Cruise 64PE434

NICO Leg 7 GoMex

R/V Pelagia

11-03-2018 to 04-04-2018

Philipsburg, Sint Maarten – Nassau, Bahamas

Chief Scientist: Darci Rush

Co-Chief Scientist: Zeynep Erdem

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1 INTRODUCTION

1.1 AIMS AND OBJECTIVES

The Gulf of Mexico is a both an economically and ecological important region, housing vast fishing stocks, large petroleum reservoirs, and at the same time being a hotspot of biodiversity. In combination with the inputs of high amounts of nutrients from agriculture there is a substantial anthropogenic pressure on the valuable ecosystem.

The Mississippi River is one of the largest rivers on the North-American continent, and discharges on average 436.000 tons of sediment to the Gulf of Mexico per day. Upon burial in the marine realm, the associated organic carbon (OC) may serve as a long-term sink for photosynthetically fixed CO_2 depending on the composition and properties of this OC, which are generally not well characterized.

Besides sediment, the Mississippi and Atchafalaya Rivers transport nutrients to the ocean, where they are used by primary producers. Increasing agricultural activity and associated fertilizer use in the drainage basin have led to a severe enrichment in particularly nitrogen and phosphorus of fresh and marine waters. The high input of nutrients triggers algal blooms, and results in the seasonal development of an oxygen deficient zone (ODZ), or dead-zone, in the Gulf of Mexico, which is now the second largest human-induced ODZ in the world. Despite attempts to reduce impacts, ecosystem functioning does not always recover, due to its 'memory', where its present state depends on its long-term history, which is often unknown. This dead-zone has been intensifying over the past decades, and although many policy efforts have been made to decrease the amount of nutrients being washed into the gulf, nitrogen and phosphorus introduced into the sea is still creating a summer dead-zone. The 2017 occurrence was 22.000 km^2, the largest ever recorded (http://www.noaa.gov/media-release/gulf-of-mexico-dead-zone-is-largest-ever-measured).

Under natural conditions the system is known to experience considerable impact from regular hurricanes, river runoff and natural methane seepage. The isostatic rebound after the last deglaciation has also reactivated normal faulting along the continental slope of the Gulf of Mexico, which might have modulated the release methane from deep sea sediments. The timing of these reactivations and also the extent to which this has affected methane release is currently unknown. Studying these changes in the past and linking these with the microbiological response yields important information on the ability of the microbial ecosystem to adept to change. Throughout the year, there is a constant release of methane from petroleum and methanogenic sources. Communities of archaeal and bacterial methanotrophs in the water column and sediment use this methane as a substrate and/or energy source, thereby quenching the potential release of hydrocarbons into the environment and the release of greenhouse gases into the atmosphere. However, the processes that modulate the release of methane from deep sea sediments, and the microbiological response, are largely unknown. Methane seepages in the Gulf of Mexico sometimes coincide with brine water, revealing insights into the effect salinity has on methanotrophy. Trace metals released at the same time potentially allow reconstructions of past methane release.

Hence, the Gulf of Mexico provides an excellent setting for several complementing and synergetic projects emerging from the lines of research of the applicants:

1) Carbon cycle dynamics – the fate of terrestrial OC in the marine system.

2) Proxy development/validation – transfer of terrestrial climate signal to marine sediments.

3) The development of an ODZ – links to anthropogenic activity in the drainage basin.

4) The effect of an ODZ on the (local) biogeochemical cycles of nitrogen, phosphorus, iron, manganese and trace metals.

5) Drivers of methane release and microbial response.

1.2 TEAM MEMBERS

1.2.1 Scientific participants

Table 1.1 Scientific party

Name	Tasks
Darci Rush, NIOZ	Chief scientist, in-situ pumps
Zeynep Erdem, NIOZ	Multicore (MC) slicing, foraminifera, Piston Core (PC)
Francien Peterse, UU	MC slicing, biomarker, PC
Rob Witbaard, NIOZ	Lander, Clean CTD after 300m
Niels van Helmond, UU	Pore water, MC
Wytze Lenstra, UU	Pore water, MC
Julie Lattaud, NIOZ	MC slicing DNA, PC
Sigrid van Grinsven, NIOZ	Incubation, DNA water filter, Clean CTD
Leon Wuis, NIOZ	Technical support
Olga Żygadłowska, UU	Clean CTD, Trace Metals
Roosmarijn van Zummeren, UU	NICO student, Pore water, alkalinity
Joëlle van der Sprong, UvA	NICO student, Pore water, MC, PC
Wouter Jan Hooijman, Independent	Photos/video, PR

1.2.2 Crew

Table 1.2 Crew members on board 64PE434

Name	Role
Bert Puijman	Captain
Noortje Loonen	Chief mate
Peter Lucassen	2nd Officer
Jaap Seepma	Chief Engineer
Roel van de Heide	Bosun
Sander Asjes	ETO
Leon Moerland	Cook
Vitalijs Maximovs	Steward
Inno Meijers	2nd Engineer
Robin Dijkhuizen	AB1
Wim-Jan Boon	AB2
Patrick Gunn	AB3

2 NICO GULF OF MEXICO CRUISE ROUTE

2.1 TRANSIT TO GULF OF MEXICO

We left Sint Maarten with a 4.5 day delay (evening on 16-03-2018 local time; 00:09 17/03/2018 UTC), due to the late arrival of the clean CTD container and the container with equipment and consumables from Texel. We modified our original cruise plan to accommodate this delay, while maximizing the scientific objectives of the leg. Unfortunately, we were unable to perform the NICO CTD samples along the transit to the Gulf of Mexico as we did not have permission to sample in Bahamian waters.

Aquaflow water was sampled every 6 hours for the phytoplankton net, commencing the morning following our departure from St Maarten.

2.2 STATIONS

Stations and actions were recorded using Casino software. Events at each station can be found at the end of this section (Table 2.1).

2.2.1 Station 1: Clean CTD test station

23-03-2018

N 25° 38' 18.143" W 85° 53' 40.848"

Water depth: 3215 m

The first opportunity to sample came on 23-03-2018 when we reached our first station in the Gulf of Mexico. Here, at 14:00 UTC, we performed a test deployment of the Ultraclean CTD, followed by a flotation test of the benthic lander. 12 of the CTD bottles did not open when they reached 40 m water depth. We therefore could only sample above 50 m water depth to avoid the implosion of the unopened CTD bottles.

Samples were taken for the NICO project (Corina Brussaard, Maria van Leeuwen), as well as samples for Fe concentrations at 50 m and 20 m water depth. It was decided to add an extra buoy to the benthic lander for deployment on the subsequent Louisiana shelf stations.

2.2.2 Station 2 – 15 m water depth

25-03-2018 9:08:22 UTC

N 28° 48' 5.767" W 91° 20' 1.262"

Water depth 16 m

We started with multibeam around 4:00 am shiptime (9:08:45 UTC) in the surrounding of the station (ca. 200 m before and after the station). Right after the multibeam, we deployed the multicorer (MC) to be able to determine the sediment type prior the lander deployment. The deployment was successful with full 12 casts. After the lander deployment Pelagia moved ca. 1 nm for the water and in situ pump work.

The regular CTD was deployed as this station was too shallow and too close to the mouth of the Atchafalaya River for the ultraclean CTD. Two casts of in situ pumps were deployed.

After the water work, we deployed the MC for the second time. From this deployment we recovered 3 MCs for F. Jorrissen foraminifera work and 2 MCs (gray tubes) for at NIOZ sampling.

Lander was programmed to stay 10 hours. Recovery of the lander and transit to station 3.

2.2.3 Station 3 – 50 m water depth

26/03/2018 0:41:54 UTC (Station 3 followed a 24 h ship work schedule we arrived 25-03-2018 evening around 20:00, shiptime)

N 28° 26' 6.346" W 91° 20' 20.587"

Water depth: 53 m

Similar to Station 2, we started with the multibeam around the station and we deployed the MC prior to Lander deployment. MC recovery was successful with 12 full casts. We deployed the Lander and moved ca. 1 nm for the water and in situ pump work.

Ultraclean CTD was deployed, followed by 1 cast of in-situ pumps.

Lander was programmed to stay 10 hours. Recovery of the lander and transit to station 4.

2.2.4 Station 4 – 600 m water depth

26/03/2018 18:51:59 UTC

N 27° 44' 21.106" W 91° 13' 51.755"

Water depth: 546 m

The hopper Camera frame was deployed following the Multibeam of the area in order to ensure that we were not disturbing any possible benthos at this station. After ca. 1 h of observation, we did not encounter any obvious benthic communities and it was decided to proceed with water column and sediment work at this station.

The Ultraclean CTD was deployed followed by the Multicore.

The first deployment of the MC was unsuccessful because the casts were too full. For analysis such as microelectrode at least 10 cm of sediment water interface layer is needed. Second deployment was successful with 12 full casts.

Pistoncorer was deployed later in the evening and total recovery was 5.84 m. The whole core was split to 1 meter sections immediately and stored in the reefer (6 sections in total). Trip core was also stored together with the piston core. Note on the change in the sediment structure: top part was brownish really rich in foraminifera while the bottom (core catcher material) was really stiff gray-black sediment. Core catcher material was also stored in chemical bags and in the reefer.

In situ pumping was performed once the ship had moved ca. 1 nm away from the sediment disturbed area.

Transit back to the shelf, station 5.

2.2.5 Station 5 – 150 m water depth

27/03/2018 7:35:47 UTC

N 28° 0' 40.054" W 91° 16' 38.042"

Water depth: 130 m

The weather conditions changed drastically. Wind and waves got stronger therefore it was not possible to deploy the lander, the ultraclean CTD nor use the in situ pumps on the line. We did multibeam in close vicinity of the station and deployed the MC three times. The first two deployments were unsuccessful because of combination of the waves and the hard ground.

Pelagia changed position and we deployed the MC for the 3rd time. All 12 casts were full but the sediment was full of shells and (reworked) fossils remnants. In one of the transparent tubes an organism was found (see MC photos Station 5), later found out that it was a sponge which belong to family Cladorhizidae.

It was realized retrospectively that the O2 sensor on the TCTD was not functioning properly.

The in situ pumps were deployed (on the CTD frame) twice, with the frame moving positions in the water column between the programmed pumping actions.

The remaining Niskin bottles on the regular CTD (e.g. those not removed to place the in situ pumps) were fired on the return from pumping the deepest water depth, and collected on board for trace metal and nutrient analyses.

2.2.6 Station 6 – 300 m water depth

27/03/2018 21:30:05 UTC (Station 6 was the second station of a 24 h sampling day)

N 27° 54' 53.802" W 91° 15' 55.681"

Water depth: 288 m

Multibeam of this station was performed previously during transit from station 4 (at 27/03/2018 6:34:45 UTC). Because of the weather conditions when we arrived at Station 6, ultraclean CTD and Lander could not be deployed. The regular CTD was deployed for Niskin water bottle collection. The decision was made to also not deploy in situ pumps.

It was realized retrospectively that the O2 sensor on the TCTD was not functioning properly.

MC was deployed 2 times because the sediment was softer than anticipated. At first deployment the casts were too full, second deployment was done with less weight (*12 instead of 18). There was about 10 cm of water so we decided to sample it. First 2-3 cm was brown in colour indicating biologic activity.

Transit to 2000 m station over night

2.2.7 Station 7 – 2000 m water depth surrounding Orca Basin

28/03/2018 11:16:28 UTC to 29/03/2018 22:18:54 UTC

N 26° 58' 21.731" W 91° 21' 2.776"

NOTE: three stops for sampling around Orca Basin; CTD and deployment of three sediment traps (on two moorings) at water depth of 2200 and 2300 m in NW of the basin, brine sampling at water depth of 2424 m and multicore sampling (station 7*) at SE of the basin from water depth of 2100 m. Four RAFOS floats (H. Furey, WHOI) were deployed at Station 7.

The first sampling site at Station 7 was a revisit of core site MD02-2550 (Meckler et al 2008). Here, multibeam was followed by CTD and in situ pump, and sediment trap (2) deployments.

It was realized retrospectively that the O2 sensor on the CTD was not functioning properly. It was replaced after Station 7 Cast 2.

MC was deployed twice at this location, both deployments the casts were too full. We decided to keep some of the casts because the sedimentary features looked interesting. It is not known how much of the top part of the sediment was lost and since there was no water in the tubes.

Porewater, microelectrode etc were not done at this station. We kept one clear core to freeze but discarded the first 10 cm because the interesting features were at the last part of the sediment. One MC was sliced entirely for biomarkers. Notes on potentially interesting layers: 14-15 cm red layer; 22 cm black layer, 24 cm red layer and 36 cm red layer. There was not enough time for redeployment at this specific site.

Two RAFOS floats were deployed at this location (Serial number 1539s and 1540).

The ship moved position to be situated at the deepest point of Orca Basin (2417 m; N 26° 54' 8.226" W 91° 20' 45.697"). Here two deployments of in situ pumps were cast on the CTD frame and line. CTD Niskin bottles were also fired during these casts. Water was collected for nutrients and to be filtered on board with a peristaltic pump system.

The video hopper system was deployed in order to determine whether an accumulated detrital layer was evident at the halocline of Orca Basin. It was not observed.

A third attempt of multicoring was performed in the southeast part of the basin in the afternoon around 16:00 shiptime (21:29:36 UTC). We deployed the MC weightless and with a frame. This time the deployment was successful with 12 casts full about 40 cm sediment in them.

Before leaving the Gulf of Mexico, the final two RAFOS floats were deployed.

Table 2.1. Casino Events for 64PE434

Date (UTC)	Time (UTC)	Latitude (deg. min.milli)	Longitude (deg. min.milli)	Phase name	Device name	Action name	Operation Id	Cast	Echosounder Depth (m)
17/03/2018	0:09:10	N 18° 0' 26.464"	W 63° 2' 42.594"	TRANSIT 1					12.63
23/03/2018	13:31:29	N 25° 38' 18.143"	W 85° 53' 40.848"	STATION 1					3215.2
23/03/2018	13:51:28	N 25° 38' 18.834"	W 85° 53' 39.872"		Ultra Clean CTD	Begin	64PE434UC CTD1	1_1	3216.3
23/03/2018	14:09:15	N 25° 37' 35.951"	W 85° 53' 22.787"		Ultra Clean CTD	Bottom	64PE434UC CTD1	1_1	3219.3
23/03/2018	14:26:36	N 25° 37' 8.497"	W 85° 53' 10.993"		Ultra Clean CTD	End	64PE434UC CTD1	1_1	3217.2
23/03/2018	14:48:25	N 25° 37' 34.871"	W 85° 52' 54.199"	TRANSIT 2					3219.8
25/03/2018	9:08:22	N 28° 48' 5.767"	W 91° 20' 1.262"	STATION 2					15.59
25/03/2018	9:08:45	N 28° 48' 6.052"	W 91° 20' 3.21"		Multibeam	Begin	64PE434EM3021	2_1	16.19
25/03/2018	9:10:25	N 28° 48' 7.34"	W 91° 20' 10.05"		Multibeam	End	64PE434EM3021	2_1	16.11
25/03/2018	9:45:11	N 28° 48' 6.516"	W 91° 20' 2.396"		Multi Corer	Bottom	64PE434MC121	2_2	15.74
25/03/2018	10:24:39	N 28° 48' 4.698"	W 91° 20' 1.871"		Lander	Deployment	64PE434MOVE1	2_3	16.46
25/03/2018	11:05:11	N 28° 47' 10.727"	W 91° 18' 49.547"		CTD with samples	Begin	64PE434CTDBOT1	2_4	16.33
25/03/2018	11:09:26	N 28° 47' 10.716"	W 91° 18' 49.504"		CTD with samples	Bottom	64PE434CTDBOT1	2_4	16.23
25/03/2018	11:24:45	N 28° 47' 10.558"	W 91° 18' 49.579"		CTD with samples	End	64PE434CTDBOT1	2_4	16.42
25/03/2018	14:20:22	N 28° 47' 9.913"	W 91° 18' 48.989"		Insitu Pump	Begin	64PE434INSITU1	2_5	16.7
25/03/2018	14:46:24	N 28° 47' 11.202"	W 91° 18' 49.763"		Insitu Pump	Start Pump	64PE434INSITU1	2_5	15.98
25/03/2018	15:47:39	N 28° 47' 9.337"	W 91° 18' 49.838"		Insitu Pump	End	64PE434INSITU1	2_5	16.57
25/03/2018	17:30:55	N 28° 47' 10.262"	W 91° 18' 49.126"		Insitu Pump	Begin	64PE434INSITU2	2_6	16.04
25/03/2018	18:02:49	N 28° 47' 9.481"	W 91° 18' 49.064"		Insitu Pump	Start Pump	64PE434INSITU2	2_6	16.39

25/03/2018	19:11:15	N 28° 47' 10.536"	W 91° 18' 49.028"		Insitu Pump	End	64PE434INSITU2	2_6	16.71
25/03/2018	19:38:56	N 28° 47' 9.924"	W 91° 18' 49.514"		Multi Corer	Bottom	64PE434MC122	2_7	16.22
25/03/2018	21:12:38	N 28° 48' 5.335"	W 91° 20' 2.144"		Lander	Recovery	64PE434MOVE2	2_8	15.98
25/03/2018	22:00:03	N 28° 47' 47.234"	W 91° 20' 1.223"	TRANSIT 3					16.94
26/03/2018	0:41:54	N 28° 26' 6.346"	W 91° 20' 20.587"	STATION 3					53.15
26/03/2018	0:42:05	N 28° 26' 5.572"	W 91° 20' 19.741"		Multibeam	Begin	64PE434EM3022	3_1	53.11
26/03/2018	0:53:11	N 28° 25' 57.414"	W 91° 20' 1.594"		Multibeam	End	64PE434EM3022	3_1	53.89
26/03/2018	1:08:15	N 28° 25' 53.357"	W 91° 20' 3.894"		Multi Corer	Bottom	64PE434MC123	3_2	53.3
26/03/2018	1:27:00	N 28° 25' 52.043"	W 91° 20' 2.789"		Lander	Deployment	64PE434MOVE3	3_3	55.24
26/03/2018	2:07:14	N 28° 25' 56.158"	W 91° 18' 32.278"		Ultra Clean CTD	Begin	64PE434UC CTD2	3_4	53.11
26/03/2018	2:18:11	N 28° 25' 56.057"	W 91° 18' 32.281"		Ultra Clean CTD	Bottom	64PE434UC CTD2	3_4	52.71
26/03/2018	2:54:38	N 28° 25' 56.366"	W 91° 18' 31.986"		Ultra Clean CTD	End	64PE434UC CTD2	3_4	53.81
26/03/2018	3:36:25	N 28° 25' 56.154"	W 91° 18' 31.777"		Insitu Pump	Begin	64PE434INSITU3	3_5	52.71
26/03/2018	4:01:31	N 28° 25' 56.096"	W 91° 18' 32.101"		Insitu Pump	Start Pump	64PE434INSITU3	3_5	54.29
26/03/2018	5:14:29	N 28° 25' 56.777"	W 91° 18' 31.558"		Insitu Pump	End	64PE434INSITU3	3_5	52.68
26/03/2018	6:46:30	N 28° 25' 56.928"	W 91° 18' 31.356"						
26/03/2018	6:56:34	N 28° 25' 56.68"	W 91° 18' 31.342"		Insitu Pump	Begin	64PE434INSITU4	3_6	53.05
26/03/2018	7:05:28	N 28° 25' 56.424"	W 91° 18' 31.594"		Insitu Pump	Start Pump	64PE434INSITU4	3_6	52.32
26/03/2018	8:17:07	N 28° 25' 57.263"	W 91° 18' 30.74"		Insitu Pump	End	64PE434INSITU4	3_6	52.91
26/03/2018	12:14:02	N 28° 25' 54.534"	W 91° 20' 3.826"		Lander	Recovery	64PE434MOVE4	3_7	53.3
26/03/2018	12:35:33	N 28° 25' 53.886"	W 91° 20' 4.855"	TRANSIT 4					53.89
26/03/2018	18:51:59	N 27° 44' 21.106"	W 91° 13' 51.755"	STATION 4					546.54
26/03/2018	18:55:46	N 27° 44' 3.404"	W 91° 13' 52.68"		Multibeam	Begin	64PE434EM3023	4_1	559.77
26/03/2018	19:17:26	N 27° 44' 26.027"	W 91° 13' 54.991"		Multibeam	Begin	64PE434EM3023	4_1	556.7
26/03/2018	19:24:52	N 27° 43' 54.592"	W 91° 13' 53.224"		Multibeam	End	64PE434EM3023	4_1	590.64
26/03/2018	19:54:57	N 27° 44' 7.526"	W 91° 13' 54.638"		Hopper Camera	Begin	64PE434HOPCAM1	4_2	567.25
26/03/2018	20:21:59	N 27° 44' 7.058"	W 91° 13' 53.771"		Hopper Camera	Start track	64PE434HOPCAM1	4_2	565.14
26/03/2018	20:38:03	N 27° 44' 2.332"	W 91° 13' 53.936"		Hopper Camera	End track	64PE434HOPCAM1	4_2	576.26
26/03/2018	20:53:42	N 27° 44' 2.17"	W 91° 13' 55.585"		Hopper Camera	End	64PE434HOPCAM1	4_2	572.43
26/03/2018	21:30:57	N 27° 44' 4.704"	W 91° 13' 54.595"		Ultra Clean CTD	Begin	64PE434UC CTD3	4_3	561.88
26/03/2018	21:46:58	N 27° 44' 4.362"	W 91° 13' 54.206"		Ultra Clean CTD	Bottom	64PE434UC CTD3	4_3	563.22
26/03/2018	22:45:39	N 27° 44' 4.639"	W 91° 13' 54.026"		Ultra Clean CTD	End	64PE434UC CTD3	4_3	560.92
26/03/2018	23:09:33	N 27° 44' 4.196"	W 91° 13' 54.599"		Multi Corer	Bottom	64PE434MC124	4_4	564.76

26/03/2018	23:50:19	N 27° 44' 4.301"	W 91° 13' 54.516"		Multi Corer	Bottom	64PE434MC125	4_5	562.46
27/03/2018	1:02:43	N 27° 44' 4.171"	W 91° 13' 55.081"		Pistoncorer	Bottom	64PE434PC1101	4_6	566.1
27/03/2018	3:10:33	N 27° 43' 44.864"	W 91° 13' 36.066"		Insitu Pump	Begin	64PE434INSITU5	4_7	627.46
27/03/2018	3:30:16	N 27° 43' 43.896"	W 91° 13' 35.922"		Insitu Pump	Start Pump	64PE434INSITU5	4_7	625.35
27/03/2018	4:50:36	N 27° 43' 45.527"	W 91° 13' 38.366"		Insitu Pump	End	64PE434INSITU5	4_7	626.31
27/03/2018	5:03:11	N 27° 43' 42.578"	W 91° 13' 35.638"	TRANSIT 5					632.83
27/03/2018	6:34:45	N 27° 53' 52.616"	W 91° 15' 28.836"		Multibeam	Begin	64PE434EM3024	6_1	300.02
27/03/2018	6:43:32	N 27° 54' 39.308"	W 91° 15' 35.978"		Multibeam	End	64PE434EM3024	6_1	285.32
27/03/2018	7:35:47	N 28° 0' 40.054"	W 91° 16' 38.042"	STATION 5					130.16
27/03/2018	7:36:06	N 28° 0' 41.609"	W 91° 16' 38.316"		Multibeam	Begin	64PE434EM3025	5_1	130.56
27/03/2018	8:52:13	N 28° 0' 45.756"	W 91° 16' 24.258"		Multibeam	End	64PE434EM3025	5_1	119.95
27/03/2018	10:54:44	N 28° 1' 26.285"	W 91° 16' 33.985"		Multi Corer	Bottom	64PE434MC126	5_2	122.52
27/03/2018	11:08:43	N 28° 1' 26.346"	W 91° 16' 31.422"		Multi Corer	Bottom	64PE434MC127	5_3	122.13
27/03/2018	13:10:16	N 28° 1' 32.358"	W 91° 16' 47.77"		Multi Corer	Bottom	64PE434MC128	5_4	146.81
27/03/2018	15:38:43	N 28° 1' 30.947"	W 91° 16' 47.399"		Insitu Pump	Begin	64PE434INSITU6	5_5	149.16
27/03/2018	18:06:00	N 28° 1' 30.994"	W 91° 16' 47.287"		Insitu Pump	End	64PE434INSITU7	5_5	147.2
27/03/2018	18:24:35	N 28° 1' 30.994"	W 91° 16' 47.287"		Insitu Pump	Begin	64PE434INSITU8		149.94
27/03/2018	18:50:10	N 28° 1' 31.235"	W 91° 16' 48.317"		Insitu Pump	Start Pump	64PE434INSITU8		146.81
27/03/2018	18:54:27	N 28° 1' 30.814"	W 91° 16' 47.935"		Insitu Pump	End	64PE434INSITU8		146.22
27/03/2018	20:06:50	N 28° 1' 30.972"	W 91° 16' 49.152"		Insitu Pump	End	64PE434INSITU9	5_6	146.5
27/03/2018	20:10:16	N 28° 1' 30.49"	W 91° 16' 49.566"	TRANSIT 6					145.73
27/03/2018	21:30:05	N 27° 54' 53.802"	W 91° 15' 55.681"	STATION 6					288.8
27/03/2018	21:50:14	N 27° 54' 12.974"	W 91° 15' 32.468"		CTD with samples	Begin	64PE434CTDBOT2	6_2	295.18
27/03/2018	21:56:34	N 27° 54' 12.766"	W 91° 15' 32.908"		CTD with samples	Bottom	64PE434CTDBOT2	6_2	294.6
27/03/2018	22:27:47	N 27° 54' 13.543"	W 91° 15' 32.854"		CTD with samples	End	64PE434CTDBOT2	6_2	294.79
27/03/2018	23:38:45	N 27° 54' 13.097"	W 91° 15' 32.54"		Multi Corer	Bottom	64PE434MC129	6_3	294.99
28/03/2018	0:01:15	N 27° 54' 12.956"	W 91° 15' 32.67"		Multi Corer	Bottom	64PE434MC1210	6_4	294.21
28/03/2018	0:22:18	N 27° 53' 45.733"	W 91° 15' 29.974"	TRANSIT 7					303.5
28/03/2018	11:16:28	N 26° 58' 21.731"	W 91° 21' 2.776"	STATION 7					2038.5
28/03/2018	11:53:10	N 26° 56' 33.839"	W 91° 20' 59.672"		Multibeam	Begin	64PE434EM3026	7_1	2241
28/03/2018	12:50:30	N 26° 57' 32.353"	W 91° 20' 37.91"		Multibeam	End	64PE434EM3026	7_1	2178.6
28/03/2018	13:00:27	N 26° 57' 17.957"	W 91° 20' 45.161"		Insitu Pump	Begin	64PE434INSITU10	7_2	2192.3
28/03/2018	13:50:35	N 26° 57' 17.777"	W 91° 20' 43.854"		Insitu Pump	Start Pump	64PE434INSITU10	7_2	2192.3
28/03/2018	16:36:42	N 26° 57' 17.96"	W 91° 20' 44.027"		Insitu Pump	End	64PE434INSITU10	7_2	2192.3
28/03/2018	16:41:53	N 26° 57' 16.909"	W 91° 20' 41.64"		Multibeam	Begin	64PE434EM3027	7_3	2195.3
28/03/2018	18:06:22	N 26° 54' 24.782"	W 91° 20' 56.803"		Multibeam	End	64PE434EM3027	7_3	2391.8

28/03/2018	21:40:42	N 26° 56' 20.148"	W 91° 20' 27.128"		Sediment Trap	Deployment	64PE434ST1	7_4	2301.9
28/03/2018	23:37:28	N 26° 56' 25.854"	W 91° 20' 17.758"		Sediment Trap	Deployment	64PE434ST2	7_5	2295.8
29/03/2018	0:50:08	N 26° 56' 49.344"	W 91° 21' 0.302"		Multi Corer	Bottom	64PE434MC1211	7_6	2222.7
29/03/2018	1:43:55	N 26° 56' 40.902"	W 91° 20' 47.918"		RAFO Floats	Deployment	64PE434RAFO1	7_7	2256.2
29/03/2018	1:45:19	N 26° 56' 35.732"	W 91° 20' 42.317"		RAFO Floats	Deployment	64PE434RAFO2	7_8	2269.9
29/03/2018	2:36:51	N 26° 56' 48.372"	W 91° 21' 0.086"		Multi Corer	Bottom	64PE434MC1212	7_9	2224.3
29/03/2018	11:01:54	N 26° 54' 8.226"	W 91° 20' 45.697"		Insitu Pump	Begin	64PE434INSITU11	7_10	2417.7
29/03/2018	12:00:20	N 26° 54' 7.16"	W 91° 20' 44.056"		Insitu Pump	Start Pump	64PE434INSITU11	7_10	2417.7
29/03/2018	14:02:52	N 26° 54' 7.315"	W 91° 20' 45.02"		Insitu Pump	End	64PE434INSITU11	7_10	2414.6
29/03/2018	14:58:07	N 26° 54' 7.74"	W 91° 20' 44.459"		Insitu Pump	Begin	64PE434INSITU12	7_11	2414.6
29/03/2018	15:59:36	N 26° 54' 7.668"	W 91° 20' 45.298"		Insitu Pump	Start Pump	64PE434INSITU12	7_11	2416.1
29/03/2018	18:11:15	N 26° 54' 6.466"	W 91° 20' 42.85"		Insitu Pump	End	64PE434INSITU12	7_11	2405.5
29/03/2018	18:25:59	N 26° 54' 8.654"	W 91° 20' 43.364"		Hopper Camera	Begin	64PE434HOPCAM2	7__12	2417.7
29/03/2018	19:16:22	N 26° 54' 5.159"	W 91° 20' 43.53"		Hopper Camera	Start track	64PE434HOPCAM2	7__12	2404
29/03/2018	20:18:39	N 26° 54' 12.107"	W 91° 20' 48.577"		Hopper Camera	End track	64PE434HOPCAM2	7__12	2411.6
29/03/2018	20:21:42	N 26° 54' 11.804"	W 91° 20' 48.34"		Hopper Camera	End	64PE434HOPCAM2	7__12	2413.1
29/03/2018	21:29:36	N 26° 53' 23.154"	W 91° 20' 8.732"		Multi Corer	Bottom	64PE434MC1213	7_13	2093.3
29/03/2018	22:17:27	N 26° 52' 52.277"	W 91° 19' 39.806"		RAFO Floats	Deployment	64PE434RAFO3	7_14	1930.3
29/03/2018	22:18:54	N 26° 52' 46.218"	W 91° 19' 34.1"		RAFO Floats	Deployment	64PE434RAFO4	7_15	1930.3
29/03/2018	22:20:17	N 26° 52' 39.583"	W 91° 19' 27.548"	TURNING 1					1938

2.3 TRANSIT FROM GULF OF MEXICO

There was indication from weather reports that we might encounter a strong current against us on our way to the Bahamas. Considering the fact we only had one generator, we decided to leave the Gulf earlier than predicted. We left Station 7 on 29-03-2018 at approximately 17:30 (22:20:17 UTC).

3 NUTRIENT ANALYSES

Karel Bakker

3.1 SUMMARY

Nutrients were analysed in a temperature controlled lab container equipped with a QuAAtro Gas Segmented Continuous Flow Analyser, measuring approximately 400 samples for the different parameters. Samples were collected from the normal CTD-Rosette and from the Ultra Clean CTD bottles and from pore-waters obtained with a Multicore. Measurements were made simultaneously on four channels for Phosphate, Ammonium, Nitrate with Nitrite together and Nitrite separate. At stations approximately 350 sub-samples were collected and preserved for Dissolved Inorganic Carbon (DIC), combined acidified PO_4 and Silicate, and H_2S in 5mL glass vials containing 40µl 1N NaOH to be analysed later in the home laboratory. All measurements were calibrated with stock-standards diluted in low nutrient seawater (LNSW) in the same salinity range as the stations.

3.2 EQUIPMENT AND METHODS

3.2.1 Sample Handling

Normal oxic waters:

The samples were collected in 60ml high-density polyethylene syringes with a three way valve to make it possible to sample air free water from the CTD bottles. The syringes with a three way valve were first rinsed three times with a small amount of sample before being completely filled up.

After sampling on deck, the samples were processed immediately in the lab; samples were filtered over a to the syringe attached combined 0.8/0.2µm filter and instantly sub-sampled for DIC in a glass vial already containing 15µl saturated $HgCl_2$ and filled with a round meniscus before being capped and stored upside down in a refrigerator. One more pony-vials, was used for storing acidified PO_4, and Si (in hypoxic or anoxic waters) as one sample for analysis in the home lab after the cruise.

PO_4, NH_4 and NO_3 plus NO_2 samples were simultaneously measured in the lab container within 12 hours after sampling. All sampling vials including caps were pre-rinsed three times with sample before use.

To avoid NH_4 contamination from the air during analysis, all vials including the calibration standards were covered with ‘parafilm’ when placed into the auto-sampler to keep gas exchange to a minimum. The sharpened sample needle of the sampler easily penetrated through the film under tension leaving only a small hole. Gas segmentation, used in the continuous flow on the QuAAtro, for mixing reagents and samples and keeping dispersion as low as possible in the continuous flow, was done using NH_4 free Nitrogen gas.

A typical sampler rate of 60 samples per hour was used. Calibration standards were diluted from stock standards of the different nutrients using 0.2µm filtered LNSW and freshly prepared every day. LNSW was also used as baseline-water for the analysis in-between the samples. Each run of the system had a correlation coefficient of at least 0.9999 for 10 calibration points, but mostly 1.0000 for linear chemistry. The samples were measured from the lowest to the highest concentration in order to keep carry-over in the flow system as small as possible, i.e. from surface to deep waters. Concentrations were recorded in ‘µmol per liter’ (µM/L) at the lab

temperature of 23°C. During the cruise each run, a freshly diluted mixed internal nutrient standard (nutrient cocktail), containing, phosphate and nitrate was diluted 100 times in LNSW and measured. This cocktail sample was used to monitor independently of the standards the performance of the system.

A second control sample (LNSW from OSIL batch LNS 21) close to the method detection limits was measured direct after the baseline.

Anoxic and hypoxic sampling:

One hour before the samples were expected to be on the deck, 60ml syringes with three way valves were prepared and filled up with anoxic made demineralised water (DIW, using N_2 gas and an aquarium bubbling stone).

Depending on the expected salt content (CTD sal), the samples were diluted with the syringes to approximately normal seawater salt content and immediately mixed, (just by taking in an aliquot of sample e.g. @ dilution factor 6: using 10ml sample added to 50ml DIW in the syringe).

Prior to analysis a dilution check was made by pipetting pure sample to DIW with e.g. the same factor 6 and compare the salt content with a refractometer with the diluted ones of the syringes. After analysis a back-correction with the appropriate dilution numbers was made.

3.2.2 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 & Riley, 1962).

Ammonium (NH_4) reacts with phenol and sodium hypochlorite 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. W. Helder and R. 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. The Nitrite is diazotized with sulphanyl-amide and naphtyl-ethylene-diamine to a pink colored complex and measured at 550nm. 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 diazotized with sulphanyl-amide and naphtyl-ethylene-diamine to form a pink colored complex and measured at 550nm. (Grasshoff et al, 1983)

3.2.3 Calibration and Standards

Nutrient primary stock standards were prepared in deionised water (18.2MΩ) at the NIOZ as follows;

Phosphate: by weighing Potassium dihydrogen phosphate in a calibrated volumetric PP flask to make 1mM PO_4 stock solution.

Ammonium: by weighing Ammonium Chloride in a calibrated volumetric PP flask to make 1mM NH_4 stock solution.

Nitrate: by weighing Potassium nitrate in a calibrated volumetric PP flask set to make a 10mM NO_3 stock solution.

Nitrite: by weighing Sodium nitrite in a calibrated volumetric PP flask set to make a 0.5mM NO_2 stock solution.

The cocktail standard, a mixture of Phosphate and Nitrate preserved with addition of 1ml saturated $HgCl_2$ liter.

All stock-standards were stored at room temperature in a 100% humidified box. The calibration standards were prepared daily by diluting the separate stock standards, using three electronic pipettes, into four 100ml PP volumetric flasks (pre-calibrated at the NIOZ) filled up to the mark with diluted LNSW. The background values of the diluted LNSW were measured on-board and added up to the standard values to compute the final calibration- values.

3.3 STATISTICS

3.3.1 Quality Control

Our cocktail standard was measured every run for all nutrients during the cruise.

Our standards have already been proven by inter-calibration exercises from ICES and Quasimeme, and since 2006 by the Inter Comparison exercises organised by MRI, Japan.

To obtain international comparable results, two KANSO CRM's produced by The General Environmental Technos Co., Ltd. Japan were analysed in the three previous legs.

3.3.2 Method Detection Limits

The method detection limit (M.D.L) was calculated during the cruise using the standard deviation of ten samples containing 1% of the highest standard used for the calibration curve and multiplied with the student's value for n=10, thus being 2.82. (M.D.L = std. dev. of 10 samples x 2.82 E.P.A. procedure). Values below are the average values of two measurements at rough sea and calm sea state.

M.D.L.	µM/l	At applied measuring range µM/l:
PO4	0.009	3.00
NH4	0.05	10.0
NO3	0.03	40.0
NO2	0.002	2.50

Precision at calibration levels.

Used concentration level µM/l and c.v. % (triplicate analysis):

	µM/l	c.v. %	µM/l	c.v. %	µM/l	c.v. %
PO4	0.6	0.4	1.2	0.4	2.0	0.8
NH4	2.0	0.7	4.0	0.5	7.0	0.9
NO3	8.0	0.9	16.0	0.6	30.0	0.7
NO2	0.5	1.5	1.0	0.8	1.75	0.5

Control sample close to the M.D.L.

As an independent control on near baseline values from in-between analytical runs, LNSW from OSIL batch LNS 21 was measured every day n=7:

OSIL batch LNS21	µM/l	st. dev. µM/l
PO4	0.008	0.005
NH4	0.059	0.015
NO3	0.008	0.009
NO2	0.026	0.007

From the day to day variation no trends over time were observed concluding the baseline-water LNSW used was stable during the time of the cruise.

Cocktail statistics.

The average value of 9 triplicates was 2.27uM for PO_4 and 34.78uM for NO_3 with a coefficient of variation being respectively 0.8 and 1.0% as an indication of in-between analytical runs precision. From the cocktail measurements no trends were observed concluding that the calibration standards were stable during the cruise.

Literature

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Murphy, J. & Riley, J.P., A modified single solution method for the determination of phosphate in natural waters. Analytica chim. Acta, 1962, 27, p31-36

Strickland, J.D.H. and Parsons, T.R., A pracitcal handbook of seawater analysis. First edition, Fisheries Research Board of Canada, Bulletin. No 167, 1968. p.65.

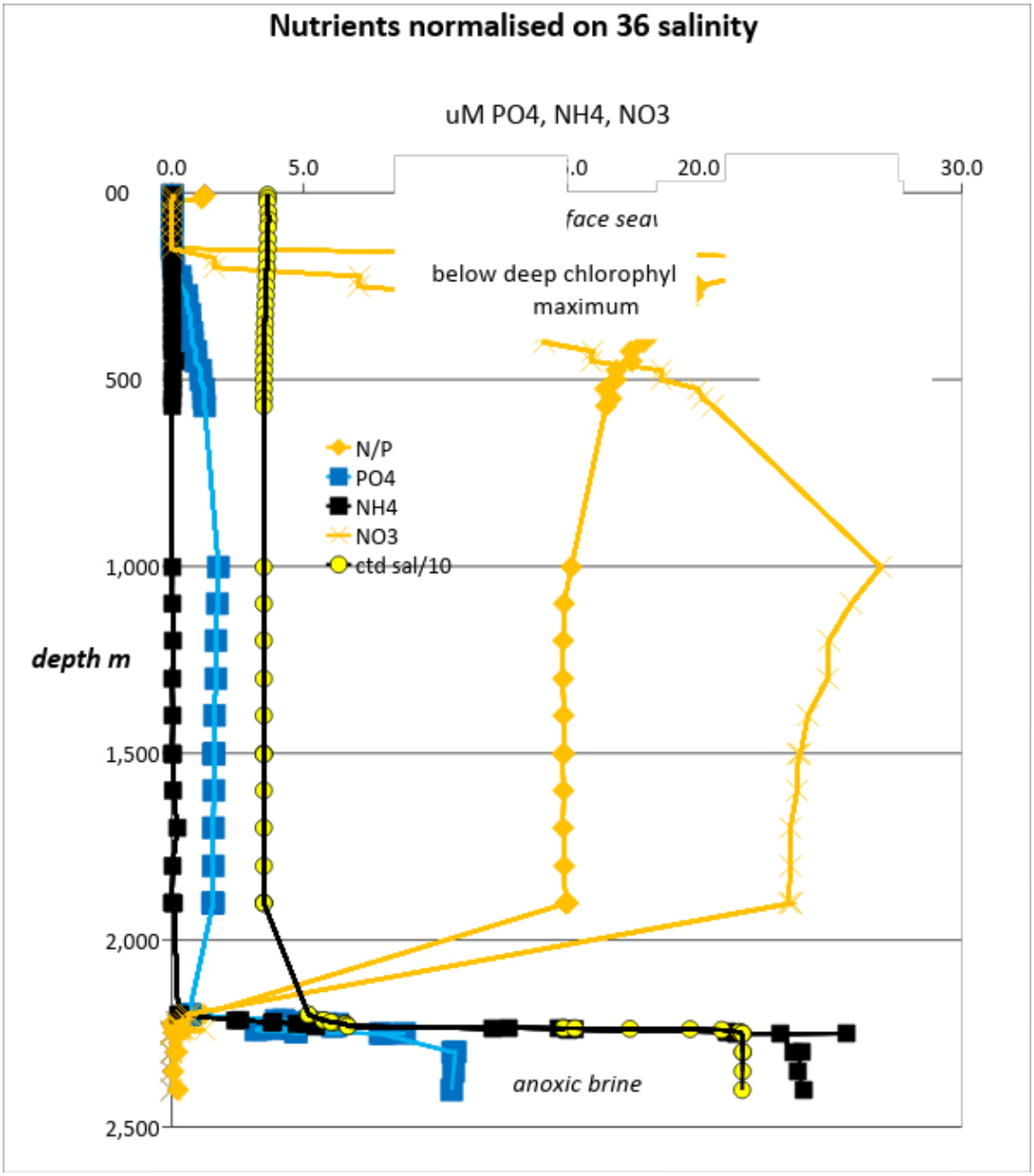

Figure 3.1. combined CTD casts analysed for nutrients at location Orca basin.

4 WATER COLUMN

4.1 CTD DATA

Water column profiling (temperature, salinity, conductivity, etc.) including water sampling was performed using a frame mounted Sea Bird Electronics SBE9plus underwater unit, a SBE11plusV2 deck unit, a SBE32 carousel, a SBE3plus thermometer, a SBE4 conductivity sensor, a SBE5T underwater pump, a SBE43 dissolved oxygen sensor, a Chelsea Aquatracka MKIII fluorometer, and a WetlabsC-Star transmissiometer. The oxygen sensor started to lose sensitivity at station 5, which resulted in probably lower than real oxygen concentrations, and was only realised after the first cast at station 7 (it was thought to be caused by the influence of a Gulf of Mexico eddy in the area). This sensor was replaced after the first CTD cast (cast 2) of station 7 (Orca Basin).
At Station 7, in the CTD cast that penetrated the brine pool, a more wide ranging salinity sensor was used (SE4/W). The data acquired with this system was used to calculate sound velocity profiles for the multibeam surveys.
Water sampled with the rosette sampler was used for nutrient analyses, methane concentration, particulate filtrations, incubation set-ups and occasionally for trace metal analyses (when the ultraclean CTD could not be used). During bad weather, the McLane in situ pumps were mounted on the CTD frame in order to avoid placing them on the line in rough swells. Niskin bottles were removed to make room for the pump(s).

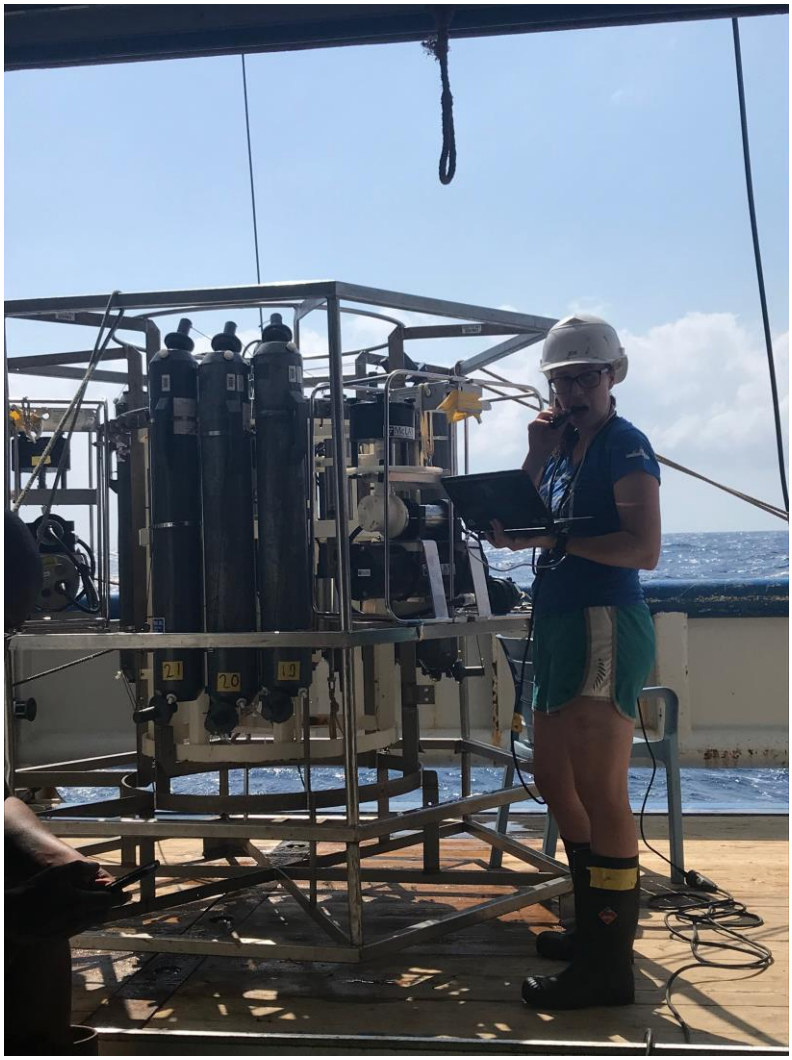

Figure 4.1. CTD frame, with Niskin bottles and mounted McLane in situ pumps. Photo credit Z. Erdem.

4.2 TRACE METAL WATER COLUMN SAMPLING WITH ULTRACLEAN CTD AND REGULAR CTD

Olga Żygadłowska

Sampling of the water column at station 3 '50m' and station 4 '600m' was carried out by using an ultra-clean trace metal conductivity-temperature-depth (CTD) sampler consisting of an all-titanium frame with 24 sample bottles of 24 L each made of PVDF plastic (abbreviated uc CTD, made at NIOZ), arranged as two rows of twelve bottles. Regular CTD was used on station 2 '15m', 5 '150', 6 '300m' and 7 '2000m'. Station 2 was sampled with regular CTD because the ultra-clean CTD cannot be used in the water column shorter than 40m while station 5, 6 and 7 could not be sample with uc CTD because of bad weather conditions.

Sampling of the uc CTD occurred in a class 100 clean-room container specially designed to get the uc CTD in and out rapidly to avoid contamination. The container was also equipped with an anti-room separating the main part of the container of the outside by a Plexiglas door to keep dust and other sources of contamination outside. Moreover the designed container allowed simultaneous sampling of 12 bottles covering both sides of the uc CTD. To prevent contamination and to keep the uc CTD safe and secure, the uc CTD was at all times placed inside the clean air container (meeting class 100 clean-room specifications) when not in use during casts.

Figure 4.2 Ultraclean CTD is getting ready to be deployed (station 1). Photo credit W. Hooijmans.

4.2.1 Description of the uc CTD

To avoid contamination, the frame of the uc CTD was made of titanium and all the electronic pressure housings and other parts were made of titanium or clean plastics like Teflon, PVDF or POM. Prior to a cast the frame was prepared inside that container and transported to the CTD-launching spot using a custom made aluminum pallet and a long bedded forklift. After the cast the uc CTD was immediately returned to the clean air container to avoid contamination of the equipment with grease, rust or smoke particles from the ship. After closing of the container the air treatment system started to clean the air using HEPA-filters (meeting class 100 clean-room specifications after 15 minutes). The electronic CTD sensor system consisted of a SBE9plus underwater unit, a SBE11plusV2 deck unit, a NIOZ developed multivalve bottle-controller, a SBE3plus thermometer, a SBE4 conductivity sensor, a SBE5T under water pump, a SBE43 dissolved oxygen sensor, a Chelsea Aquatracka MKIII fluorometer, a Wetlabs C-Star transmissiometer (25 cm, deep, red) and a Satlantic PAR-sensor for underwater-PAR. Due to the butterfly-type closure on both ends of the bottle the opening was maximized resulting in an excellent flow-through. Opening and closing of the bottles were controlled by a hydraulic system. For bottom-detection a Benthos PSA-916 altimeter was installed.

4.2.2 Collection for trace metals

Before sampling, the uc CTD and container were thoroughly rinsed with freshwater as handling of the uc CTD by the crew members could have introduced dust/dirt into the container and the nutrient sample collection could have compromised the quality of the Teflon valves on the bottles.

Unfiltered, filtered samples were collected in acid washed Low Density PolyEthylene (LDPE) bottles (overnight at 60 °C 1 % Decon bath, overnight 60 °C 10 % HCl reagent grade and 0.1 % HCl baths, stored in 0.1 % HCl). LDPE tubing was acid washed following the same procedure as for the LDPE bottles (overnight at 60 °C 1 % Decon bath, overnight 60°C, 10 % HCl reagent grade and 0.1 % HCl baths). Each sample bottle was rinsed with the sample to collect using the following procedure: shaking for a few seconds, pouring of the seawater into the cap, rinsing of the threads of the cap and bottle. This procedure was repeated three times before collection. Total and dissolved samples were acidified on board to pH 1.8 with distilled hydrochloric acid prepared at the home laboratory in Utrecht.

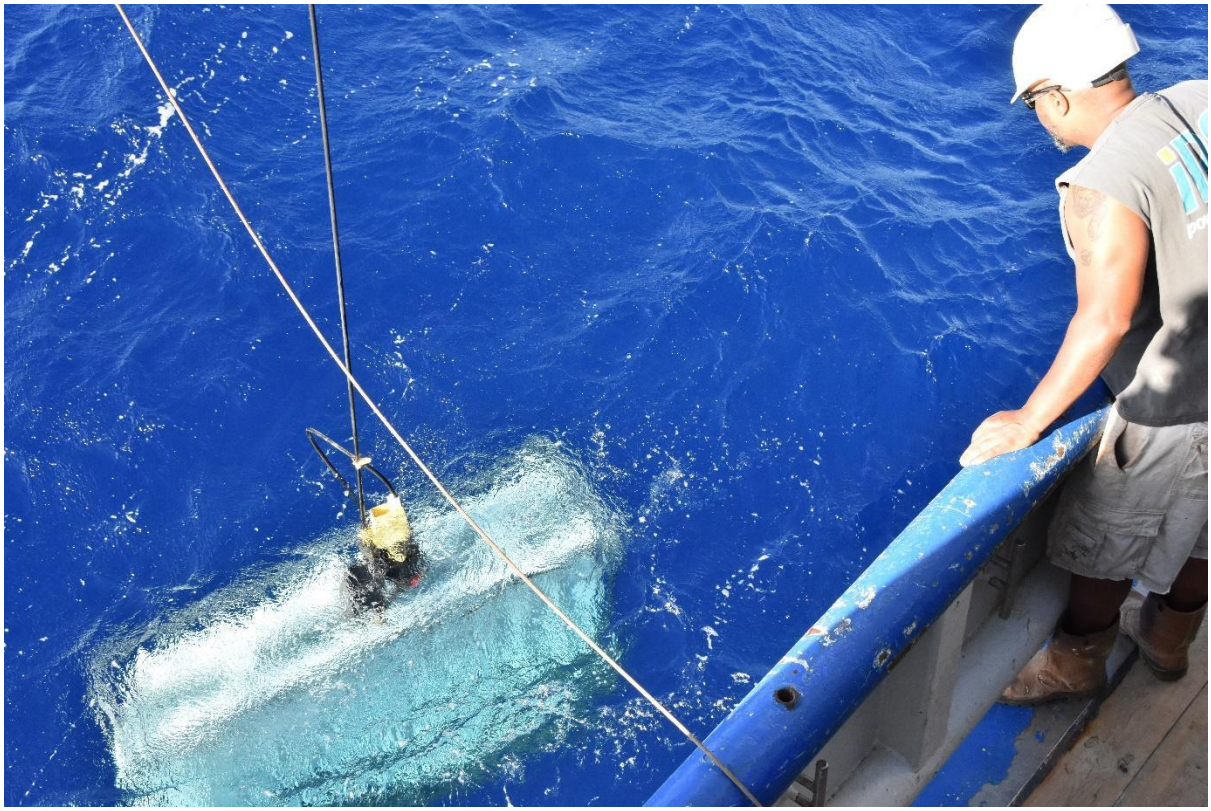

Figure 4.3. Ultraclean CTD being recovered. Photo credit W. Hooijmans.

4.2.3 Procedure for ultraclean CTD

The sample collection involved a simple set up, LDPE and C-Flex tubing and the filter holder.

- Unfiltered samples were directly collected from the uc CTD bottles into 250 mL acid washed LDPE bottle using a LDPE 10 cm long tubing, to avoid contact with the titanium frame.

- 0.2 µm dissolved samples were directly filtered from the uc CTD bottles under nitrogen pressure using 0.2 µm Sartobran 300 cartridges. The cartridge was rinsed with at least 0.5 L of sample and the 250 mL bottle was filled up to the shoulder.

All the samples were acidified in the clean room with 500µL of concentrated HCl and packed in new triple bags.

4.2.4 Procedure for regular CTD

For the regular CTD the sampling procedure was similar to the one for clean CTD. The samples were collected on the deck so all the attention had to be focused on being as clean as possible. The metal frame of CTD was covered with clean napkins and the CTD bottle lip was rinsed with MQ before sampling. For the filtered fraction the tubing was passed through peristaltic pump with the filter attached at the end. The pump was covered with plastic bag because a big part of it was rusted. Each LDPE bottle was taken out of the triple bag with gloves and put back in directly after being filled with sample. The bottles never touched anything else except for glove and the triple bag inside. The samples in triple bags were then taken to the clean container. In the anti-room the outside bag was taken off so no dirt from the deck was introduced to the clean room. All the samples were acidified in the clean room with 500µL of concentrated HCl and packed in new triple bags.

For station 7 the filtering part was performed in the clean room. 7 unfiltered samples were collected from regular CTD for each depth. One of the plastic bottles was then labeled as

unfiltered sample and the rest was used for rinsing the filter, rinsing the plastic bottle and collecting the sample. After that all the samples were acidified in the clean room with 500µL of concentrated HCl and packed in new triple bags.

Figure 4.4 Regular CTD Niskin bottles used to collect trace metal samples. Photo credit: Z.Erdem

4.2.5 Stations:

Station 2 '15m'

Table 4.1. Regular CTD, 7 depths, filtered on the deck using peristaltic pump, acidified in clean container, packed in new triple bags

Station 2 '15m'		sample bottle nr	
CTD bottle	Depth [m]	unfilter	filter
1	15	1	1
5	14	2	2
9	13	3	3
13	11	4	4
17	8	5	5
20	5	6	6

Station 3 '50m'

Table 4.2. Clean CTD, 12 depths, everything done in clean container

Station 3 '50m'		sample bottle nr	
CTD bottle	Depth [m]	unfilter	filter
1	48	1	1

2	48	2	2
3	45	3	3
4	42	4	4
5	39	5	5
6	36	6	6
7	33	7	7
8	30	8	8
9	30	9	9
10	27	10	10
11	24	11	11
12	20	12	12
13	16	13	13
14	12	14	14
15	9	15	15
16	6	16	16
17	3	17	17

Station 4 '600m'

Table 4.3. Clean CTD, 24 depths, everything done in clean container

Station 4 '600m'		sample bottle nr	
CTD bottle	Depth [m]	unfilter	filter
1	570	1	1
2	550	2	2
3	525	3	3
4	500	4	4
5	475	5	5
6	450	6	6
7	425	7	7
8	400	8	8
9	375	9	9
10	350	10	10
11	325	11	11
12	300	12	12
13	275	13	13

14	250	14	14
15	225	15	15
16	200	16	16
17	175	17	17
18	150	18	18
19	125	19	19
20	92,5	20	20
21	72,5	21	21
22	51,9	22	22
23	25	23	23
24	4,5	24	24

Station 5 '150m'

Table 4.4. Regular CTD, 7 depths (6 for filtered - we forgot to filter one of the bottles), filtered on the deck with peristaltic pump, acidified in clean container, packed in new triple bags

Station 5 '150m'		sample bottle nr	
CTD bottle	Depth [m]	unfilter	filter
10	3	6	6
9	25	5	5
8	50	4	4
7	75	3	3
6	100	1	2
5	125	2	1
4	141	7	7

Station 6 '300m'

Table 4.5. Regular CTD, 24 depths, filtered on the deck with peristaltic pump, acidified in clean container, packed in new triple bags

Station 6 '300m'		sample bottle nr	
CTD bottle	Depth (m)	unfilter	filter
1	290	1	1
2	264	2	2
24	264	3	4
23	240	4	5
22	240	5	6

21	215	6	7
20	215	7	8
19	190	8	9
18	190	9	11
17	163	10	12
16	163	11	14
15	139	12	13
14	139	13	15
13	115	14	16
12	115	15	17
11	90	16	18
10	90	17	19
9	65	18	20
8	65	19	21
7	50	20	22
6	50	21	23
5	15	22	24
4	3	23	4x
3	3	24	3x

Station 7 '2424m'

Table 4.6. Regular CTD, first cast 12 depths – second cast 12 depths, collected 1 bottle for unfiltered sample and 3 bottles for filtered sample, brought back to the clean container, filtered in clean container using peristaltic pump, acidified in clean container, packed in new triple bags

Station 7 '2424m'		sample bottle nr	
CTD bottle	depth	unfilter	filter
4	2400	4	1
5	2300	5	2
6	2300	6	
9	2250	9	3
10	2240	10	4

15	2240	15	
16	2225	16	5
17	2225	17	
18	2215	18	6
19	2215	19	
20	2200	20	7
21	2200	21	
4x	2350	4x	8
5x	2245	5x	9
6x	2245	6x	
7x	2237	7x	10
8x	2237	8x	
9x	2235	9x	11
10x	2235	10x	
15x	2230	15x	12
16x	2230	16x	
17x	2220	17x	13
18x	2220	18x	

4.3 METHANE CONCENTRATION AND METHANE OXIDATION RATE

Sigrid van Grinsven

Methane concentrations and methane oxidation rates were only determined for station 3 (50m) and station 7 (2000m, Orca). At station 3, samples for the methane concentration and oxidation rates were only taken at 30m depth. At station 7, the methane concentration was determined at 10 depths around the chemocline (see table below). At 4 of these depths, the methane oxidation rate was also determined.

Table 4.7 Samples taken for methane concentration and oxidation rates at Station 7.

From CTD bottle, cast 11

CTD bottle #	Depth (mbs)	# on vials
4	2350	2
5	2245	4
7	2237	5
8	2237, perhaps a little shallower	10
9	2235	9
15	2230	7
17	2220	6
Methane oxidation rates		
From CTD bottle, casts 2 and 10		
Depth	# on vials	
1900	MOR depth 1	
2250	MOR depth 2	
2240	MOR depth 5	
2225	MOR depth 3	

4.4 INCUBATIONS

4.4.1 Incubations of Sigrid van Grinsven

Incubations were set up at two different stations: station 3 (50m) and station 7 (2000m, Orca basin).

Methane oxidation in eutrophic, seasonally stratified areas

Eutrophic areas may show high methane production in the sediments due to the high labile organic matter input. St 3 is in a highly eutrophic area that experiences seasonal anoxia. This creates a highly dynamic environment in terms of oxygen and nutrient conditions. The microbial community may shift strongly between oxic and anoxic periods. The incubations performed at this station are aimed at finding methane oxidizers in both oxic and anoxic conditions, and to determine whether there are facultative anaerobe methanotrophs present, which are capable of performing methane oxidation in both oxic and anoxic conditions.

Samples for incubations at this station were taken from 30m depth with the regular CTD. In situ pump filters were also taken and stored in in situ water, to be taken to the NIOZ as living material.

Methane oxidation in an anoxic brine

The Orca basin is an extreme environment, with an extremely high salinity, permanent anoxia and very high concentrations of methane (±800 µM). We focus on the methane oxidizers that are capable of performing methane oxidation is these conditions, by studying the natural

community, and by performing labeling experiments with $^{13}CH_4$. Part of the incubations are enriched in iron oxides to test whether these stimulate methane oxidation.

Samples for incubations at this station were taken from 2250m depth with the regular CTD. In situ pump filters were also taken and stored in in situ water, to be taken to the NIOZ as living material.

4.4.2 Incubations for Saara Suominen

Saara's experiment will compare the organisms that readily attach to particles and utilize complex carbon substrates common in the marine environment. It will answer questions on the affect that organic matter composition has on the microbial community. Specifically, are some members of the community adapted to utilise specific carbon compounds or is there a few members of the total community that are capable of the initial hydrolysis of many different complex compounds. Also the resulting attached organisms relevant in the environmental community data and thereafter, what is the importance of particulate complex matter in sustaining the extant community.

Magnetic beads coated with different complex marine carbohydrates will be used as substrate, and samples will be collected 3 times.

Samples for these incubations were taken with the regular CTD, in the Orca Basin brine pool. Four depths were chosen, to cover the diversity around the chemocline. The depths selected were 1900m (oxic), 2220m (suboxic), 2250 (anoxic), 2235 (anoxic). Magnetic beads consisting of different organic molecules were added to the samples, after which they were placed in the dark at 5°C (in situ temperature). These experiments are expected to run for approximately 6 weeks.

4.5 NICO CTD PROJECT

Roosmarijn van Zummeren, Joëlle van der Sprong

4.5.1 Goal

The aim was to conduct about 2 NICO CTDs sampling per week. From each CTD cast, water samples were taken from three fixed depths (3m, 15m, and 200m) as well as three variable depths determined by the downcast profile observed as the CTD descended. These variable depths corresponded to the deep chlorophyll maximum (hitherto referred to as the DCM) boundaries: start of the DCM (named DCM upper during this cruise leg), the top of the DCM (named DCM peak during this cruise leg) and the bottom of the DCM. Due to the volumes necessary for analysis a total of 8 CTD bottles were required for sampling. With the exception of water samples taken at 15 m depth and the DCM peak, one bottle was closed at each depth; for the two aforementioned depths 2 bottles were closed per depth. See Table 1 below for the stations (cast and depths) sampled.

Table 4.8. Overview of sampled stations

Date	Station	Cast	Bottle	Depth
23/3/2018	1	1	7	20
23/3/2018	1	1	1	50
29/3/2018	8	3	21	5
29/3/2018	8	3	20	15
29/3/2018	8	3	19	75 (DCM MAX)

Water samples collected were analysed for two projects; samples for flow cytometry (FCM) and molecular analysis for Prof Corina Brussaard (NIOZ), and samples for DMSP content, pigment composition analysis by high pressure liquid chromatography (HPLC), particulate organic carbon (POC), and photosynthetic ability (PAM fluorometry) for Dr Maria van Leeuwe (RUG). Samples for dissolved inorganic macronutrients were taken for both projects. In Table 2 the type of analysis conducted for both projects, as well as the water volumes required from the CTD, are summarized. Water samples for fluorometry (PAM) were subsampled from the HPLC samples prior to analysis.

Table 4.9. Type of analysis conducted from CTD samples.

Depth	Flowcytometry	Nutrients	Molecular work	HPLC	POC	DMSP
3m	50 mL	50 mL	4L	2L	2L	70 mL
15m	50 mL	50 mL	5L	2L	2L	70 mL
DCM upper	50 mL	50 mL				
DCM peak	50 mL	50 mL	5L	2L	2L	70 mL
DCM bottom	50 mL	50 mL				
200m	50 mL	50 mL				

4.5.2 Methods

The following is a brief description of the methods; in depth procedures to be followed can be found in the attached protocols. Prior to collecting water from the CTD all sampling bottles were labelled with a number corresponding to the CTD bottle from which needed to be sampled. Samples were collected from the CTD in bottles bagged in black plastic bags to keep dark as much as possible. The order of sample collection was: Collection of water for DMSP from all required depths (6 bottles, 2 depths), carefully avoiding the formation of bubbles in the bottle. Water for nutrients and flow cytometry (12 bottles, 6 depths) was then collected. Then collection for the molecular work filtrations (2 bottles, 2 depths), and HPLC and POC analysis (3 bottles, 3 depths per analysis). Once all the samples were collected and adequately stored (everything kept dark either in the fridge, on ice, in cool box or grey box) processing would begin. Sample processing proceeded as follows. First DMSP sampling was conducted by one person while the other one started doing the PAM measurements. Once all samples for DMSP were processed and stored, the DCM Sterivex filtration would be started. While this was ongoing the HPLC filtrations would also be started. Per HPLC depth samples were wrapped in aluminium foil and kept in the liquid nitrogen dewar. Once the Sterivex filtration had concluded this filter would also be prepared for storage and kept in the dewar. The Anotop filtration was then started and then the POC filtration. While these two filtrations were running the flow cytometry fixations would get done, left to fix in the fridge and then frozen and also kept in the dewar with liquid nitrogen. Once PAM analysis was done the second person would then do the subsampling for the nutrients. Only one filtration for molecular work was usually done on the day of the CTD with the second filtration, due to time constraints, would be done the following morning. Once done all samples were stored in the appropriate freezers (-20 or -80 ºC) or in the fridge lab. Water samples for molecular work were kept cool on ice until analysis, and were per depth first filtered over a 0.22 µm Sterivex filter to collect the larger planktonic organisms, flash frozen in liquid nitrogen and stored at -80˚C in a labelled plastic bag. The filtrate collected from this first filtration was then filtered over a 0.02 µm Anotop filter to collect the viruses also present in the water column, after which stored under the same conditions as the Sterivex filter. Water from the 15m depth was processed first. To determine abundance of plankton as well as bacteria and viruses samples

from all depths were fixed for flowcytometry, i.e. with formaldehyde/hexamine for phytoplankton and glutaraldehyde for bacteria and viruses (duplicate samples). Samples were fixed for 30 min in the fridge, followed by flash freezing in liquid nitrogen and storage at -80˚C in labelled plastic bag labelled (e.g. labelling cryovials: 64PE434 S1-C1-B7 23/03/2018 20m). Water for nutrient analysis, i.e. dissolved inorganic silicate (Si), nitrogen (N) and phosphate (P) was taken from 3m, 15m and DCM peak if present (otherwise 50m) and filtered over 0.2 µm pore-size

Acrodisc syringe filter. Sample for silicate was stored at 4 ˚C, and for N+P upright in the -20 ˚C freezer, for N and P analysis. Pony-vials were numbered consecutively, starting from 1, independent of station and depth; the same number was used for duplicate vials originating from the same CTD water sample. For DMSP each sample taken was then subsampled into two separate 20 mL vials; the first vial contained 10 mL of unprocessed water while the second vial contained 10 mL of water gravity filtered over a 4.5 cm glass fibre filter. Vials were labelled with the leg identifier 64PE434 as well as leg number, station number, depth, A or B depending on whether it was the first or second bottle for a given depth, and T (for unfiltered water) or F (for filtered water). Example of labelling DMS vials: 64PE434 L7 S1 20m A/T. To each 20 mL vial 50 µL D3-P (an internal standard) as well as a pellet of NaOH was added. Once the pellet was completely dissolved all samples were stored at -20 ˚C. HPLC samples, used to determine algal pigments, were vacuum filtered over 4.7cm GF/F filters while 2.5 cm GF/F filters were used for POC samples. For both filtrations the volume of water filtered over each filter (3 in total for each depth) was noted. The filters where then stored in prepared aluminium foil marked with leg and station number, as well as depth and filter number, snap frozen in liquid nitrogen and stored in labelled plastic bags. HPLC filters were stored at -80 ˚C while POC filters were stored at -20˚C. (e.g. labelling filters: 64PE434 L7 S1 20m filter 1).

For PAM measurements water was subsampled from the HPLC water samples into the brown bottles used to collect water for DMSP sampling. These were then kept in the dark until such time as they could be processed. Water from the brown bottles (3 mL) was then pipetted into the PAM vials, 2 vials per depth, and dark acclimated for 10 minutes before measuring. For all measurements Ft values were ensured to be above 100 before proceeding. In such instances where this was not the case the PM-Gain and Out-Gain were increased up to 12. Samples for which the gain setting needed to be above 12 in order to have high enough Ft values were discarded. PAM measurements were always carried out in the same order starting with water from 3 m depth first, then 15 m, and finally the DCM peak when present. If the DCM peak was not present a sample was taken from a depth of 50 m.

4.6 IN SITU FILTRATION

Darci Rush, Sigrid van Grinsven

Five McLane Large Volume Water Transfer System Sampler (WTS-LV) in-situ pumps (McLane Research Laboratories Inc., East Falmouth, MA, USA) were deployed at Stations 2, 3, 4, 5, and 7. One of the pump, borrowed from Utrecht University, contained a dual filtration support, allowing for two filters to be collected at the same depth. Filters were collected for water column material originating from Mississippi and Atchafalaya Rivers (F. Peterse, Z. Erdem, F. Sangiorgi), suspension of redox metal (W. Lenstra), microbial community evaluation (D. Rush) and methanotroph incubations (D. Rush and S. van Grinsven). Depths were chosen according to the CTD profiles focusing particularly on surface and bottom waters for Stations 2, 3, 4, and 5. Station 7 showed the feature of a brine pool at Orca Basin and the NIOZ pumps were deployed into this brine to study the (methanotroph) microbial communities across the

brine redoxcline. Due to bad weather, pumps were not deployed on the cable at all stations and were instead redeployed on the CTD frame. Due to time restraints, multiple redeployments of the in situ pumps were not possible at Orca Basin. Instead, CTD bottle water was collected (on 29-03-2018) in Nalgene containers, stored at 4°C, and filtered in the wet lab (on 30-03-2018) with a peristaltic pump on 142 mm GF75 (0.3 uM pore size).

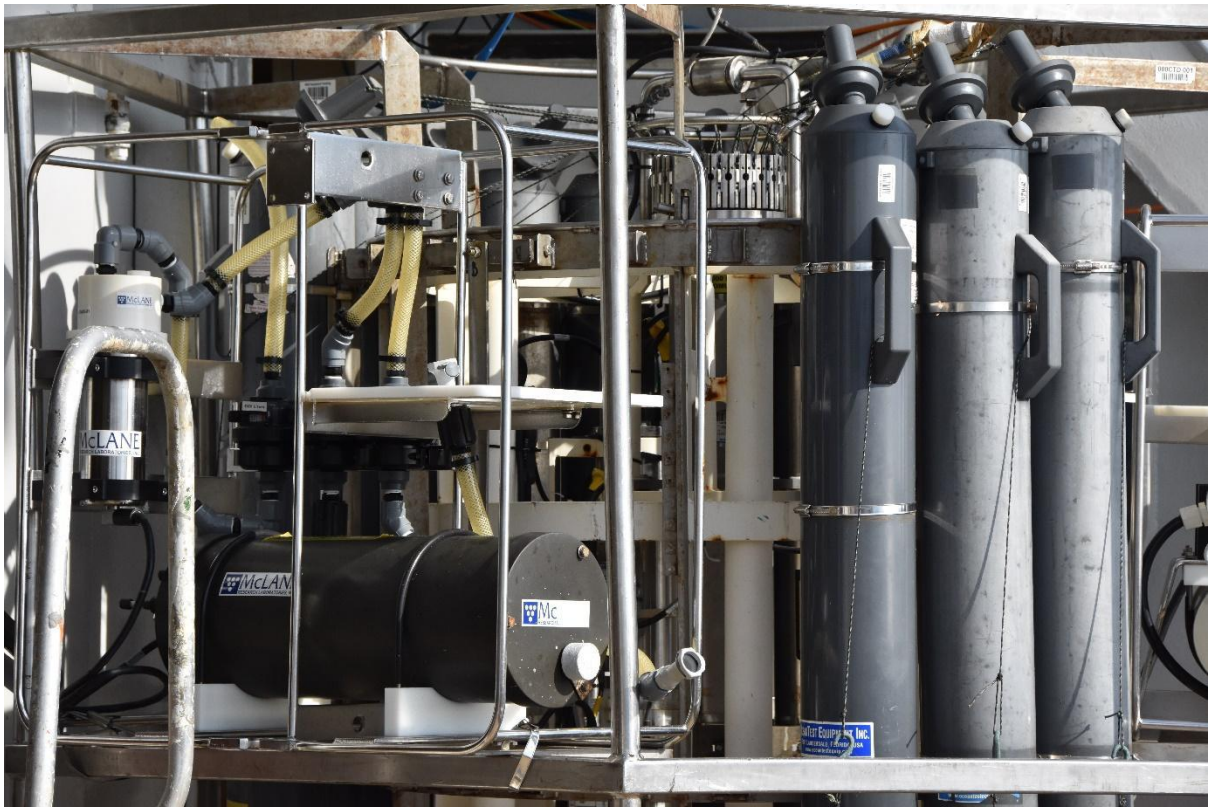

Figure 4.5. In situ pumps on the regular CTD cast. Photo credit W. Hooijmans.

Table 4.10. In situ pumping volumes

Station	Cast	Pump	Depth (m below surface)	pump meter start	pump meter end	Volume according to pump meter(L)	Volume according to software (L)	Filter type
2 (15 m)	5	A	2,5	79007	79026,5	19,5	20,2	GF75
2 (15 m)	5	D	1,4	7701,3	7719,5	18,2	19,97	poly
2 (15 m)	5	UU	total	19840	20185	345	300	
2 (15 m)	5	FH1	13,9	9438	9438	0		GF75
2 (15 m)	5	FH2	13,9	7402	7411	9		poly
2 (15 m)	6	A	6	790275	790510	235	27,18	GF75
2 (15 m)	6	B	12	119466	119517	51	102,45	GF75
2 (15 m)	6	C	12	101182	101226	44	58,64	GF75
2 (15 m)	6	D	6	772,4	774,8	2,4	21,58	GF75
2 (15 m)	6	UU	12	20197	20541	344	300	

2 (15 m)	6	FH1		9438	9438	0		poly
2 (15 m)	6	FH2		7411	7415	4		GF75
3 (50 m)	5	A	30	79051	79242	191	210,46	GF75
3 (50 m)	5	B	30	19517	19753	236	300	GF75
3 (50 m)	5	C	1,5	101229	101441	212	299,99	GF75
3 (50 m)	5	D	1,5	7748	7820,9	72,9	77,73	poly
3 (50 m)	5	UU	51,5	20541	20880	339	300,02	
3 (50 m)	5	FH1		9438	9443	5		GF75
3 (50 m)	5	FH2		7414	7423	9		poly
3 (50 m)	6	A	34	79242	79369	127	140,32	GF75
3 (50 m)	6	B	34	19753	19973	220	300	GF75
3 (50 m)	6	C	surface	101442	101700	258	299,99	GF75
4 (600 m)	7	A	72	79369	79717	348	354,58	GF75
4 (600 m)	7	B	125	119973	120427	454	481,17	GF75
4 (600 m)	7	C	Surface	101700	101947	247	356,85	GF75
4 (600 m)	7	D	Surface	7822,6	7892,7	70,1	78,03	poly
4 (600 m)	7	UU	620 m	21245	21808	563	505,96	
4 (600 m)	7	FH1	touched bottom	9449	9456	7		GF75
4 (600 m)	7	FH2		7432	7445	13		poly
5 (150 m)	5	A	69 m	79717	79991	274	287,69	GF75
5 (150 m)	5	UU	Surface	21808	22373	565	503,52	
5 (150 m)	5	FH1		7445	7454	9		GF75
5 (150 m)	5	FH2		9456	9457	1		poly
5 (150 m)	6	B	Bottom	120424	120662	238	347,22	GF75
5 (150 m)	6	D	Bottom	7896,5	8053	156,5	154,51	poly
7 (2000 m)	2	UU	1900	22372	22911	539	488,57	
7 (2000 m)	2	FH1		7454	7470	16		GF75
7 (2000 m)	2	FH2		9458	9464	6		GF75
7 (2000 m)	2	D	1500	8055,9	8460,2	404,3	401,49	GF75
7 (Orca Basin)	10	B	2250 m (ca. 30 m into brine)	120662	120785	123	243,19	GF75
7 (Orca Basin)	10	C	2250 m (ca. 30 m into brine)	101949	102139	190	261,6	GF75
7 (Orca Basin)	11	D	2220	8463,4	8746,5	283,1	315,32	GF75
7 (Orca Basin)	11	A	2235	79991	80019	28	28,29	GF75

Table 4.11. On board peristaltic pump filtration volumes for Orca Basin (Station 7).

Finish time	CTD Bottle	DEPTH (m)	Volume filtered (L)	GF75 size	Remarks
08:55	Cast 11 Bottle 8	2237 (might have gone shallower with boat movement)	8.68	142	Bottle was fired at same depth as cast 11, bottle 7, but ship moved
09:55	Cast 11 Bottle 7	2237	8.35		
12:05	Cast 10 Bottles 16 + 17	2225	15.67		2 bottles of water
14:50	Cast 11 Bottles 15	2230	17.74		
16:50	Cast 10 Bottle 7, 8, 9	2250	12.38		
17:20	Cast 11 Bottle 4	2350	8.20		Good yellow colour
19:20	Cast 10 Bottles 10 + 15	2240	18.12		
20:30	Cast 11 Bottles 5 + 6	2245	19.45		

4.7 NICO PHYTOPLANKTON NET

Roosmarijn van Zummeren, Joëlle van der Sprong

The “Plankton Pump” forms an integral part of the NICO program to be carried out by various MSc-students selected to participate during all legs of the NICO expedition, except for legs 1 and 3. In this program the central parameter to be determined is the biomass of micro plankton as it varies across the North Atlantic, and in particular to what extent it changes according to the day/night cycle. The “Plankton Pump” 9 (figure 4.6) is a highly efficient way of collecting surface water micro plankton in the >0.1 mm range throughout a research cruise. It uses the ship's deck-wash or fire extinguishing system to continuously filter large volumes of surface water (typically 30-60 m^3 per interval of 6 hours), without costing ship-time, while sea surface parameters such as temperature and salinity are semi-continuously measured by the ship's system (“Aquaflow”). It has successfully been used for three decades to sample skeletal micro plankton, particularly the calcitic planktonic foraminifera. Continuous surface water plankton pumping is particularly attractive in combination with water column sampling by depth profiling using plankton tows (e.g. Multi net, vertical net or Ring net), CTD-rosette and/or large volume sampler at sampling stations.

Surface water is continuously pumped up from an inlet at 3 m depth in the bow of the RV Pelagia, and eventually passes through a hose via a flowmeter into the plankton net (100 µm mesh size) that is suspended in a cube vessel on the aft deck. Every 6 hours, at 09:00, 15:00, 21:00 and 03:00 (ship-time), the flowmeter (to the nearest 0.1m3) and time (to the minute) are

noted and the hose is taken out to drain the net. Then the hose is used to wash the contents from the outside down the net into the cod-end beaker. The full beaker is taken off and replaced by an empty one. In the meantime, a water sample is taken in a 250ml PE bottle for nutrient analysis, total alkalinity, DIC and water isotopes.

Figure 4.6. Photo of plankton pump cod-end. Credit W. Hooijmans

The full cod-end is taken to the wet-lab and its content completely transferred onto a 90 µm sieve using seawater. The plankton sample is shortly rinsed with Milli-Q to remove the sea salts, then flushed into a small zip-lock plastic bag labelled with the cruise name (64PE434 for Leg 7), consecutively numbered PP1 to PP99, and sampling date. See table 1 below for a part of sampling dates and codes. Samples are frozen and stored at -80°C. The nutrient sample is taken up in a syringe and pressed through a 0.2um acrodisc filter to fill two ponyvials to 1 cm below the top (ca. 5 ml each), of which one is stored at 4°C (for dissolved Si-analysis) and the other at -20°C (for phosphate and nitrate analysis), for later analysis in the NIOZ nutrient lab. The water isotope sample also uses the water from the syringe to fill up the small glass vial to the very top, so that no air bubble remains. Put the small crimp cap with red inner septum on top of the glass vial and use the tong to close the cap. The alkalinity and DIC samples also use the water from the syringe to fill two ponyvial containing a small drop of HgCl2 (toxic) to well below the top (ca. 5 ml). These were stored at 4°C for later analysis of total alkalinity in the NIOZ nutrient lab.

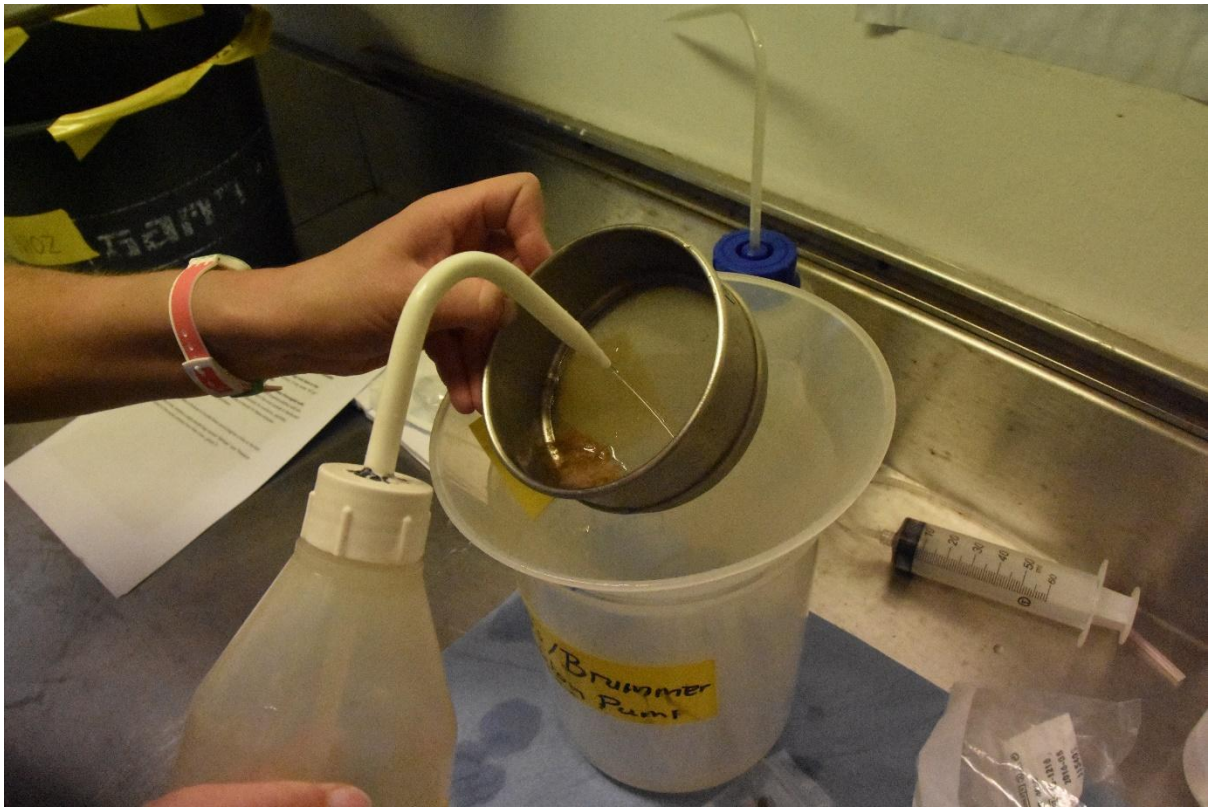

Figure 4.7. Photo of the sample recovered from plankton pump. Photo credit W. Hooijmans.

5 VIDEO

A HD video system, which is mounted on a Hopper frame, was deployed at two stations. This system is designed and developed by NIOZ. This frame also has a forward looking camera and two lasers pointing downwards. The spots generated by these lasers have a fixed distance and as they are perfectly parallel they can be used for size measurements and estimation of camera height above the bottom and thus the determination of the field of vision. The footage is available in real-time on board on line because the camera is connected by the ship by glass fiber mediated data transfer. The camera is lowered to 1-2 meters above the seafloor and towed forward with a maximum ground speed of 0.5 knots.

This system was used at Station 6 (600 m) in order to confirm the absence of benthic communities before sediment sampling. The most excitement of videoing Station 6 was when we disturbed a fish (or other animal – exact organism was out of view of the camera) and got jetted with its protective camouflage.

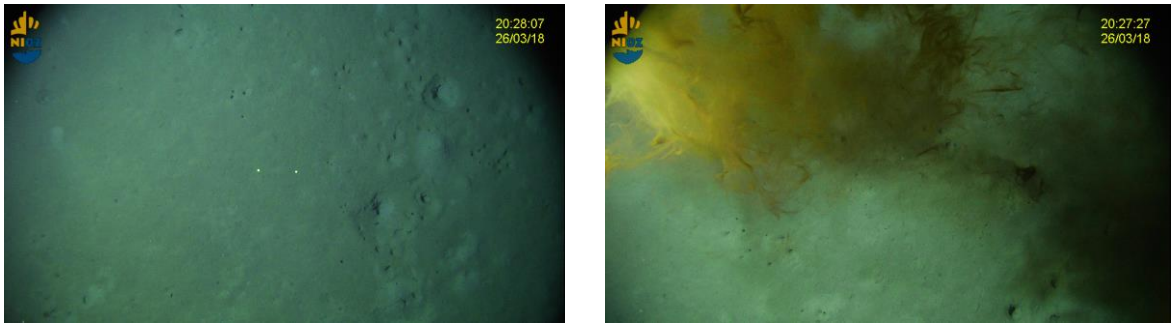

Figure 5.1. Typical seabed of Station 6 (600 m) left, and camouflage of disturbed animal, right.

The hopper system was deployed for the second time at Station 7 (Orca Basin), into the brine pool. Here's a water colour change was observed, from blue to green, across the brine interface, but no clear detrital layer was seen floating on the surface of the dense brine.

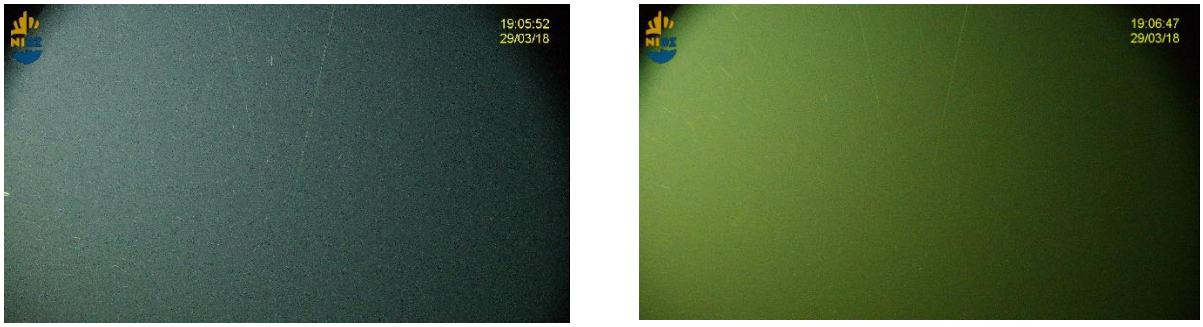

Figure 5.2. Colour of non-brine (blue, left) and brine (green, right) at Station 7 (Orca Basin)

Figure 5.3. Dead shrimp floating at brine interface of Orca Basin (Station 7).

6 ALBEX LANDER DEPLOYMENT

Rob Witbaard, Wytze Lenstra

6.1 GOAL

The goal of the lander deployments is to determine oxygen respiration and fluxes of nutrients and metals at the sediment water interface.

6.2 METHOD

The NIOZ ALBEX landers were deployed at 2 stations in the Gulf of Mexico. Deployment length needed was approximately 10 hours (incubation time 8 hours). Each lander was equipped with 3 measurement chambers enclosing a bottom surface of 144 cm^2. The depth that the chambers penetrated the sediment was determined by a resistivity probe mounted on the side of the measurement chamber and electronically connected to the chamber control unit. Once the resistivity changes by 12% the penetration of the measurement chamber into the sediment is interrupted. In Table 6.1 an overview of the sampling schedule used for all deployments is given.

Table 6.1. The NIOZ ALBEX landers were deployed at 2 stations.

Station	Successful boxes	Incubation length (hours)
2 (15 m)	3	10
3 (50 m)	2	10

Figure 6.1. ALBEX Lander. Photo credit W. Hooijmans

Every 2 hours (t=0,2,4,6,8 hours) a water sample of 30 ml from inside the box (overlying water) and the outside (bottom water) was taken for flux measurements. The 30 ml of water extracted from the headspace was replaced by water entering from outside the chamber. During the measurements the oxygen concentration in the overlying water was measured every minute with a JFE-Advantech self-logging optode. The observed decrease in oxygen concentration was used to calculate the benthic oxygen demand. Samples of 30 ml were directly subsampled out of the syringes through a 0.45 um filter. Only for Fe a sample was taken without filtering Table 6.2.

Each Albex unit takes the incubated bottom sample to the surface. The closing mechanism is such that disturbance of the bottom material is minimal. The bottom surface area of each box was photographed and the sediment was washed over a 0.5 mm screen. The residue was fixated in 4% formaldehyde.

During the cruise we were able to do only 2 lander deployments each with a duration of 10 hours. One frame (Albex-2) was used. The frame held 3 Albex incubation chambers. The deployment depths were 15 and 50 meter. Power was supplied by new li-ion batteries built into a Benthos glass sphere. The electrical system in all Albex measurement units had been replaced by Novec 7500 as a replacement of Fluorinert F77.

All units were equipped with JFE optodes which were mounted on one of the sides of the measurement box. Beforehand the optodes were calibrated with 100% aerated demi water and deoxygenated demi water (by N2 bubbling). Calibration was done relative to the default calibration values supplied by the producer of the optodes to enable the loss of signal strength over time.

Table 6.2. Lander sample volumes taken for nutrient and trace metal analyses

Analysis	Vol. (ml)	Vial	Treatment	Code	Method	Storage
PO4, Silica	2	Pony vial	5 µl 5M suprapur HCl	PO4	NIOZ, onshore	4°C
NH4,NOx	3	Pony vial	None	Bulk	NIOZ On board	4°C until analysis, then -20°C
Fe,Mn Unfiltered	10	12 ml Nalgene vial	10 µl suprapur 30% HCl per ml	Fe unfil.	Flow injection ICP-MS	4°C
Fe,Mn Filtered (0.45 um)	10	Nalgene vial	10 µl suprapur 30% HCl per ml	Fe 0.45	Flow injection ICP-MS	4°C
DIC	5	Glass vial		DIC	NIOZ	4°C
Total	30					

The measurement chambers were programmed in such a way that after arrival at the sea floor the syringes 1 time flushed instead of 3 times, this to save time. After flushing the first sample was shortly taken before closure of the measurement chamber. With four approximate 2 hour intervals Samples 2, 3, 4 and 5 were taken. During sampling one syringe was filled with water from the headspace of the measurement chamber, the other was filled with water from outside the chamber. The volume extracted from the chamber is complemented with water (30 ml) flowing into the chamber. Tube volume is estimated at 1.5 to 2 ml. After the last water sample the box takes the bottom sample and was withdrawn from the sediment.

At station 2 (15m) all boxes worked fine. Headspace volume ranged between 900 and 1900 ml. Unfortunately, optode 128 gave a corrupted file which could not be recovered from the memory card. Hence the oxygen consumption data got lost. In the second deployment at station 3 (50m) box 8B was overfilled with sediment and the box did not close. Overfill was probably caused by the fact that the resistivity already touched sediment before the start of the box down action. No difference could be measured in resistivity between overlying seawater and sediment. It remains unclear why the box did not close. A summary of results and samples taken from the incubation chambers is given in Figure 6.2 and Table 6.3.

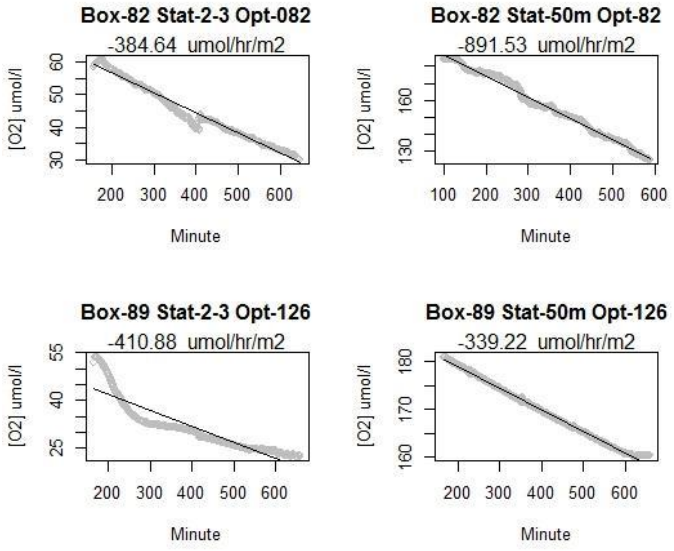

Figure 6.2. Overview of the successful Albex chamber lander incubations during the 64Pe434 cruise in the Gulf of Mexico on 25th and 26th March 2018.

Table 6.3. Overview of incubation details and samples taken from box together with deployment depth and estimated average oxygen consumption rate in µmol l-1hr-1m-2. The start and end time refer to the time interval over which the rate of oxygen decrease was estimated.

Station	**Box**	**Vol.l**	**Start**	**End**	**µmol.hr .m2**	**Start O2 mg/l**	**Fauna Sample**	**Nutrient Sample**	**Water Depth**
Stat 2-3	Box-82	1.64	25/03/2018 06:38	25/03/2018 08:40	-521.09	1.91	√	√	15
Stat 2-3	Box-82	1.64	25/03/2018 08:40	25/03/2018 10:42	-696.23	1.64	√	√	15

Stat 2-3	Box-82	1.64	25/03/2018 10:42	25/03/2018 12:44	-394.81	1.36	√	√	15
Stat 2-3	Box-82	1.64	25/03/2018 12:44	25/03/2018 12:44	-354.96	1.17	√	√	15
Stat 2-3	Box-82	1.64	25/03/2018 06:38	25/03/2018 14:46	-462.57	1.91	√	√	15
Stat 2-3	Box-89	1.90	25/03/2018 06:45	25/03/2018 08:48	-1575.14	1.71	√	√	15
Stat 2-3	Box-89	1.90	25/03/2018 08:48	25/03/2018 10:51	-177.03	1.05	√	√	15
Stat 2-3	Box-89	1.90	25/03/2018 10:51	25/03/2018 12:54	-279.83	0.92	√	√	15
Stat 2-3	Box-89	1.90	25/03/2018 12:54	25/03/2018 12:54	-173.24	0.79	√	√	15
Stat 2-3	Box-89	1.90	25/03/2018 06:45	25/03/2018 14:57	-513.87	1.71	√	√	15
Stat 3-3	Box-82	1.71	25/03/2018 21:39	25/03/2018 23:41	-696.96	5.89	√	√	50
Stat 3-3	Box-82	1.71	25/03/2018 23:41	26/03/2018 01:43	-1345.36	5.57	√	√	50
Stat 3-3	Box-82	1.71	26/03/2018 01:43	26/03/2018 03:45	-925.15	5.00	√	√	50
Stat 3-3	Box-82	1.71	26/03/2018 03:45	26/03/2018 03:45	-934.51	4.48	√	√	50
Stat 3-3	Box-82	1.71	25/03/2018 21:39	26/03/2018 05:47	-884.82	5.89	√	√	50
Stat 3-3	Box-89	1.81	25/03/2018 21:47	25/03/2018 23:49	-395.47	5.88	√	√	50
Stat 3-3	Box-89	1.81	25/03/2018 23:49	26/03/2018 01:52	-385.33	5.68	√	√	50
Stat 3-3	Box-89	1.81	26/03/2018 01:52	26/03/2018 03:55	-361.50	5.49	√	√	50
Stat 3-3	Box-89	1.81	26/03/2018 03:55	26/03/2018 03:55	-344.12	5.31	√	√	50
Stat 3-3	Box-89	1.81	25/03/2018 21:47	26/03/2018 05:58	-366.81	5.88	√	√	50

7 SEDIMENT (MULTICORE – MC)

7.1 MULTICORE SAMPLING (MC)

Zeynep Erdem, Wytze Lenstra, Niels van Helmond

Ten cm diameter multicores are recovered with an Oktopus multicoring apparatus (www.oktopus-mari-tech.de). Twelve cores are recovered per cast. Each core contains ~30-60 cm of sediment, plus overlying water. The weighting system of the multicorer is adjusted at each site to achieve optimum sediment recovery. Multicore sampling was done prior to Albex Lander deployment at stations 2 (15m) and 3 (50m). The sediment type showed rapid changes between stations which is described below in detail. After core collection, the multi-cores are transported one-by-one to the thermo container where they are placed in the grey core racks or stored in 4°C storage.

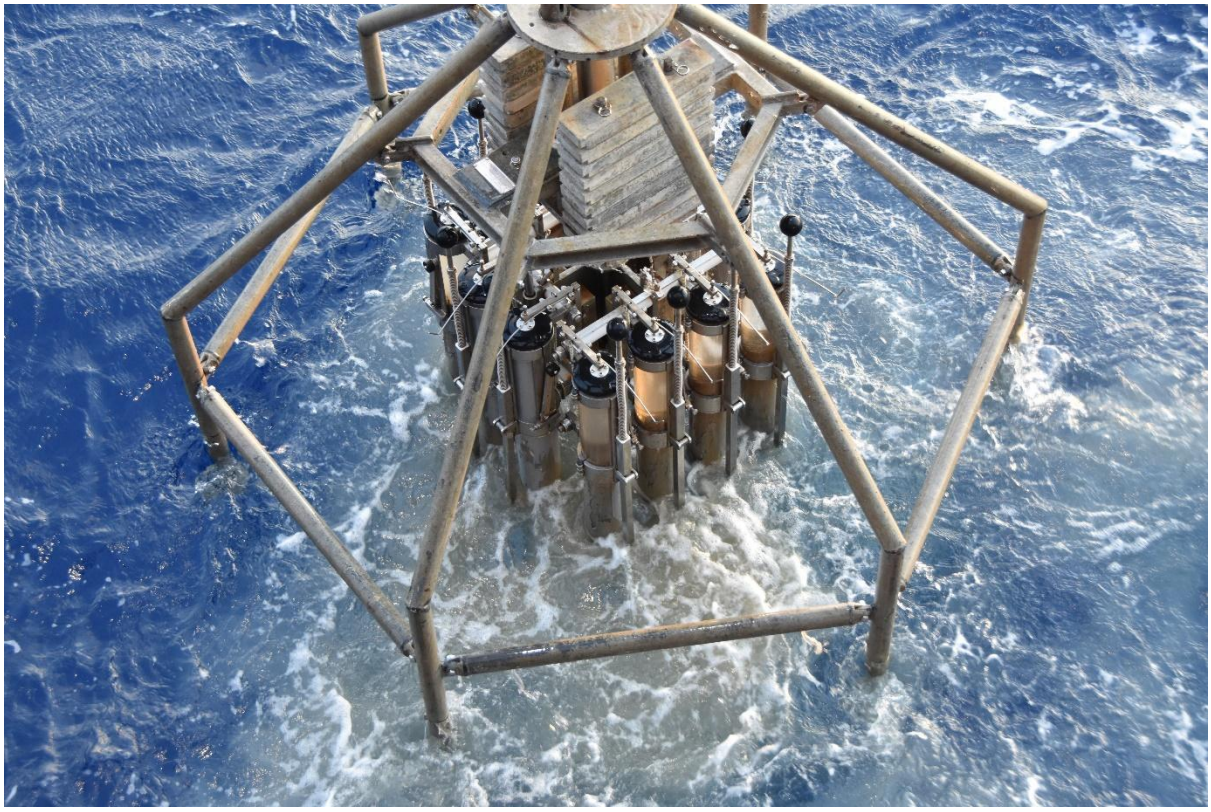

Figure 7.1. Multicore sampling. Photo credit W. Hooijmans

Key stations and sampling scheme – preferably all cores from the same cast:

I 1 MC: Anoxic sediment and porewater (Niels and Wytze)

II 1 MC: Oxic sediment and porewater (Francien, Julie and Olga)

III 1 MC: Methane (Wytze and Niels)

IV 1 MC: Micro-electrodes (Roosmarijn/Joelle)

V 1 MC: Solid phase, frozen + core photograph (Roosmarijn/Joelle/ Zeynep)

VI 1 MC: Solid phase, frozen for Peter Kraal (Zeynep, Niels and Wytze)

VII 1-3 MCs: Sediment 0-5 cm and 5-10 cm for incubations (Francien, Julie and Niels)

VIII 1 MC: Sediment 0-5 cm and 5-10 cm for micro plastics (Francien and Julie)

IX 1 MC: Biomarkers: every 1cm until 10 cm (Francien and Julie)

X 1 MC: Diols: 0-1cm and 1-5cm (Francien and Julie)

XI 1 MC: 4°C storage – grey tubes (subsampling in NIOZ; F. Sangiorgi)

XII 1 MC: 4°C storage – grey tubes (subsampling in NIOZ)

Extra 1: Foraminifera research x3 MCs from 2nd deployment from station 2 (15 m) (for Frans Jorissen): 1 MC first 7 cm, 2 MCs first 2.1cm with 0.7cm resolution (Zeynep Erdem).

Extra 2: for DNA research x1 MC from station (50 m) (Sigrid van Grinsven): every 0.5cm until 2cm then every 1cm until 10cm then every 2cm until 30cm

Extra 3: stored in 4°C with stoppers.

Table 7.1: overview of multicores collected per station

Station	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Extra
2 (15 m)	X	X	X	X	X	X	*3	X	X	X			
2 (15 m)											X	X	*3
3 (50 m)	X	X	X	X	X	X		X	X	X	X	X	X
4 (600 m)	X	X	X	X	X	X		X	*2	X	X	X	
5 (150 m)	X	X	X	X	X	X		X	X	X	X	X	
6 (300 m)	X	X	X	X	X	X	X	X	X	X	X	X	
7 (2200 m)					X				X¶			X	
7* (2100 m)	X	X	X	X	X			X	X	X	X	X	X

¶Entire core was sliced for biomarkers

7.2 ANOXIC SEDIMENT AND POREWATER (CENTRIFUGATION)

Niels van Helmond, Wytze Lenstra

7.2.1 Goal

Anoxic sediment is collected for pore water analysis and solid phase analysis in Utrecht, i.e. organic carbon, total destruction, and sequential Fe and S extractions.

7.2.2 Method

On deck, one core from each cast is stoppered at the top and base and transported to a temperature-controlled container (temperature set to match bottom water in situ temperature). Due to an unusable cold container on deck we had to use a container which minimum temperature was 18 degrees Celsius.

One sediment core per site is processed. Two bottom water samples are taken from the overlying water with a 20 ml syringe as soon as possible after core collection and, for anoxic sites, are transferred to a glove box where they are filtered into a 15 ml greiner tube (BULK).

Most of the remaining bottom water is then removed with a syringe (but ca. 3 cm of water is kept so that the top will not oxidize) and the sediment core is brought into the glovebag and is sliced under nitrogen with at least 20 depth intervals per core. Cores are sliced in the scheme presented at the end of this section unless otherwise determined on-board. Always slice the whole.

The sediment in each section is placed in centrifuge tubes (50 ml), which are sluiced out of the glove bag and centrifuged at 3000-4500 rpm for 20 minutes to collect porewater.

Supernatant water (porewater) is filtered via a 20 ml syringe and 0.45 µm filter into a 15ml greiner. Subsampling is performed from this 15ml greiner (or multiple greiners in the case of >15ml porewater). The sample for sulfide is subsampled as quickly as possible, i.e. directly after filtration of each sample. Sediment residues are stored frozen in greiner tubes (in aluminum bags flushed with N2) at -20 C.

Table 7.2. Subsample scheme for porewater anoxic core:

Analysis	Vol. (ml)	Vial	Treatment	Code	Method	Storage
HS	0.5	Glass or pony vial (NIOZ)	2 ml 2% ZnAcetate	HS	UU colorimetric	4°C
PO4, Silica	1	Pony vial (NIOZ)	5 µl 5 M HCl*	PO4, Si	PO4, Si NIOZ AA	4°C
NH4	0.5 (taken from bulk)	15 ml Greiner (UU)	None	Bulk	Onboard AA	4°C until analysis, then -20°C
Alkalinity	1	Pony vial	None	ALK	Onboard titration	4°C
S, Fe, Mn, trace metals, major elements	1	15 ml greiner	10 µl suprapur 30% HCl per ml	ME	ICP-OES ICP-MS UU	4°C
S, Fe, Mn, trace metals, major elements	~2	15 ml greiner	10 µl suprapur 30% HCl per ml	ME_0.2	ICP-OES ICP-MS UU	4°C
SO4, Cl	0.15	IC vial (UU)	None	IC	IC UU	4°C

*supplied by NIOZ.

##: Note: 1 ml for ME, 2 ml for ME_0.2 because of loss in syringe.

The volume for many analyses can be reduced if required. Also samples can be skipped for selected analyses, as long as a full profile is still obtained for each component. Top priority: HS, ME. Note that a separate core will be sliced under normal atmospheric conditions for NOx and DIC profiling.

7.3 OXIC SEDIMENT AND POREWATER (CENTRIFUGATION)

Francien Peterse, Julie Lattaud and Olga Zygadlowska

7.3.1 Goal

Collect sediment for Pb-210 analysis and pore water for analysis of dissolved inorganic carbon and NOx

7.3.2 Method

One sediment core per site is processed. Two bottom water samples are taken from the overlying water with a 20 ml syringe.

Most of the remaining bottom water is then removed with a syringe and the sediment core is brought onto the hydraulic slicing device and is sliced at the same resolution as obtained for the anoxic core.

Ca. 10 ml of uncentrifuged material from each sediment layer is put into pre-weighed 20 ml glass vessels for the determination of the water content (porosity) and possibly for solid phase analyses, i.e. CN and Total Destructions. The remaining sediment in each section is placed in centrifuge tubes (50 ml), which are centrifuged at 3000-4500 rpm for 20 minutes to collect porewater.

Supernatant water (porewater) is filtered via a 20 ml syringe and a 0.45 µm filter (pre-cleaned with UHQ water to prevent NOx contamination of the filter) into a 15ml greiner (labeled: NOx). Subsampling is performed from this 15ml greiner. Sediment residues can be used for 210Pb dating and are stored frozen in greiner tubes at -20°C.

Table 7.3. Subsample scheme for porewater oxic:

Analysis	Vol. (ml)	Vial	Treatment	Code	Method	Storage
NOx	1	Pony vial (NIOZ)	None	NOx	Onboard AA	4°C
DIC	5	glass vial	10 µl saturated HgCl2	DIC	NIOZ AA	4°C

Table 7.4. General core slicing scheme (incl. bottom water – often forgotten, during labeling):

Sample number	**Depth range (cm)**	**Total thickness (cm)**
BW1	-	-
BW2	-	-
1	0.0 - 0.5	0.5
2	0.5 -1.0	0.5
3	1.0 -1.5	0.5
4	1.5 - 2.0	0.5
5	2.0 – 2.5	0.5
6	2.5 – 3.0	0.5
7	3.0 – 3.5	0.5
8	3.5 – 4.0	0.5
9	4.0 – 4.5	0.5
10	4.5 – 5.0	0.5
11	5 - 6	1
12	6 - 7	1
13	7 - 8	1
14	8 - 9	1
15	9 - 10	1
16	10 - 12	2
17	12 - 14	2
18	14 – 16	2
19	16 – 18	2
20	18 – 20	2
21	20 - 24	4
22	24 - 28	4
23	28 - 32	4
24	32 - 36	4
25	36 - 40	4

Up to 5 additional samples possible, depending on the length of the core. Maximum: 30 samples.

7.3.3 Results of anoxic and oxic pore water

Pore water profiles of alkalinity (meq), NH4 (umol/L), NO2- (umol/L) and NO3- (umol/L).

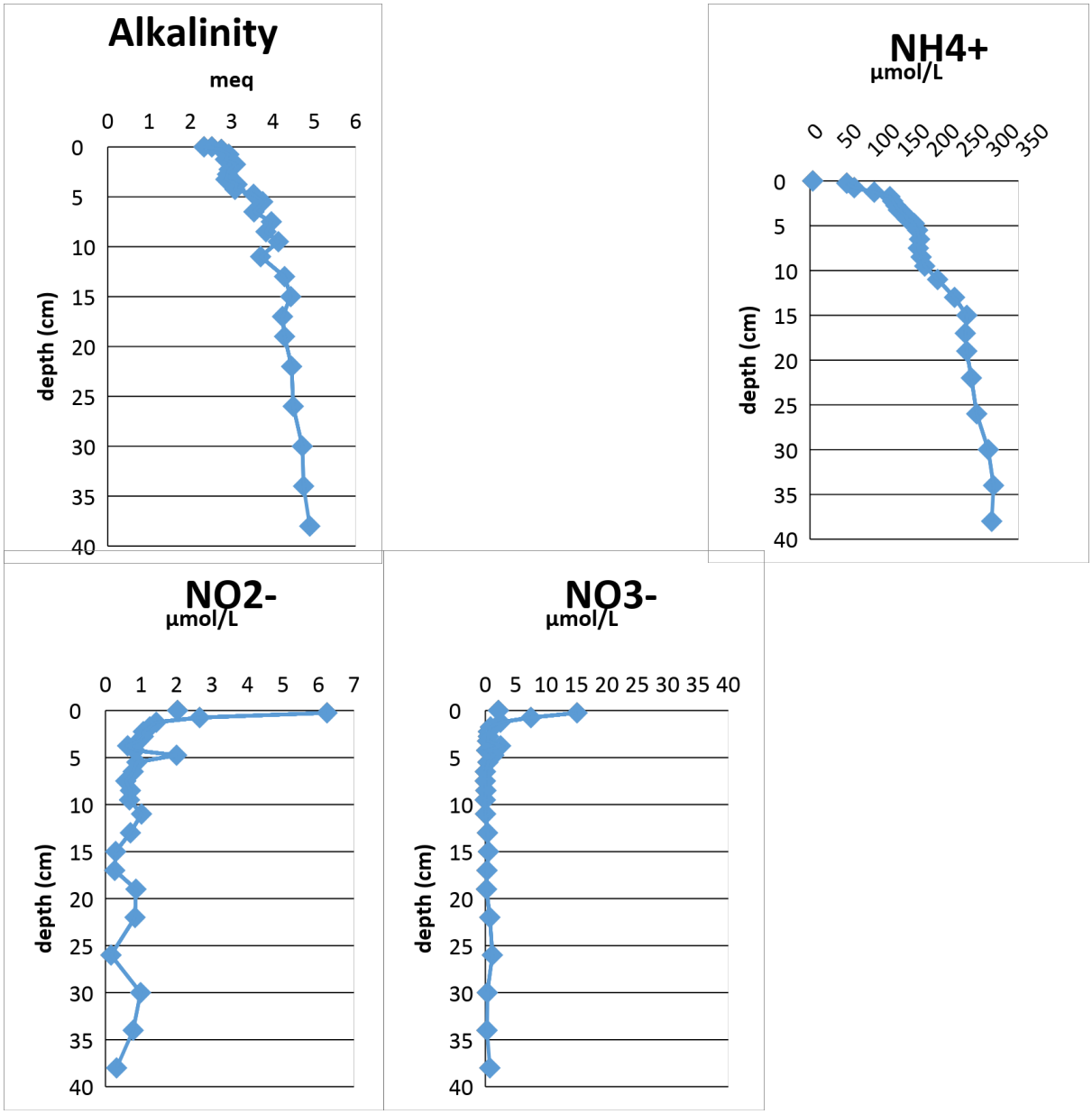

Figure 7.2. Pore water nutrients at Station 2

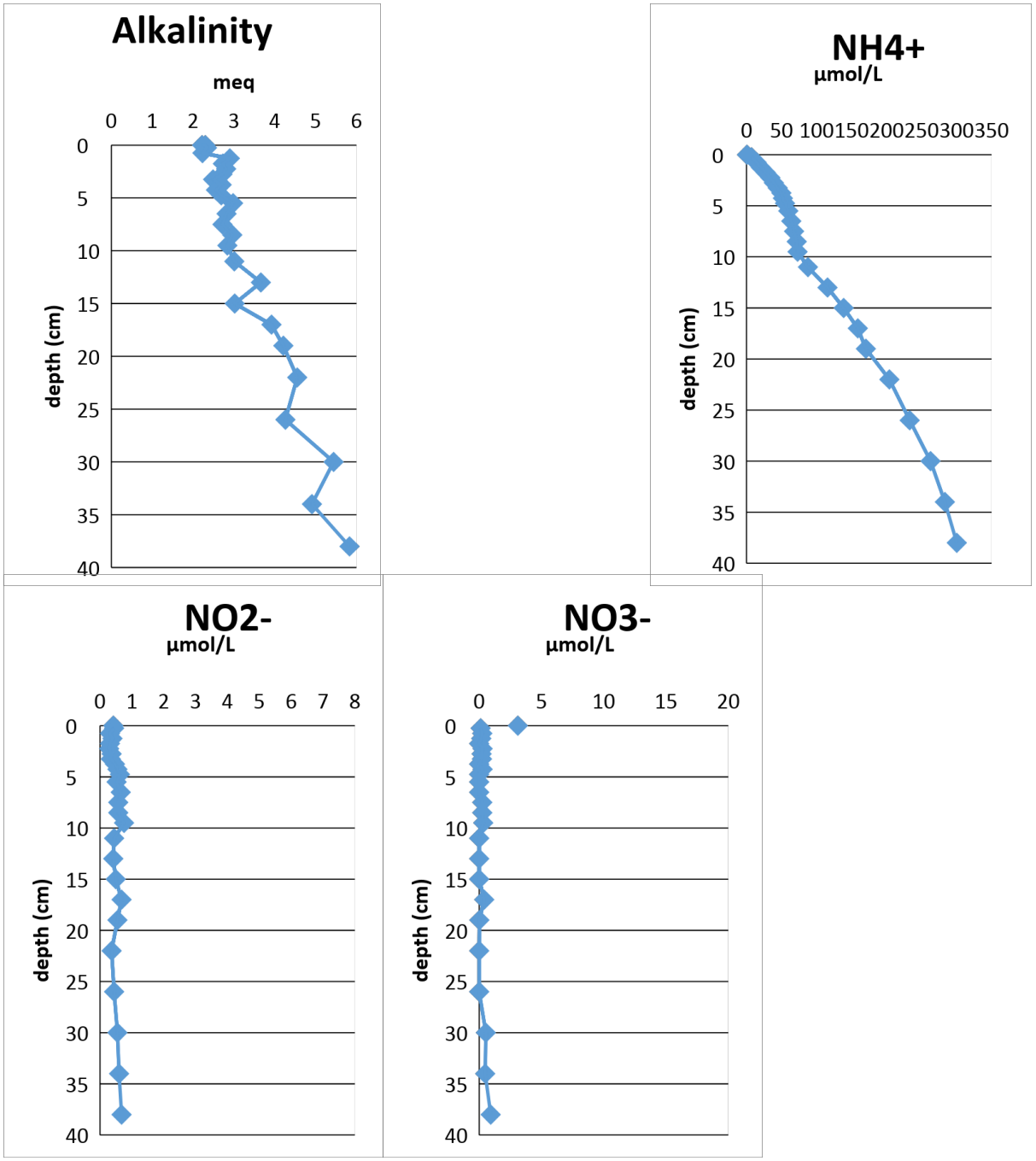

Figure 7.3. Pore water nutrients at Station 3

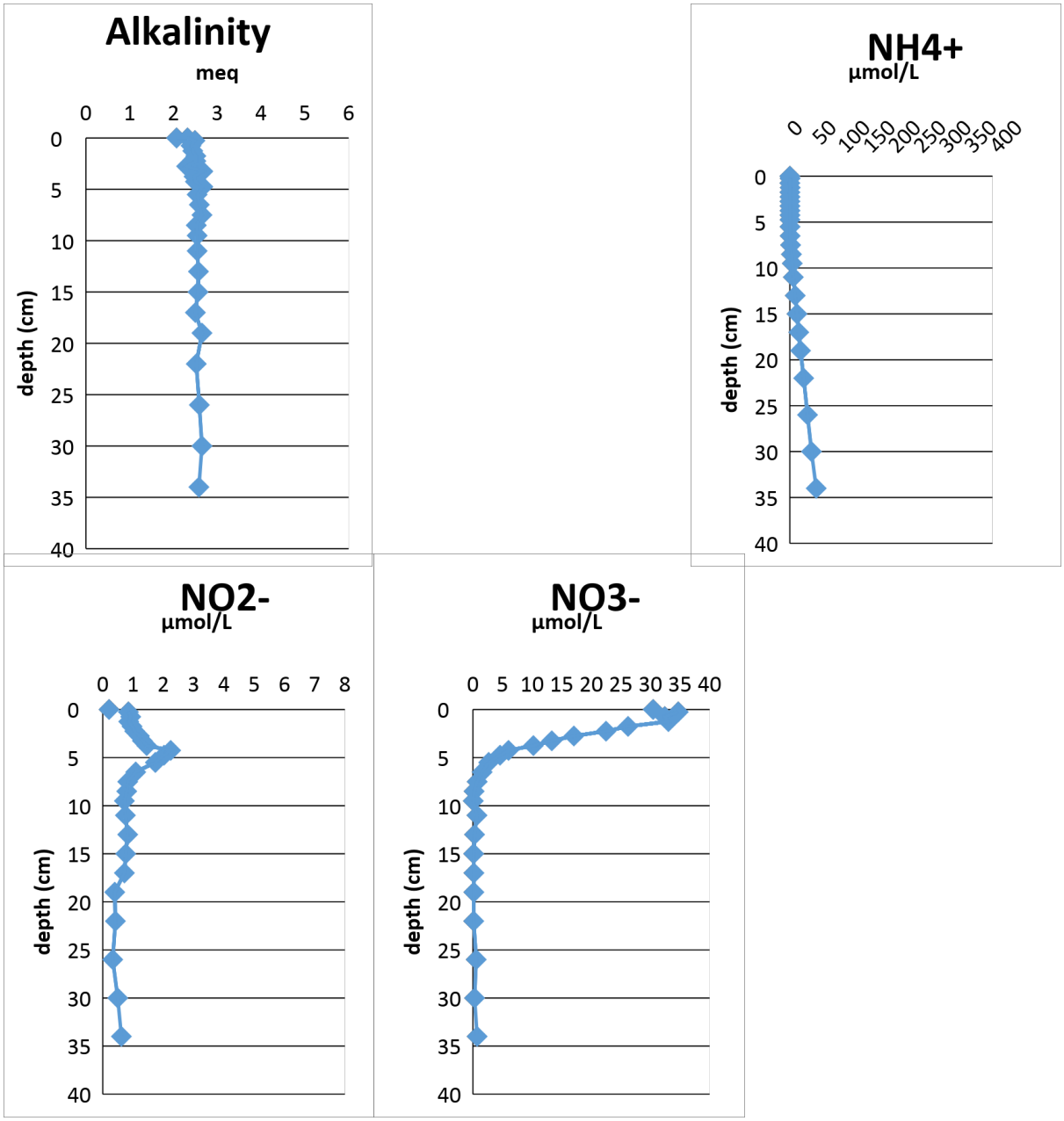

Figure 7.4. Pore water nutrients at Station 4

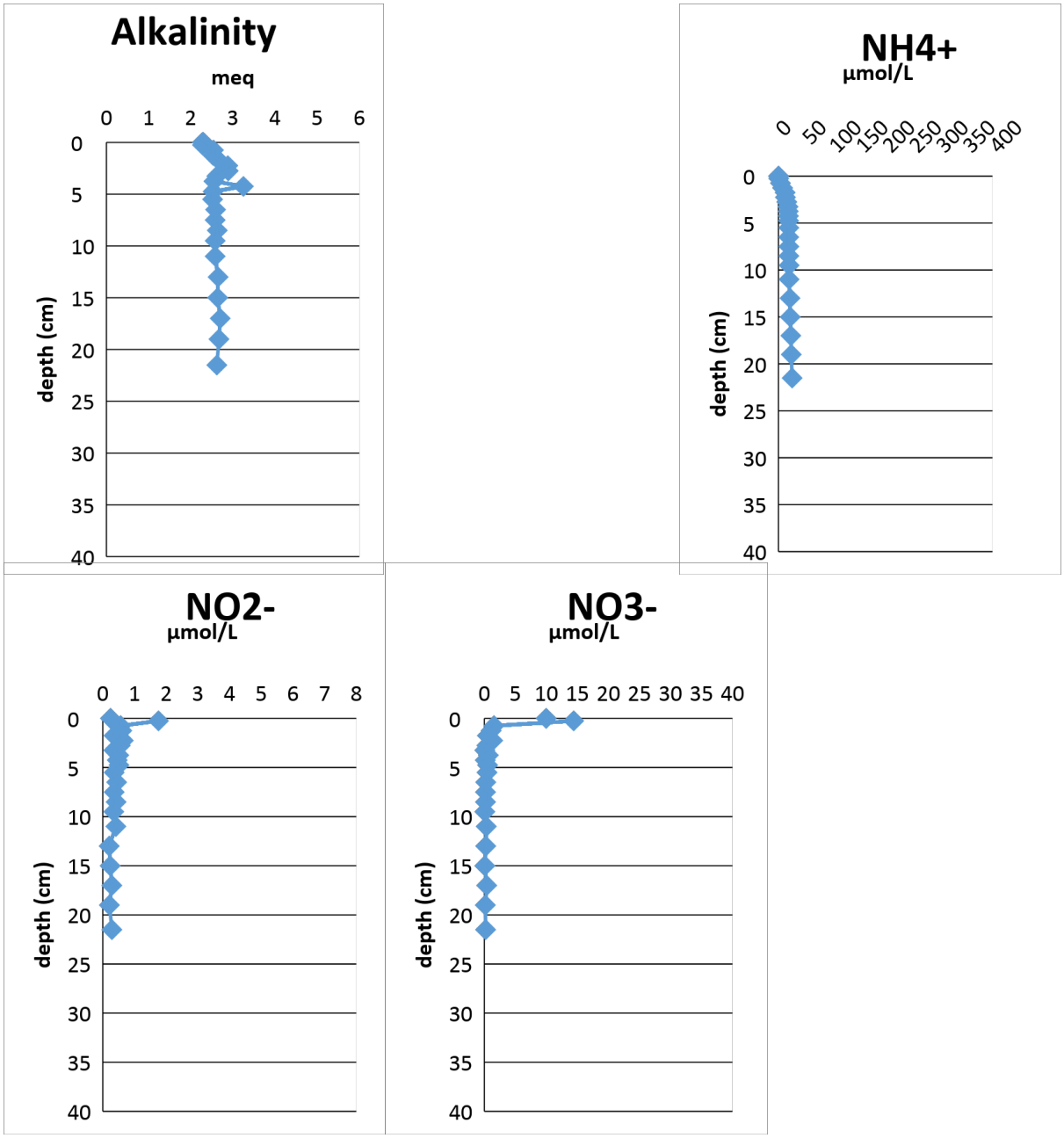

Figure 7.5. Pore water nutrients at Station 5

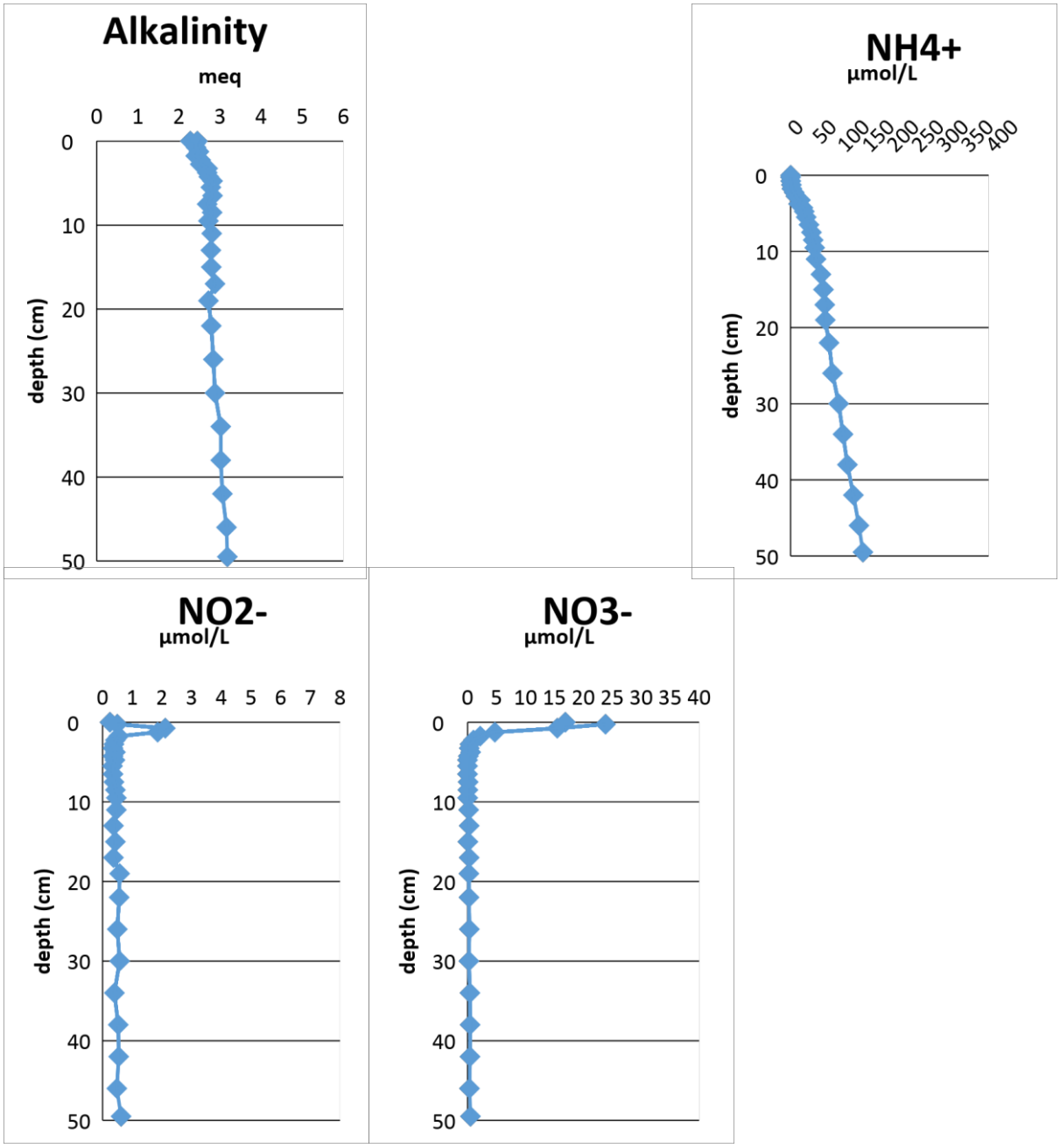

Figure 7.6. Pore water nutrients at Station 6

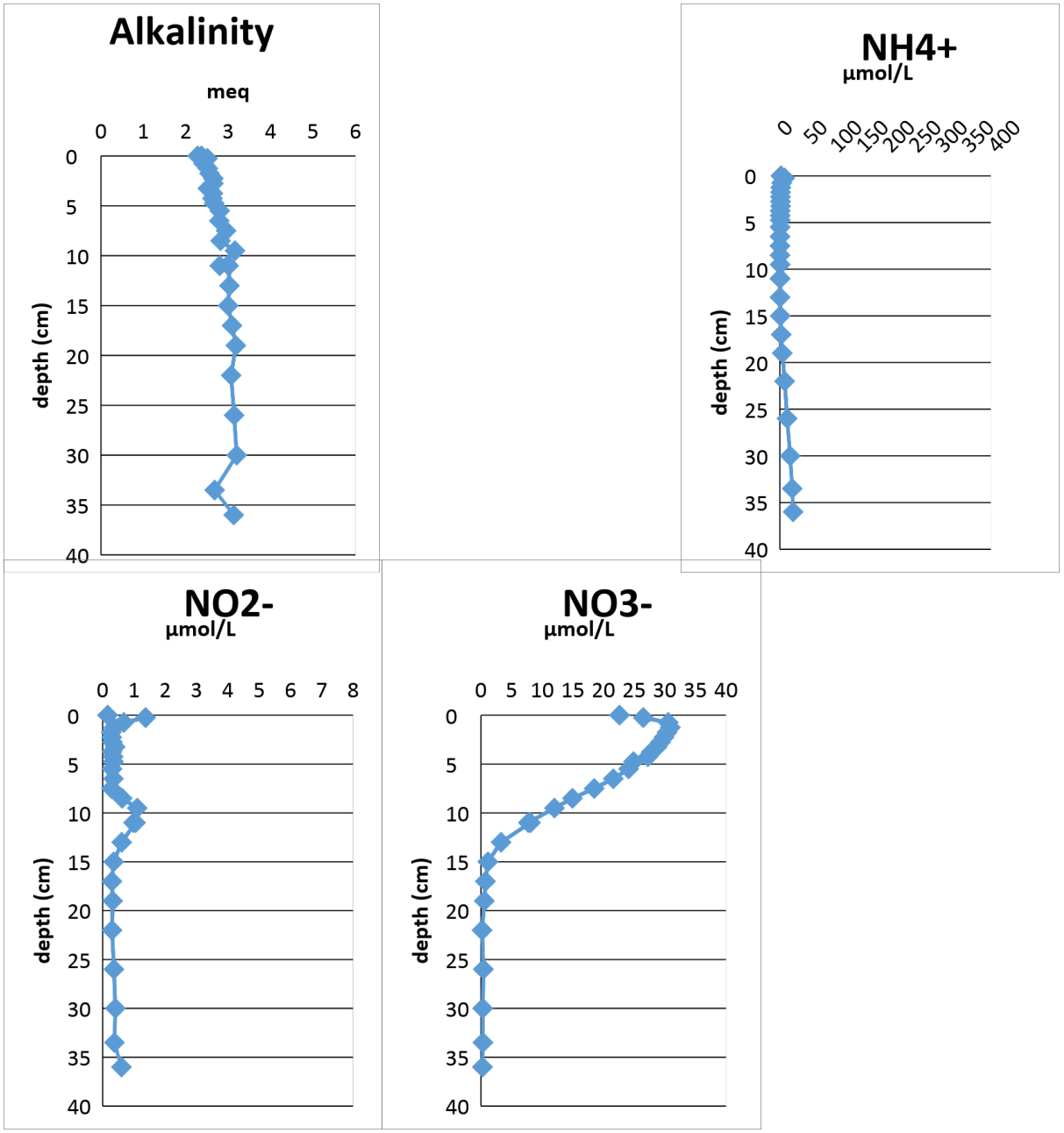

Figure 7.7. Pore water nutrients at Station 7

7.4 METHANE

Niels van Helmond, Wytze Lenstra

7.4.1 Goal

Collect sediment for pore water methane determination

7.4.2 Method

For sampling pore water methane in the multicores, one core pre-drilled core with 2 cm diameter holes (two rows of 10 cm resolution holes on opposing sides of the tube, offset by 5 cm). The holes are taped with electrical tape prior to coring. Upon recovery, the core is immediately stoppered and removed from the multicorer. On deck, the taped holes are cut open with a Stanley knife and a 10 mL cutoff syringe is inserted horizontally to extract precisely 10 mL sediment. This is transferred directly to a 65 mL glass bottle pre-filled with saturated NaCl solution. The solution is topped up after addition of the sample and a rubber stopper is inserted, ensuring that no air bubbles enter the bottle. A screw cap is then applied and the bottle is stored upside-down. The samples will be transported back to Utrecht, where 10 mL nitrogen headspace will be injected prior to analysis for methane (gas chromatography).

7.5 FROZEN CORES

Zeynep Erdem, Niels van Helmond, Wytze Lenstra, Roosmarijn van Zummeren, Joëlle van der Sprong

For every station one or two (Peter Kraal - core) MCs have to be sealed with rubber stoppers at the base and the top and placed vertically in a freezer for a minimum of 24 hours at -20°C. Make sure to take pictures of this core, including a label with the station name, date etc. and a scale bar, before putting it in the freezer. The next day the core is rinsed with hot water to let it thaw slightly, when the sediments starts to move the entire core can be removed from the liner after which it is quickly rinsed with some warm water and photographed. After photographing, the core is placed in a plastic bag, which is compressed to get rid of oxygen. Finally this plastic bag is placed in an aluminum bag flushed and filled with N2 gas, and stored again in a freezer at -20°C.

7.5.1 Core photos

Station 2 (15 m)

Station 3 (50 m)

Station 4 (600 m)

Station 5 (150 m)

Station 6 (300 m)

Station 7* (2100 m)

Figure 7.8. Photos of MCs of 64PE434

7.6 CORES FOR INCUBATIONS

7.6.1 Goal

Collect sediment material for analysis of microplastic and incubations

7.6.2 Method

At each station (if possible), collect sediment cores and take two sediment slices at 5 cm resolution (i.e. 0-5 cm and 5-10 cm depth). Each slice is directly transferred into a geochemical bag and sealed and stored at -20℃. The slicing was done under oxic conditions.

7.7 DIFFUSIVE GEL MEASUREMENTS OF FE2+ AND H2S

Wytze Lenstra

7.7.1 Goal

Diffusive gels were used to determine high resolution (1 mm) 2D pore water profiles of Fe2+ and H2S. Resin embedded subcores were taken for solid phase high resolution measurements with micro-XRF.

7.7.2 Method

Probes with two diffusive gels, 1 for Fe2+ and 1 for H2S, were used at 6 stations (Table x). Until a day before use, gels probes were stored wet and cold in a plastic bag at 4 degrees C. 4 hours before use the probes were soaked in deoxygenated 0.7M NaCl solution. Probes were used in the same core which was used for measurements with microelectrodes.

Probes were inserted in the sediment with ~ 1 cm of the sample window above the sediment-water interface. Probes were left 4 hours in the sediment before measurement. Gels used for Fe2+ measurements were placed on a transparent, a gel with color reagent was placed on top and another transparent was placed on top of that. Gels were left like this for 15 minutes before scanning, a second scan was made after 30 minutes.

Gels used for H2S measurements were soaked for 12 hours in a 0.01 M hydroxylammonium chloride to remove interference from oxidized Fe compounds color reagent before measuring.

7.8 RESIN EMBEDDING OF SUBCORES

Wytze Lenstra

Subcores for resin embedding were taken at 5 stations (Table x). Subcores were taken out of the same core which was used for micro electrode measurements and diffusive gels. Subcores were stored in 50 ml of acetone.

Table 7.5. Diffusive gel and resin samples

Station	Diffusive gel	Resin embedding
2 (15m)	X	X
3 (50 m)	X	X
4 (600 m)	X	X
5 (150 m)	X	
6 (300 m)	X	X
7* (2000 m)	X	X

7.9 MICROELECTRODE PROFILING

Roosmarijn van Zummeren, Joëlle van der Sprong

High resolution depth profiling was performed with microelectrodes for O2 (50-µm), H2S (50-µm), pH (100-µm) and electrical potential (EP, 500-µm) on multicores. Temperature of the porewater/core was continuously measured with a temperature electrode at 2-cm depth. These microelectrodes were connected to a four-channel Microsensor Multimeter (Unisense A/S). Calibrations for the O2 and pH sensors were performed daily, calibrations for the H2S sensor was performed every 2/3 days, prior to retrieving the multicores on deck.

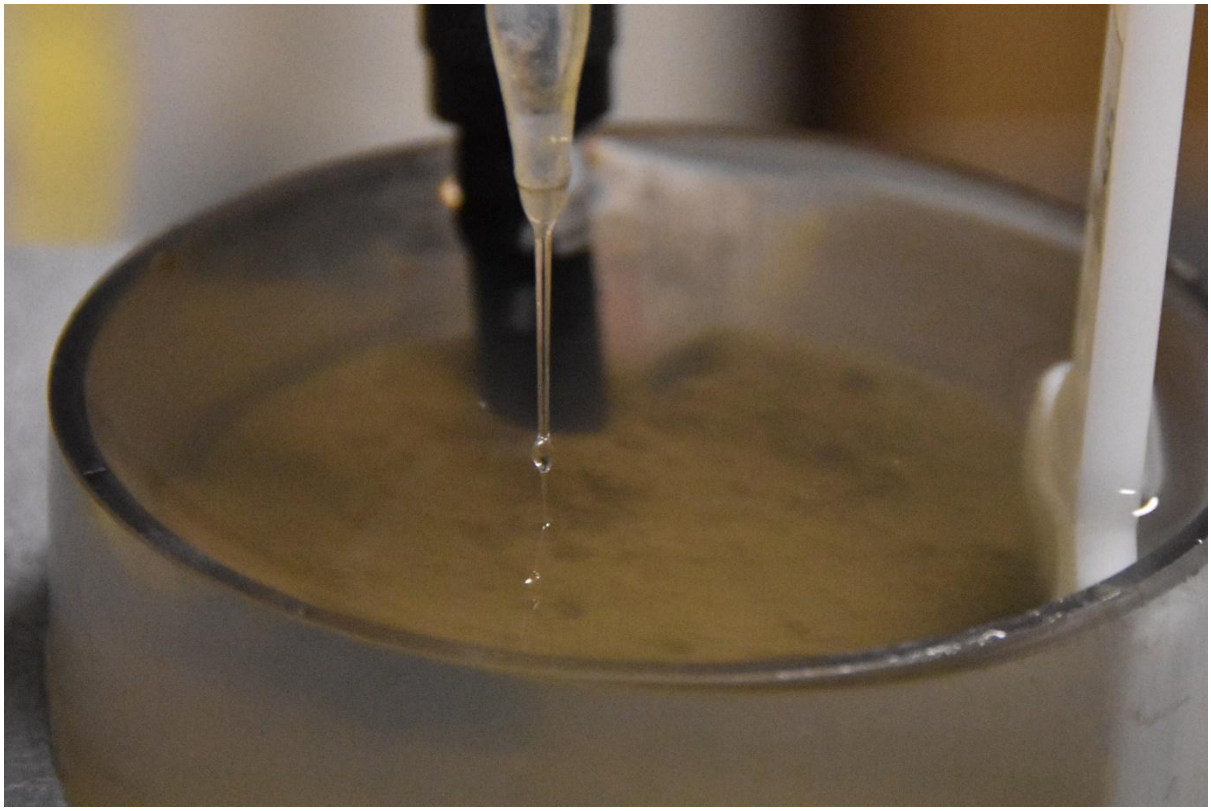

Figure 7.9. Microelectrode. Photo credit W. Hooijmans.

7.9.1 O_2 calibration

The O2 sensor was calibrated in artificial seawater with a similar salinity as the station that was measured that day by using the calibration chamber (Unisense A/S, Denmark). The first calibration point was made in air-saturated seawater (100% saturation) by vigorously pumping air in the calibration chamber with an aquarium pump. The second calibration point was made by flushing the calibration chamber with nitrogen for 10 minutes.

7.9.2 H_2S calibration

The H2S sensor is light sensitive, since the electrolyte in the sensor gets photo-degraded by high light intensities, resulting in a false high background signal compared to the signal in the dark. Therefore, all calibrations were done in a dark room. Na2S standards were used for a 5 point calibration (0, 0.59, 1.47, 2.94 and 5.88 µM). The Na2S stock solution (≈ 0,01M ΣH2S) was anoxic prepared by dissolving ~0,24 g Na2S x 9 H2O in 100mL of N2-flushed water and subsequent storage in a nitrogen purged glovebox. Since the H2S (50-µm) sensor detects the partial pressure of H2S gas, which is only a fraction of ΣH2S, the calibration was performed quickly in N2-flushed acidified seawater (pH ~3.5) to ensure there was no introduction of oxygen and that all ΣH2S was available as H2S.

7.9.3 pH calibration

Calibrations for pH were performed with three NIST (pH 4, 7 and 10) buffers (Hach) and a TRIS buffer to correct for salinity effects. The pH is reported on the total scale.

7.9.4 Measurements

After retrieval of the multicores on deck, one multicore was installed in the chemical lab within 15 minutes for high resolution depth profiling. Since the micro sensors have a limited length, the sediment in the multicore was pushed up with rubber stoppers. This ensured that the sediment almost reached the top of the multicore with 5 cm overlying water. Complete stagnation of overlying water was prevented by movements of the ship. The multicores were placed on an aluminium crate and attached to the laboratory table with a gas cylinder clamp. For stepwise movement the microsensors were installed in a 2D micromanipulator (Unisense A.S., Denmark). The micromanipulator was controlled by the SensorTrace Suite Profiling (v.2.2.100) software (Unisense A/S, Denmark). Stepwise movement was 50-µm for O2, 100-µm for H2S/pH and 500-µm for EP. Profiling went from 0.5-cm above the sediment-water interface, to a depth of 5-cm for O2 (if O2 was not depleted), H2S and pH, and to a depth of 3-cm for EP.

The table below gives an overview of the different sites that were selected for high resolution depth profiling. The core of station 4 (150m) was enriched with shell fragments. Profiling was therefore avoided to prevent the electrodes from breaking.

Table 7.6. Overview of sites selected for high resolution depth profiling of oxygen, sulphide, pH and EP in the sediment.

Station nr.	Water depth	Date
2	15m	25-03-2018
3	50m	25-03-2018
4	600m	26-03-2018
6	300m	27-03-2018
7*	2100m	29-03-2018

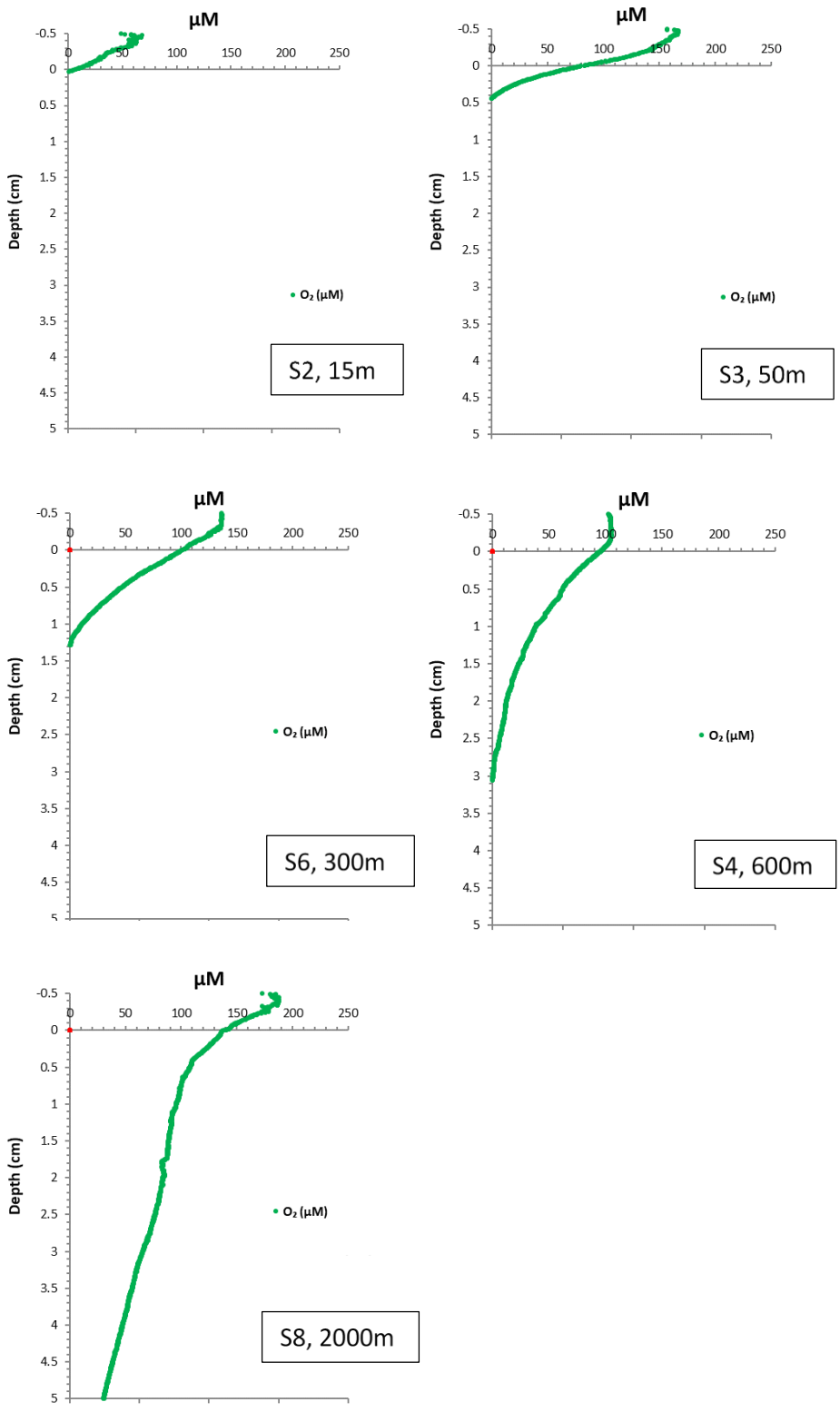

Figure 7.10. High resolution depth profiles of oxygen for all stations. Oxygen penetration depth increases with water column depth.

8 SEDIMENT – PISTON CORE (PC)

One piston core was recovered for the purpose of multiproxy applications and paleo-reconstructions. The core was recovered from station 3 – 600 m water depth. Because of the position of the Ultraclean CTD on the deck, the piston core length was limited to 9 m (max.). Total recovery was 5.84 m. The core later was split to 1 m sections and stored in 4°C storage together with the trip core. Further sampling will be organized within the cruse participants once the samples arrive to the NIOZ during a post cruise meeting.

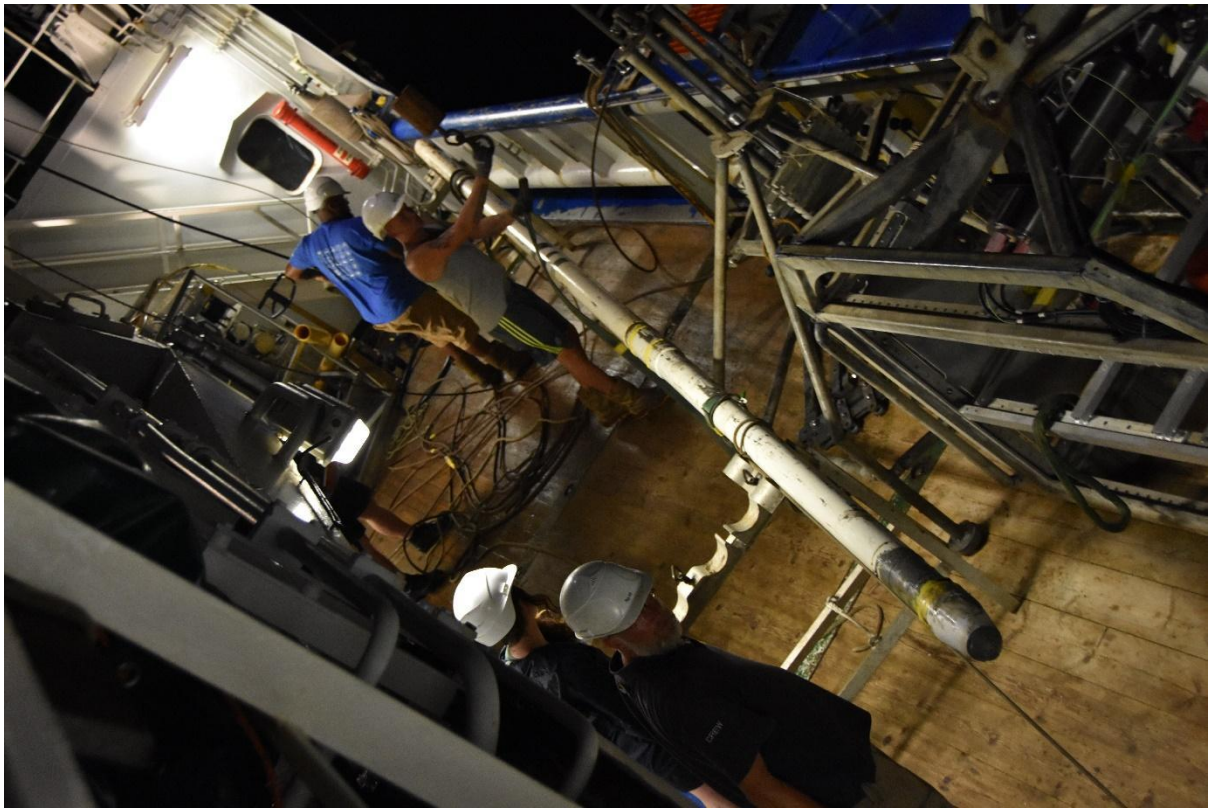

Figure 8.1. Piston core on board. Photo credit W. Hooijmans.

Top part of the core was foraminifera rich and core catcher material was grey black silty clay mud. According to the previous research from this region, the expected sedimentation rates for this water depth is around 30 cm/kyr (Bout-Roumazeilles and Trentesaux, 2007). Expected time interval recovery is around 18000 years.

References:

Bout-Roumazeilles and Trentesaux, 2007. Sedimentological Analysis of Cores Recovered from the RV Marion Dufresne Cruise in the Gulf of Mexico, Chapter 5 in (Winrers et al.) Initial Report of the IMAGES VIII/PAGE 127 Gas Hydrate and Paleoclimate Cruise on the RV Marion Dufresne in the Gulf of Mexico, 2–18 July 2002.

Winters et al., 2007. Initial Report of the IMAGES VIII/PAGE 127 Gas Hydrate and Paleoclimate Cruise on the RV Marion Dufresne in the Gulf of Mexico, 2–18 July 2002

9 SEDIMENT TRAPS

Figure 9.1. Loading the sediment traps on board in Sint Maarten. Photo credit W. Hooijmans.

Two sediment moorings were deployed on 28 March. The decision to remove the currentmeters from the mooring plans was made on the day so that these could be deployed despite the rough seas.

at 21:40:42 UTC sediment trap mooring 1, with one PPS-5 sediment trap (trap 3) and one acoustic release, was deployed at 26°56.3358N 91°20.45214 W. The traps in this carousel were poisoned using $ZnCl_2$ (0.018 M; 2.51 g/L) and buffered with borax (1.5 g/L). The beacon is this mooring is 37518 8220.

at 23:37:28 UTC sediment trap mooring 2, with two PPS-5 sediment traps (traps 1 and 2) and one acoustic release, was deployed at 26°56.4309 N 91°20.29596 W. The traps in this carousel were poisoned using $HgCl_2$ (0.0037 M; 1 g/L) and buffered with borax (1.5 g/L). The beacon of this mooring is 71710 4120.

These traps were programmed to begin collecting sinking particulates on 01-04-2018 at a frequency of 12.5 days per bottle. Traps will stop collecting on 29-08-2018.

10 RAFOS FLOATS

Four RAFOS floats were deployed for Heather Furey (WHOI) on 29-03-2018, This was done from the aft deck, while moving at a speed of ca. 5 knots.

RAFOS float Serial number 1539 was deployed at 26° 56.682 N 91°20.799 W at 20:44 28 March (ship time), or 1:43:55 29-03-2018 (UTC)

RAFOS float Serial number 1540 was deployed at 26° 56.596 N 91°20.705 W at 20:45 28 March (ship time), or 1:45:19 29-03-2018 (UTC)

We stayed in the vicinity for almost 24 hours and were able to delay the deployment of the final two floats.

RAFOS float Serial number 1537 was deployed at 26° 52.871 N 91°19.663 W at 17:17 29 March (ship time), 22:17:27 29-03-2018 (UTC)

RAFOS float Serial number 1532 was deployed at 26° 52.770 N 91°19.568 W at 17:18 29 March (ship time), or 22:18:54 29-03-2018 (UTC)

Figure 10.1. Deployment of RAFOS floats on aft deck. Photo credit L. Moerland.

11 PHOTOGRAPHY

On board activity, both scientific and recreational, was captured by professional photographer Wouter-Jan Hooijmans. The chief and co-chief scientists feel that closing the cruise report with his description of life and work on board best puts an end to this chapter of science in the Gulf of Mexico:

Wouter Hooijmans / 'Photographer of Landscapes' and Graphic Designer /
NICO.LEG No7 / St Maarten . Delta Mississippi River, Gulf of Mexico . Nassau / 04.04.2018.

The NIOZ Organisation was so generous to invite me as the Photographer of Landscapes to be on board during the cruise Nico-Leg No 7 - 10.03.2018 | 05.04.2018 - which initially seemed to be a long time.

Today, the day before leaving the research vessel Pelagia, now in Nassau's harbour, for the flight to The Netherlands, I realised that it was too short. As a Photographer of Landscapes with the 4x5 Linhof Large Format Camera, I am trained to look 'into' landscapes and found through more than 30 years of autonomous photography my way to translate the reality of the 'untouched' environment of nature. The place where mankind was born and grew up. Before us, it was the timeless world, the subject of my work until I traveled to St Maarten, Friday 9 March. This cruise changed my perspective from timeless to a timed world.

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To be on board, night and day, with the 360º circle of view, pure but not untouched, was for me in this way, unprecedented. Of course water was always an element in my work, but never so direct and important as I understand now, today. The confrontation with the everyday different appearance of the sea with the daily information from the scientists on the background, reset my view on the world into a total other direction. This, despite the story of the earth and our culture which were always my first interest since I was 7, 9 years old. So I am, or I was, not blanco. What this means for my autonomous work ? I do not know, yet. Landscapes were playing a role for a long time in my professional life. A 'seascape' is so different to understand because what happens in reality is not always visible. Water and waves, the sun and the wind are everywhere the same. The content and context creates the focus and the way to understand what the sea really is for us. Deep down in the knowledge, deep down in the sea. There are the secrets. Like in a landscape. You can, in my opinion, only understand and interpret the meaning of what you see when you know your personal position in life. A photograph is otherwise only, nice or interesting, an illustration and not an object what you can 'read'. Looking at landscapes is a process ; we can learn it. Observing a landscape large or very small - an after dinner table is also a landscape, or better a scape – is a creative process in itself, requesting knowledge and experience. You can start on your table in your kitchen, like the impressionists did. So when I embarked the Pelagia, I was prepared to accept the opposite of what I expected. I was wondering and looking forwards. I was open for new experiments in my eyes, and brains. Now, at the end of the cruise, I am able to see water as solid matter, like stone. For me the character of water has changed. It lost its innocence. Water became 'concrete' . . . . . .

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The research vessel Pelagia is a typical object. It is not a normal ship crossing the waters ; its design and construction is based to do research ; cruising from location to location in the open sea. Under all kinds of circumstances.

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On board there are many kinds of possibilities for the researchers to do their highly specialized work. Firstly, the crew is responsible for the ship itself, sailing the oceans ; very professional work too. Science and ship need to work together. Each of them from their own position and task.
People, working together on a ship with limited size and space inside and outside. Doing everyday work with different perspectives and goals. Working and helping each other every day again during the whole period. It gives another view on people. Their characters and the background of their professions and responsibilities showing me a world I never imagined.
Two lines come together. My slow work with the analogue camera on the tripod, heavy and very precise and the other ; my direct digital instrument working as 'a splitsecond viewmaster pressed to my left eye'. This 'direct image showing up instrument' deliver us the world in images, it makes a copy of everything. Today everyone is a photographer, which is a remarkable development in our culture !
So I started to make a documentary series of photographs with the Nikon camera / 18-200mm Nikkor, during the entire time of the cruise. Because all those other good photographers on board were at work.
Daily life and activities of both parties on board, in their working places in and outside but always on board with the 360º circle around for more than 24 days.

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Last but not least. The dialogue with scientists and crew were leading my work too. And changed my perspective on the 'reality' and my view on everything around. Slowly I understood the deeper meaning of the research deep down the oceans and in this case the Gulf of Mexico near the delta of the Mississippi River.
The sea is the world for documentaries on TV or internet. It is the world of the largest and complex transport we have. The sea is pleasure and industry of all kinds. And the dump of wasted materials. That is what we think and know. But unseen for almost everyone are the treasures in the water on all levels in the water column or deep into the bottom. Information about the last decades and all those millions of years before. Finally for me this dialogue with the scientists was maybe the most important for the long term. It changed my imagination.
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The sea, always there, is finally the 'natural' décor of all my images and thoughts. I have made a lot of pictures. At the end of our trip there was a slide show in the mess for everyone. I was one with the audience and forgot my role as the 'home photographer'.
With thanks to all the members on board and with specials thanks to the board of NIOZ.