo	Bottom	23	8
27/08/2016	15:37:25	N 17° 22.93014'	W 63° 17.45238'	CTD jojo	Bottom	23	8
27/08/2016	15:43:33	N 17° 22.93482'	W 63° 17.45706'	CTD jojo	Bottom	23	8
27/08/2016	15:45:30	N 17° 22.9329'	W 63° 17.45892'	CTD jojo	Bottom	23	8
27/08/2016	15:48:56	N 17° 22.92846'	W 63° 17.45844'	CTD jojo	Bottom	23	8
27/08/2016	15:52:55	N 17° 22.9245'	W 63° 17.45766'	CTD jojo	Bottom	23	8
27/08/2016	15:56:50	N 17° 22.9251'	W 63° 17.45616'	CTD jojo	Bottom	23	8
27/08/2016	16:00:47	N 17° 22.9278'	W 63° 17.45766'	CTD jojo	Bottom	23	8
27/08/2016	16:04:58	N 17° 22.92618'	W 63° 17.4564'	CTD jojo	Bottom	23	8
27/08/2016	16:05:19	N 17° 22.9254'	W 63° 17.4561'	CTD jojo	Start Heave	23	8
27/08/2016	16:10:05	N 17° 22.9272'	W 63° 17.45754'	CTD jojo	End		
27/08/2016	16:13:04	N 17° 22.94112'	W 63° 17.46678'	SCAMP	Begin	23	9
27/08/2016	16:15:22	N 999° 0'	E 999° 0'	SCAMP	Start Heave	23	9
27/08/2016	16:20:37	N 17° 22.96206'	W 63° 17.50884'	SCAMP	End	23	9
27/08/2016	16:46:12	N 17° 22.9893'	W 63° 17.40102'	Gradient sampler	Recovery	23	10
27/08/2016	17:19:42	N 17° 20.72658'	W 63° 15.07722'	CTD	Begin	24	1
27/08/2016	17:23:38	N 17° 20.72304'	W 63° 15.06336'	CTD	Bottom	24	1
27/08/2016	17:33:51	N 17° 20.73006'	W 63° 15.05868'	CTD	End	24	1
27/08/2016	18:04:20	N 17° 20.74422'	W 63° 15.0648'	Gradient sampler	Deployment	24	2
27/08/2016	18:26:26	N 17° 20.79018'	W 63° 15.00576'	CTD jojo	Begin	24	3
27/08/2016	18:30:24	N 17° 20.79168'	W 63° 14.99958'	CTD jojo	Bottom	24	3
27/08/2016	18:35:37	N 17° 20.7933'	W 63° 14.99754'	CTD jojo	Bottom	24	3
27/08/2016	18:41:12	N 17° 20.79498'	W 63° 15.00072'	CTD jojo	Bottom	24	3
27/08/2016	18:46:11	N 17° 20.7939'	W 63° 14.9955'	CTD jojo	Bottom	24	3
27/08/2016	18:51:38	N 17° 20.79408'	W 63° 14.99742'	CTD jojo	Bottom	24	3
27/08/2016	18:57:18	N 17° 20.79924'	W 63° 14.9964'	CTD jojo	Bottom	24	3
27/08/2016	19:02:58	N 17° 20.7939'	W 63° 14.99064'	CTD jojo	Bottom	24	3
27/08/2016	19:08:25	N 17° 20.7912'	W 63° 14.99064'	CTD jojo	End	24	3
27/08/2016	19:12:01	N 17° 20.7828'	W 63° 14.9862'	SCAMP	Begin	24	4
27/08/2016	19:22:08	N 17° 20.74884'	W 63° 14.98416'	SCAMP	End	24	4
27/08/2016	19:44:26	N 17° 20.74776'	W 63° 15.05916'	Gradient sampler	Recovery	24	5
27/08/2016	19:56:58	N 17° 20.75112'	W 63° 15.07356'	CTD	Begin	24	6
27/08/2016	19:58:30	N 17° 20.74998'	W 63° 15.07446'	CTD	Bottom	24	6
27/08/2016	20:07:41	N 17° 20.74992'	W 63° 15.07152'	CTD	End	24	6
27/08/2016	20:13:07	N 17° 20.75262'	W 63° 15.10722'	SCAMP	Begin	24	7
27/08/2016	20:19:32	N 17° 20.74218'	W 63° 15.19542'	SCAMP	Start Heave	24	7

27/08/2016	20:21:11	N 17° 20.73498'	W 63° 15.21732'	SCAMP	End	24	7
27/08/2016	20:37:25	N 17° 20.74578'	W 63° 15.06912'	Gradient sampler	Deployment	24	8
27/08/2016	21:01:07	N 17° 20.77278'	W 63° 15.06564'	CTD jojo	Begin	24	9
27/08/2016	21:02:12	N 17° 20.77704'	W 63° 15.0642'	CTD jojo	Bottom	24	9
27/08/2016	21:05:59	N 17° 20.77482'	W 63° 15.06648'	CTD jojo	Bottom	24	9
27/08/2016	21:08:52	N 17° 20.77638'	W 63° 15.05478'	CTD jojo	Bottom	24	9
27/08/2016	21:11:45	N 17° 20.78748'	W 63° 15.0546'	CTD jojo	Bottom	24	9
27/08/2016	21:14:49	N 17° 20.78898'	W 63° 15.05472'	CTD jojo	Bottom	24	9
27/08/2016	21:17:28	N 17° 20.7825'	W 63° 15.05118'	CTD jojo	Bottom	24	9
27/08/2016	21:20:08	N 17° 20.78784'	W 63° 15.05052'	CTD jojo	Bottom	24	9
27/08/2016	21:22:46	N 17° 20.7984'	W 63° 15.05298'	CTD jojo	Bottom	24	9
27/08/2016	21:25:38	N 17° 20.79396'	W 63° 15.05976'	CTD jojo	End	24	9
27/08/2016	22:00:18	N 17° 20.74548'	W 63° 15.0669'	Gradient sampler	Recovery	24	10
28/08/2016	11:13:24	N 17° 30.99084'	W 63° 12.36048'	Hopper frame	Begin	114	1
28/08/2016	11:53:08	N 17° 30.79056'	W 63° 12.27132'	Hopper frame	End	114	1
28/08/2016	12:23:52	N 17° 29.60796'	W 63° 13.47156'	Hopper frame	Begin	115	1
28/08/2016	13:39:06	N 17° 29.78754'	W 63° 13.79616'	Hopper frame	End	115	1
28/08/2016	14:05:27	N 17° 29.23452'	W 63° 13.64436'	Hopper frame	Begin	116	1
28/08/2016	15:08:44	N 17° 29.2602'	W 63° 13.95048'	Hopper frame	End	116	1
28/08/2016	16:12:33	N 17° 27.96186'	W 63° 15.00594'	Hopper frame	Begin	117	1
28/08/2016	16:33:52	N 17° 27.98604'	W 63° 14.90874'	Hopper frame	End	117	1
28/08/2016	16:53:23	N 17° 28.06746'	W 63° 14.11392'	Hopper frame	Begin	118	1
28/08/2016	17:09:03	N 17° 28.07214'	W 63° 14.04216'	Hopper frame	End	118	1
28/08/2016	17:38:44	N 17° 27.53382'	W 63° 13.06206'	Hopper frame	Begin	119	1
28/08/2016	18:45:30	N 17° 27.48708'	W 63° 13.401'	Hopper frame	End	119	1
28/08/2016	19:08:01	N 17° 26.78592'	W 63° 12.8379'	Hopper frame	Begin	120	1
28/08/2016	19:47:13	N 17° 26.74986'	W 63° 13.02654'	Hopper frame	End	120	1
28/08/2016	20:13:45	N 17° 25.4781'	W 63° 12.07896'	Hopper frame	Begin	121	1
28/08/2016	21:04:01	N 17° 25.3803'	W 63° 12.34644'	Hopper frame	End	121	1
28/08/2016	21:39:09	N 17° 23.73726'	W 63° 11.6985'	Hopper frame	Begin	122	1
28/08/2016	22:25:38	N 17° 23.91'	W 63° 11.93868'	Hopper frame	End	122	1
28/08/2016	23:40:16	N 17° 20.72004'	W 63° 14.96814'	Hopper frame	Begin	123	1
29/08/2016	00:18:23	N 17° 20.8092'	W 63° 15.21564'	Hopper frame	End	123	1
29/08/2016	11:10:40	N 17° 21.49962'	W 63° 9.00438'	CTD	Begin	26	1
29/08/2016	11:20:02	N 17° 21.50382'	W 63° 9.00888'	CTD	Bottom	26	1
29/08/2016	11:46:39	N 17° 21.50958'	W 63° 9.00786'	CTD	End	26	1
29/08/2016	11:51:15	N 17° 21.49878'	W 63° 9.06252'	SCAMP	Begin	26	2
29/08/2016	12:06:52	N 17° 21.6069'	W 63° 9.28248'	SCAMP	Start Heave	26	2
29/08/2016	12:06:53	N 17° 21.60708'	W 63° 9.28278'	SCAMP	End	26	2
29/08/2016	12:40:11	N 17° 23.77368'	W 63° 11.6478'	CTD	Begin	27	1
29/08/2016	12:43:57	N 17° 23.77074'	W 63° 11.6493'	CTD	Bottom	27	1
29/08/2016	12:47:32	N 17° 23.76804'	W 63° 11.64642'	CTD	End	27	1
29/08/2016	13:13:36	N 17° 23.79936'	W 63° 11.78466'	Gradient sampler	Deployment	28	1
29/08/2016	13:35:54	N 17° 23.73636'	W 63° 11.85006'	CTD	Begin	28	2

29/08/2016	13:37:29	N 17° 23.73636'	W 63° 11.85018'	CTD	Bottom	28	2
29/08/2016	13:44:15	N 17° 23.73204'	W 63° 11.85636'	CTD	End	28	2
29/08/2016	13:48:01	N 17° 23.75208'	W 63° 11.86878'	SCAMP	Begin	28	3
29/08/2016	13:54:01	N 17° 23.7978'	W 63° 11.95458'	SCAMP	Start Heave	28	3
29/08/2016	14:03:50	N 17° 23.87358'	W 63° 11.83488'	SCAMP	End	28	3
29/08/2016	14:25:19	N 17° 23.7993'	W 63° 11.784'	Gradient sampler	Recovery	28	4
29/08/2016	15:04:09	N 17° 27.0228'	W 63° 14.52078'	CTD	Begin	29	1
29/08/2016	15:06:46	N 17° 27.01968'	W 63° 14.50578'	CTD	Bottom	29	1
29/08/2016	15:10:48	N 17° 27.01206'	W 63° 14.50314'	CTD	End	29	1
29/08/2016	16:15:55	N 17° 32.38278'	W 63° 17.78178'	Gradient sampler	Deployment	30	1
29/08/2016	16:42:47	N 17° 32.32566'	W 63° 17.82102'	CTD	Begin	30	2
29/08/2016	16:46:00	N 17° 32.32896'	W 63° 17.82378'	CTD	Bottom	30	2
29/08/2016	16:52:39	N 17° 32.32272'	W 63° 17.8236'	CTD	End	30	2
29/08/2016	16:58:04	N 17° 32.34186'	W 63° 17.85072'	SCAMP	Begin	30	3
29/08/2016	17:03:35	N 17° 32.38206'	W 63° 17.89506'	SCAMP	Start Heave	30	3
29/08/2016	17:05:10	N 17° 32.39946'	W 63° 17.90784'	SCAMP	End	30	3
29/08/2016	17:06:24	N 17° 32.41224'	W 63° 17.91852'	SCAMP	Begin	30	4
29/08/2016	17:12:04	N 17° 32.46954'	W 63° 17.9712'	SCAMP	Start Heave	30	4
29/08/2016	17:14:23	N 17° 32.49858'	W 63° 17.98914'	SCAMP	End	30	4
29/08/2016	17:47:19	N 17° 32.38296'	W 63° 17.77554'	Gradient sampler	Recovery	30	5
29/08/2016	18:54:02	N 17° 37.40334'	W 63° 23.48904'	CTD	Begin	31	1
29/08/2016	18:57:23	N 17° 37.39914'	W 63° 23.49378'	CTD	Bottom	31	1
29/08/2016	19:00:04	N 17° 37.40196'	W 63° 23.49744'	CTD	End	31	1
29/08/2016	20:10:32	N 17° 42.26412'	W 63° 28.22814'	Gradient sampler	Deployment	32	1
29/08/2016	20:36:04	N 17° 42.29262'	W 63° 28.08504'	CTD	Begin	32	2
29/08/2016	20:40:07	N 17° 42.3036'	W 63° 28.08354'	CTD	Bottom	32	2
29/08/2016	20:49:21	N 17° 42.29592'	W 63° 28.08918'	CTD	End	32	2
29/08/2016	21:29:59	N 17° 42.3429'	W 63° 28.05432'	SCAMP	Begin	32	3
29/08/2016	21:40:56	N 17° 42.46782'	W 63° 28.07388'	SCAMP	Start Heave	32	3
29/08/2016	21:45:01	N 17° 42.51168'	W 63° 28.08246'	SCAMP	End	32	3
29/08/2016	22:11:43	N 17° 42.26328'	W 63° 28.22292'	Gradient sampler	Recovery	32	4
29/08/2016	23:12:21	N 17° 46.0044'	W 63° 33.0072'	CTD	Begin	33	1
29/08/2016	23:25:04	N 17° 46.00098'	W 63° 33.00288'	CTD	Bottom	33	1
29/08/2016	23:55:05	N 17° 46.0023'	W 63° 32.99634'	CTD	End	33	1
30/08/2016	00:00:08	N 17° 46.05258'	W 63° 32.98236'	SCAMP	Begin	33	2
30/08/2016	00:10:08	N 17° 46.1334'	W 63° 33.03378'	SCAMP	Start Heave	33	2
30/08/2016	00:15:25	N 17° 46.16814'	W 63° 33.06366'	SCAMP	End	33	2
30/08/2016	11:20:44	N 17° 28.30362'	W 63° 22.91958'	Hopper frame	Begin	124	1
30/08/2016	12:03:55	N 17° 28.17228'	W 63° 22.76304'	Hopper frame	End	124	1
30/08/2016	12:57:51	N 17° 26.45658'	W 63° 16.84122'	Hopper frame	Begin	125	1
30/08/2016	13:40:40	N 17° 26.62284'	W 63° 16.93986'	Hopper frame	End	125	1
30/08/2016	14:15:55	N 17° 23.14368'	W 63° 17.55504'	Hopper frame	Begin	126	1
30/08/2016	15:25:13	N 17° 22.83912'	W 63° 17.34342'	Hopper frame	End	126	1

30/08/2016	16:11:23	N 17° 20.7555'	W 63° 15.09402'	CTD	Begin	34	1
30/08/2016	16:15:51	N 17° 20.75964'	W 63° 15.09114'	CTD	Bottom	34	1
30/08/2016	16:24:56	N 17° 20.75742'	W 63° 15.09444'	CTD	End	34	1
30/08/2016	16:57:08	N 17° 20.75802'	W 63° 15.09024'	Gradient sampler	Deployment	34	2
30/08/2016	17:14:35	N 17° 20.83794'	W 63° 15.18714'	SCAMP	Begin	34	3
30/08/2016	17:20:23	N 17° 20.83626'	W 63° 15.3081'	SCAMP	Start Heave	34	3
30/08/2016	17:22:29	N 17° 20.84016'	W 63° 15.35184'	SCAMP	End	34	3
30/08/2016	17:23:17	N 17° 20.84112'	W 63° 15.36858'	SCAMP	Begin	34	4
30/08/2016	17:28:30	N 17° 20.8494'	W 63° 15.48048'	SCAMP	Start Heave	34	4
30/08/2016	17:29:20	N 17° 20.85054'	W 63° 15.49794'	SCAMP	End	34	4
30/08/2016	17:30:15	N 17° 20.85174'	W 63° 15.51726'	SCAMP	Begin	34	5
30/08/2016	17:35:07	N 17° 20.8617'	W 63° 15.61818'	SCAMP	Start Heave	34	5
30/08/2016	17:35:52	N 17° 20.86326'	W 63° 15.63312'	SCAMP	End	34	5
30/08/2016	18:20:57	N 17° 20.76006'	W 63° 15.09108'	Gradient sampler	Recovery	34	6
30/08/2016	19:07:34	N 17° 16.30176'	W 63° 16.86768'	CTD	Begin	35	1
30/08/2016	19:11:06	N 17° 16.30248'	W 63° 16.85736'	CTD	Bottom	35	1
30/08/2016	19:24:47	N 17° 16.2945'	W 63° 16.85418'	CTD	End	35	1
30/08/2016	19:52:25	N 17° 16.2933'	W 63° 16.8531'	Gradient sampler	Deployment	35	2
30/08/2016	20:07:55	N 17° 16.34424'	W 63° 16.95942'	SCAMP	Begin	35	3
30/08/2016	20:16:45	N 17° 16.34046'	W 63° 17.136'	SCAMP	Start Heave	35	3
30/08/2016	20:54:59	N 17° 16.35132'	W 63° 17.12718'	SCAMP	End	35	3
30/08/2016	21:50:01	N 17° 16.29798'	W 63° 16.85268'	Gradient sampler	Recovery	35	4
31/08/2016	11:17:58	N 17° 23.99646'	W 63° 2.00304'	UC CTD	Begin	36	1
31/08/2016	11:27:51	N 17° 23.99856'	W 63° 2.00316'	UC CTD	Bottom	36	1
31/08/2016	12:01:50	N 17° 24.00396'	W 63° 1.99926'	UC CTD	End	36	1
31/08/2016	12:14:52	N 17° 23.99604'	W 63° 2.00208'	CTD	Begin	36	2
31/08/2016	12:24:28	N 17° 24.00114'	W 63° 2.0049'	CTD	Bottom	36	2
31/08/2016	12:35:36	N 17° 24.00222'	W 63° 1.99644'	CTD	End	36	2
31/08/2016	13:24:21	N 17° 25.48134'	W 63° 6.02004'	CTD	Begin	37	1
31/08/2016	13:35:40	N 17° 25.4841'	W 63° 6.00108'	CTD	Bottom	37	1
31/08/2016	14:06:46	N 17° 25.5012'	W 63° 6.01116'	CTD	End	37	1
31/08/2016	14:50:13	N 17° 26.99292'	W 63° 9.75966'	UC CTD	Begin	38	1
31/08/2016	14:59:01	N 17° 26.99394'	W 63° 9.75396'	UC CTD	Bottom	38	1
31/08/2016	15:23:54	N 17° 26.99832'	W 63° 9.74124'	UC CTD	End	38	1
31/08/2016	16:07:15	N 17° 27.01398'	W 63° 13.67784'	CTD	Begin	39	1
31/08/2016	16:20:02	N 17° 27.00624'	W 63° 13.67886'	CTD	Bottom	39	1
31/08/2016	16:21:29	N 17° 27.00888'	W 63° 13.67346'	CTD	End	39	1
31/08/2016	16:59:35	N 17° 27.00498'	W 63° 14.93532'	UC CTD	Begin	40	1
31/08/2016	17:10:38	N 17° 26.99508'	W 63° 14.9361'	UC CTD	Bottom	40	1
31/08/2016	17:17:51	N 17° 27.00246'	W 63° 14.93052'	UC CTD	End	40	1
31/08/2016	17:27:22	N 17° 26.99742'	W 63° 14.90958'	CTD	Begin	40	2
31/08/2016	17:31:22	N 17° 26.99418'	W 63° 14.91468'	CTD	Bottom	40	2
31/08/2016	17:39:04	N 17° 27.0027'	W 63° 14.91018'	CTD	End	40	2
31/08/2016	18:23:27	N 17° 26.99466'	W 63° 16.88286'	CTD	Begin	41	1

31/08/2016	18:28:25	N 17° 26.99298'	W 63° 16.88778'	CTD	Bottom	41	1
31/08/2016	18:38:09	N 17° 27.0063'	W 63° 16.85928'	CTD	End	41	1
31/08/2016	19:26:47	N 17° 26.99676'	W 63° 21.8484'	CTD	Begin	42	1
31/08/2016	19:29:18	N 17° 26.99406'	W 63° 21.84882'	CTD	Bottom	42	1
31/08/2016	19:36:10	N 17° 26.99796'	W 63° 21.8379'	CTD	End	42	1
31/08/2016	20:27:39	N 17° 27.00948'	W 63° 27.96672'	CTD	Begin	43	1
31/08/2016	20:30:32	N 17° 27.00438'	W 63° 27.9687'	CTD	Bottom	43	1
31/08/2016	20:37:47	N 17° 27.00714'	W 63° 27.9624'	CTD	End	43	1
31/08/2016	21:56:52	N 17° 26.99562'	W 63° 38.0067'	UC CTD	Begin	44	1
31/08/2016	22:01:51	N 17° 26.9979'	W 63° 38.00232'	UC CTD	Bottom	44	1
31/08/2016	22:17:33	N 17° 26.99964'	W 63° 37.99608'	UC CTD	End	44	1
01/09/2016	08:58:39	N 17° 27.00834'	W 64° 26.57514'	CTD	Begin	45	1
01/09/2016	09:54:56	N 17° 27.00078'	W 64° 26.59698'	CTD	Bottom	45	1
01/09/2016	10:52:44	N 17° 27.00702'	W 64° 26.58468'	CTD	End	45	1
01/09/2016	11:07:28	N 17° 27.00528'	W 64° 26.58444'	UC CTD	Begin	45	2
01/09/2016	12:00:59	N 17° 27.0039'	W 64° 26.58162'	UC CTD	Bottom	45	2
01/09/2016	13:36:25	N 17° 26.99298'	W 64° 26.5851'	UC CTD	End	45	2
01/09/2016	16:32:30	N 17° 26.9979'	W 64° 4.10706'	CTD	Begin	46	1
01/09/2016	17:18:21	N 17° 26.99466'	W 64° 4.08342'	CTD	Bottom	46	1
01/09/2016	18:33:06	N 17° 27.00996'	W 64° 4.09482'	CTD	End	46	1
01/09/2016	20:31:49	N 17° 27.00372'	W 63° 48.00306'	UC CTD	Begin	47	1
01/09/2016	20:38:21	N 17° 26.9976'	W 63° 48.00294'	UC CTD	Bottom	47	1
01/09/2016	20:54:51	N 17° 26.99814'	W 63° 48.00678'	UC CTD	End	47	1
01/09/2016	21:44:13	N 17° 24.66288'	W 63° 43.62564'	Hopper frame	Begin	127	1
01/09/2016	23:22:55	N 17° 24.6567'	W 63° 43.62276'	Hopper frame	Begin	127	2
02/09/2016	00:26:06	N 17° 24.96192'	W 63° 44.12238'	Hopper frame	End	127	2
02/09/2016	11:11:07	N 17° 21.00072'	W 63° 44.9283'	Hopper frame	Begin	128	1
02/09/2016	11:26:43	N 17° 20.93412'	W 63° 44.82204'	Hopper frame	End	128	1
02/09/2016	12:28:37	N 17° 18.83502'	W 63° 38.16558'	Hopper frame	Begin	129	1
02/09/2016	12:53:55	N 17° 18.7089'	W 63° 37.94262'	Hopper frame	End	129	1
02/09/2016	13:54:59	N 17° 12.62718'	W 63° 36.54138'	Hopper frame	Begin	130	1
02/09/2016	15:26:45	N 17° 12.9867'	W 63° 36.89994'	Hopper frame	End	130	1
02/09/2016	16:42:42	N 17° 15.33972'	W 63° 30.96174'	Hopper frame	Begin	131	1
02/09/2016	18:06:28	N 17° 15.67164'	W 63° 27.42162'	Hopper frame	End	131	1
02/09/2016	19:05:47	N 17° 15.40848'	W 63° 20.62368'	Hopper frame	Begin	132	1
02/09/2016	19:43:23	N 17° 15.73428'	W 63° 20.66796'	Hopper frame	End	132	1
02/09/2016	20:25:34	N 17° 16.23618'	W 63° 16.83444'	Hopper frame	Begin	133	1
02/09/2016	21:39:31	N 17° 16.69794'	W 63° 17.08266'	Hopper frame	End	133	1
02/09/2016	22:57:36	N 17° 22.51572'	W 63° 22.5255'	Lander	Recovery	12	3
03/09/2016	11:06:56	N 17° 44.00196'	W 63° 3.01848'	CTD	Begin	48	1
03/09/2016	11:20:14	N 17° 44.00298'	W 63° 3.02238'	CTD	Bottom	48	1
03/09/2016	11:53:12	N 17° 44.01168'	W 63° 3.01512'	CTD	End	48	1
03/09/2016	13:27:29	N 17° 39.91926'	W 63° 14.01978'	CTD	Begin	49	1
03/09/2016	13:35:54	N 17° 39.90306'	W 63° 14.0205'	CTD	Bottom	49	1
03/09/2016	14:03:01	N 17° 39.90666'	W 63° 14.00388'	CTD	End	49	1
03/09/2016	15:59:39	N 17° 40.48746'	W 63° 21.0759'	CTD	Begin	50	1

03/09/2016	16:11:42	N 17° 40.50174'	W 63° 21.07554'	CTD	Bottom	50	1
03/09/2016	16:41:48	N 17° 40.48788'	W 63° 21.07158'	CTD	End	50	1
03/09/2016	17:47:26	N 17° 41.97444'	W 63° 25.97796'	CTD	Begin	51	1
03/09/2016	18:02:09	N 17° 41.96844'	W 63° 25.9662'	CTD	Bottom	51	1
03/09/2016	18:30:33	N 17° 41.97846'	W 63° 25.95474'	CTD	End	51	1
03/09/2016	19:20:45	N 17° 44.75862'	W 63° 28.17306'	CTD	Begin	52	1
03/09/2016	19:31:52	N 17° 44.75754'	W 63° 28.16556'	CTD	Bottom	52	1
03/09/2016	20:00:19	N 17° 44.7594'	W 63° 28.16676'	CTD	End	52	1
03/09/2016	20:51:41	N 17° 40.4946'	W 63° 30.2364'	CTD	Begin	53	1
03/09/2016	21:02:37	N 17° 40.51014'	W 63° 30.22626'	CTD	Bottom	53	1
03/09/2016	21:31:05	N 17° 40.5'	W 63° 30.23622'	CTD	End	53	1
03/09/2016	22:24:45	N 17° 38.4711'	W 63° 34.94466'	CTD	Begin	54	1
03/09/2016	22:35:33	N 17° 38.47266'	W 63° 34.93566'	CTD	Bottom	54	1
03/09/2016	23:06:11	N 17° 38.46132'	W 63° 34.9458'	CTD	End	54	1
04/09/2016	11:02:42	N 17° 37.91946'	W 63° 41.88942'	CTD	Begin	55	1
04/09/2016	11:13:46	N 17° 37.91772'	W 63° 41.88054'	CTD	Bottom	55	1
04/09/2016	11:46:26	N 17° 37.92294'	W 63° 41.87664'	CTD	End	55	1
04/09/2016	13:05:53	N 17° 38.00418'	W 63° 47.42778'	CTD	Begin	56	1
04/09/2016	13:16:32	N 17° 37.99242'	W 63° 47.45412'	CTD	Bottom	56	1
04/09/2016	13:44:40	N 17° 37.9911'	W 63° 47.43654'	CTD	End	56	1
04/09/2016	15:13:37	N 17° 35.9151'	W 63° 52.96872'	CTD	Begin	57	1
04/09/2016	15:27:19	N 17° 35.91144'	W 63° 52.97052'	CTD	Bottom	57	1
04/09/2016	16:06:07	N 17° 35.93166'	W 63° 52.96722'	CTD	End	57	1
04/09/2016	17:06:16	N 17° 35.79078'	W 63° 59.30076'	CTD	Begin	58	1
04/09/2016	17:18:06	N 17° 35.80734'	W 63° 59.30922'	CTD	Bottom	58	1
04/09/2016	17:46:00	N 17° 35.81568'	W 63° 59.29842'	CTD	End	58	1
04/09/2016	19:02:24	N 17° 31.6389'	W 64° 2.47092'	CTD	Begin	59	1
04/09/2016	19:21:34	N 17° 31.64142'	W 64° 2.46168'	CTD	Bottom	59	1
04/09/2016	20:05:43	N 17° 31.6455'	W 64° 2.46288'	CTD	End	59	1
05/09/2016	10:57:35	N 17° 23.80524'	W 64° 10.75704'	CTD	Begin	60	1
05/09/2016	11:44:37	N 17° 23.80482'	W 64° 10.7409'	CTD	Bottom	60	1
05/09/2016	12:52:20	N 17° 23.80326'	W 64° 10.74714'	CTD	End	60	1
05/09/2016	14:00:55	N 17° 20.6688'	W 64° 14.30946'	CTD	Begin	61	1
05/09/2016	14:59:31	N 17° 20.67348'	W 64° 14.31378'	CTD	Bottom	61	1
05/09/2016	16:18:30	N 17° 20.72454'	W 64° 14.3067'	CTD	End	61	1