

RV Pelagia Cruise Report:

Cruise 64PE304

INATEX-GEO SE African margin, 10 March – 2 April 2009

Geert-Jan A. Brummer, Simon Jung and shipboard party

NIOZ, Royal Netherlands Institute for Sea Research
Texel, 2009

The research reported here was funded by the
Netherlands Organisation for Scientific Research
(NWO) within the ZKO-Oceans Programme INATEX



Introduction

For nearly a decade, geoscientists, physical oceanographers and ocean-climate modellers from oyal NIOZ, Utrecht University, VUA and KNMI have joined forces to unravel modern and past inter-ocean exchange around southern Africa, as part of the international WCRP-CLIVAR programme. Recently we successfully submitted a joint research proposal to the Dutch ZKO-Oceans programme to consolidate and intensify collaboration in order to further our understanding of ocean-atmosphere climate dynamics. This envisaged research addresses the exchange between the Indian Ocean and the Atlantic through time (“INATEX”) and focuses on:

- In-situ instrumental observation of Agulhas Current transports and sedimentation
- Paleo-records of climate change in the greater Agulhas Current system, from coastal to deep ocean sediments
- Model synthesis of both regional and global scale ocean-atmosphere teleconnections in the climate system

Cruise 64PE304 is the first of several cruises carried out within INATEX, and focuses on modern to past sedimentation in response to ocean-climate change off SE Africa. It was carried out from Dar es Salaam, Tanzania, starting on March 10 to Durban, Republic of South Africa, ending on April 2, 2009 (figure 1).

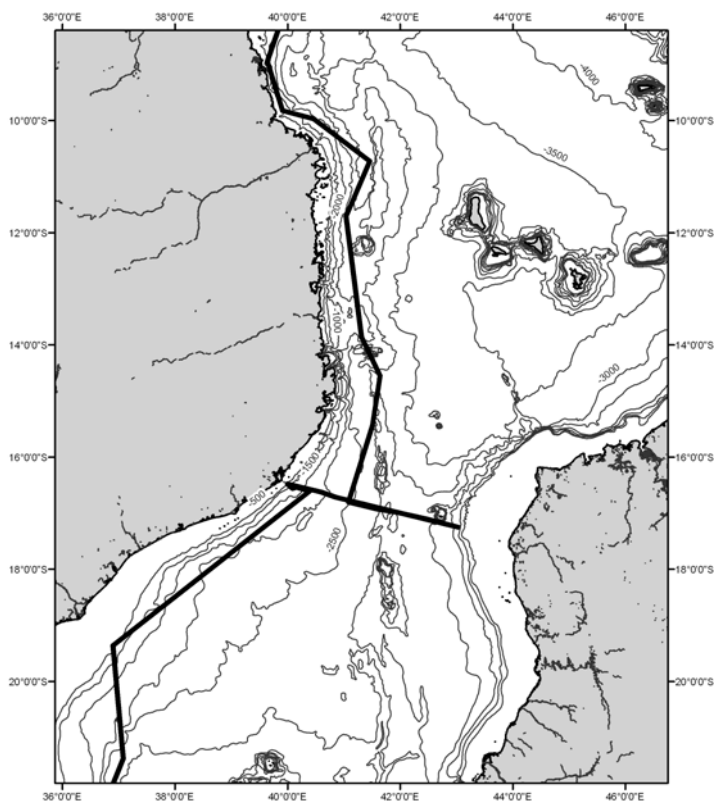


Figure 1. Cruise track of RV Pelagia cruise 64PE304

1.1 Cruise information

a: Expedition Designation (EXPOCODE): 64PE304

b: Chief Scientist: Dr. G.-J.A. Brummer
Royal Netherlands Institute for Sea Research (NIOZ)
P.O.Box 59 1790AB Den Burg/Texel The Netherlands
Telephone: 31(0)222-369442
Telefax: 31(0)222-319674
e-mail: brummer@nioz.nl

c: Ship: RV Pelagia, Call Sign: PGRQ
Captain: Mr. Kees de Graaff
Length: 66 m.
Beam: 12.8 m
Draft: 4 m
maximum speed: 11 knots

d: Cruise dates and ports of call:
March 10, 2009, Dar es Salaam (Tanzania)
April 2, 2009, Durban (Republic of South Africa)

1.2 Shipboard party

Name	Institute	Nationality	Function/specialty
Geert-Jan Brummer	Royal NIOZ	NL	Chief scientist
Simon Jung	University Edinburgh	German	Co-chief scientist Paleoceanography
Jenny Ullgren	Royal NIOZ	Swedish	Physical Oceanography
Rik Tjallingii	Royal NIOZ	NL	Marine Geology
Isla Castaneda	Royal NIOZ	USA	Organic Biogeochemistry
Roel Nagtegaal	Royal NIOZ	NL	Marine Geology
Jeroen van der Lubbe	Vrije Universiteit Amsterdam	NL	Marine Geology
Kate Darling	University Edinburgh	British	Genetics
Willeminj Quaijtaal	Universiteit Utrecht	NL	Biogeology
Sven Ober	Royal NIOZ	NL	LADCP, CTD
Jack Schilling	Royal NIOZ	NL	Moorings, coring
Lorendz Boom	Royal NIOZ	NL	Moorings, coring
Santiago Gonzalez	Royal NIOZ	NL	Traps, Multibeam

2. Scientific Programme and Methods

The aims of the INATEX-GEO cruise 64PE304 were to:

1. determine the impact of modern eddy-induced, seasonal and IOD/ENSO-scale variability in thermocline temperature/salinity, together with the response in time-series sediment fluxes, using in-situ instrumental observation across the main path of Indo-Atlantic exchange,
2. identify and calibrate sedimentary proxies of thermocline and bottom water conditions, and assess terrestrial advection, transport and burial dynamics of climate tracers in the upstream Agulhas Current and in the returnflow of intermediate Antarctic and North Atlantic Deep Water in the Agulhas Undercurrent,
3. resolve seasonal to millennial-scale variability in paleorecords of climate change in the source area of the greater Agulhas Current, and assess the propagation of human and natural impacts in sub-Saharan Africa through time,
4. contrast, assimilate and integrate paleorecords with modelling results and determine interhemispheric teleconnections during present and past climatic modes.

2.1 Hydrographic Stations and Sampling

A total of 20 CTD casts were carried out. A lowered Acoustic Doppler Current Profiler (LADCP) was attached to the CTD frame to measure vertical profiles of the current speed and direction. In addition the CTD frame was equipped with sensors measuring dissolved oxygen concentration, optical backscattering for turbidity as well as a fluorometer for chlorophyll concentration. With few exceptions water samples were drawn from all of these casts for later analysis of their oxygen isotope composition. A mono-corer that was attached to a 12 m long rope on the CTD frame took samples from the seafloor. At the hydrographic stations the SBE9/11+ CTD was lowered with a speed of about 1 m/s. The positions of the hydrographic stations along the mooring sections are indicated in figure 2.

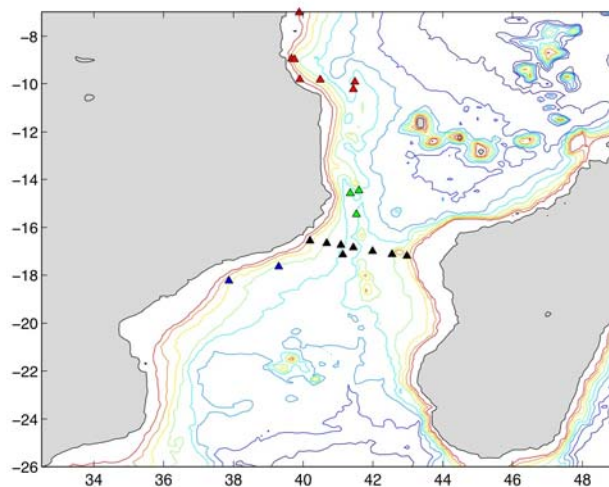


Figure 2. Distribution of hydrographic stations.

During the up-cast of the CTD/rosette station up to 22 water samples were taken at regular depth intervals for shore-based analysis of the oxygen isotope composition. From all casts surface and bottom water samples were taken . Also the CTD was equipped with a small corer for bottom sediment sampling.

2.2 Moorings

A major goal of this cruise was the recovery, servicing and (re)deployment of 4 long-term sediment trap moorings, including 2 as part of a much larger array of 7 moorings in the narrowest part of the Mozambique Channel equipped with ADCPs, current meters and T-S sensors (fig. 3). One of these moorings has been deployed for the first time in November 2003 and was serviced in March 2005, March 2006 and January 2008. In addition, one mooring

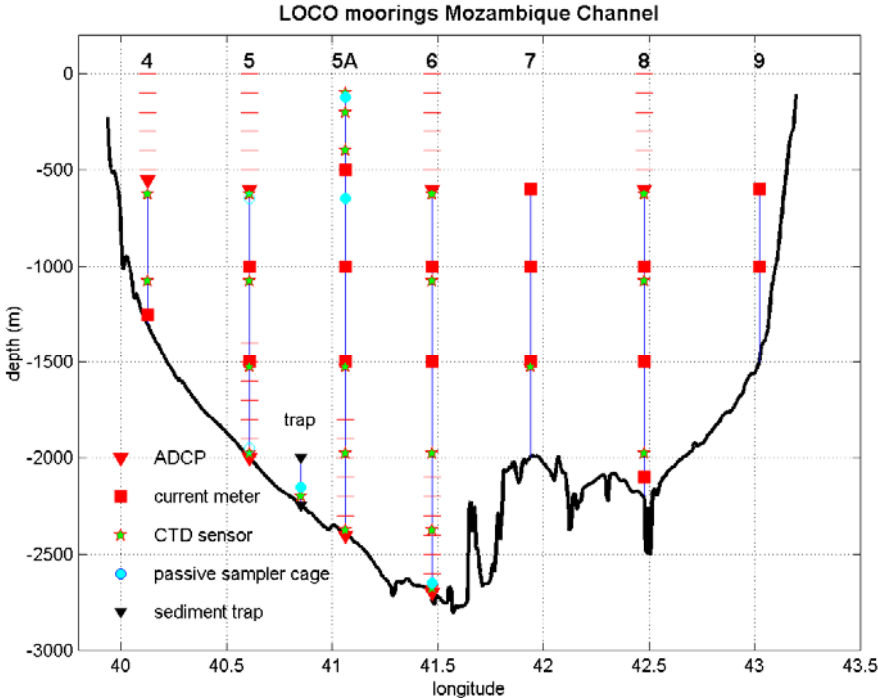


Fig. 3. Moorings in the Mozambique Channel (2003-2009).

with 2 sediment traps, current meters and T-S sensors was deployed. The position of the moorings and the location and type of instruments in the cross-section is shown in figure 5. The measuring interval of the physical instruments ranges from 5 minutes (T-S sensors), 15 minutes (current meters) to 30 minutes (ADCP's). The cups in the sediment traps collect discrete samples over intervals of 17 days. Detailed information on the new moorings is given in appendix B.

2.3 Sediment sampling: Mono-, Multi- and piston-coring

A primary goal was to disclose the evolution of ocean currents and hydrographic properties on geological time scales, given the surprisingly high quality of bottom sediment recovered on the Mozambique side of the channel during previous cruises. For that purpose, a total of 23 pistoncore stations were carried out, each associated with a Multicore station, including several associated with the long-term moorings stations. In addition, the CTD was provided with a small Monocorer for bottom sediment sampling. All pistoncores were analysed shipboard for magnetic susceptibility and shore-based for element composition using the XRF-corescanner. For further details, see below and the appendices.

2.4 Plankton sampling

In addition to the water column profiling, also a number of plankton samples was taken, primarily for the distribution of planktonic foraminifera and dinoflagellates.

Scientific Programme and Methods

3 Underway Measurements

3.1 Continuous underway measurements

Continuous underway measurements regard navigation (latitude, longitude, speed over ground, course over ground and heading), water depth (uncorrected echo sounder depth), Sea surface properties (temperature, salinity, fluorescence and optical transmission), and meteorology (surface air temperature and humidity, relative wind speed and direction, and global radiation). Sea surface properties were measured continuously using the AQUAFLOW system with the water intake at a depth of about 2 m. All data were recorded every minute in the underway data logging system.

The navigational data were collected from the ship's navigation system (differential GPS). The depth was determined with a 3.5 kHz echosounder. For the calibration of the sea surface temperature and salinity the 3 m CTD temperature and salinity from the downcast was used. The meteorological instruments were calibrated by the Royal Netherlands Meteorological Institute (KNMI) in De Bilt. At NIOZ the data will be processed further to produce a well calibrated data set of underway measurements.

3.2 Current velocity measurements

A 75 kHz (RDI) vessel mounted ADCP (VM-ADCP) recorded the current field continuously. Data were collected with a dedicated service computer and, together with the navigational data regularly transferred to the appropriate directory of the ship's computer network. Final data

processing will take place at NIOZ after the cruise, including post-processing calibration with data from the lowered ADCP.

3.3 Sea floor imaging

The Multibeam EM 120 was used to obtain a detailed three-dimensional bathymetric image of the seafloor to guide the sediment coring at swath widths ranging between 0.25 and 7 kilometers. Tracks were continuously recorded at and between stations on the cruise track off southern Tanzania, along and across the Mozambique Channel, off the Zambezi, as well as in transit to Durban. The width of a Multibeam track depends on the water depth and if possible we sailed partially overlapping tracks to improve and extend our data because also the resolution of the Multibeam data decreased when ship speeds were high (7-10 kn). For similar reasons we took into account the tracks recorded during the preceding GLOW-cruise (64PE303) off southern Tanzania and the tracks in the Mozambique Channel recorded during last year's cruise M75/1 and M75/2 with the FS Meteor.

3.4 Underway plankton sampling

Six surface plankton samples for genetic profiling of planktonic foraminifers were collected by pumping sea water from 2m depth through the ship's non-toxic sea water supply using a small 50µm mesh net attached to the hose (Appendix XXX). The plankton net samples were retained in the -80°C freezer after removal of the planktonic foraminifers required for genotyping. Furthermore two additional plankton samples have been taken for dinoflagellates and fixed in 5% formalin to assess their similarities and differences (for sample list, see table X).

4 Hydrographic measurements

4.1 CTD measurements and rosette sampling

A Seabird Electronics (SBE) 9/11+ CTD (SN 0790) was used to measure hydrographic profiles. The CTD was mounted in the centre of a rack, fitted with a 24 position rosette sampler and 22 Niskin sampler bottles. The remaining 2 positions on the rack were used to mount the LADCP (type, etc.).

For the data collection the Seasave software for Windows (V 5.28c), produced by SBE, was used. The CTD data were recorded with a frequency of 24 data cycles per second. After each CTD cast the data were copied to a hard disk of the ship's computer network, and a daily back-up copy was made.

On board the up-cast data files were sub-sampled to produce files with CTD data corresponding to each water sample, taken with the rosette sampler. The CTD data were processed with the preliminary calibration data, and reduced to 1 dbar average ASCII files. These were used for the

preliminary analysis of the data. Full data processing with the final calibration values will be completed at NIOZ, Texel.

Mounted on the CTD-rack was a high precision SBE35 reference temperature sensor, SN 0019, which recorded the temperature every time a sampler was closed. These data will be used for the control and/or the calibration of the CTD temperature sensor, SN 4778.

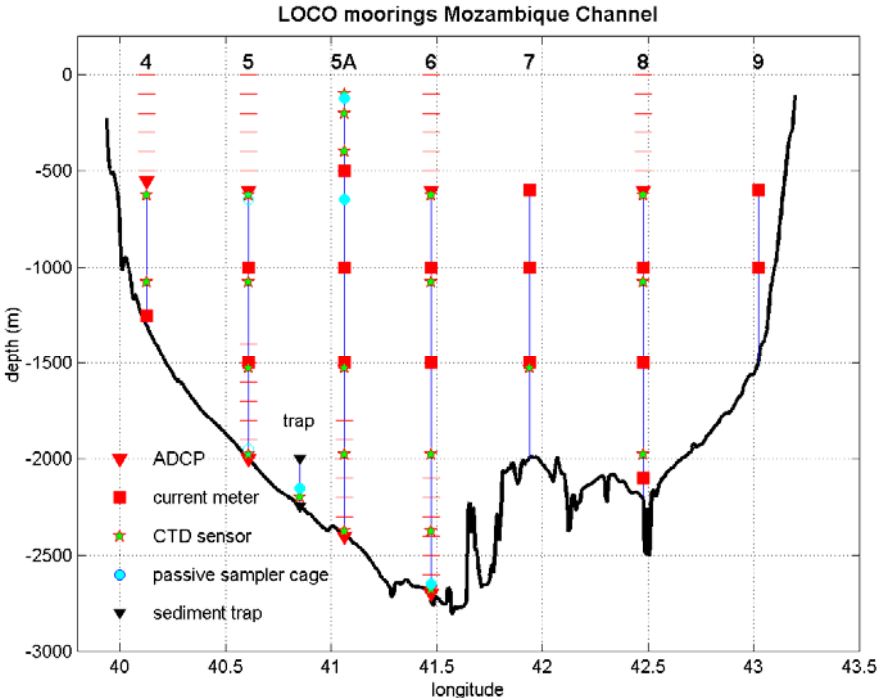
Additional to the CTD sensors, sensors for the determination of optical backscatter (Seapoint, SN 1728), fluorescence (Chelsea, SN 88026) and oxygen (SBE, SN 0431141) were mounted in the CTD rack. The data of these sensors were relayed, via the CTD cable to the CTD computer, and were stored synchronously with the CTD data.

Back on Texel all data will be downloaded into the NIOZ computer network. Separate copies of the back up were taken directly from Durban to Texel.

4.2 Lowered Acoustic Doppler Current Profiling

A downward looking Acoustic Doppler Current profiler (L-ADCP) was attached to the CTD frame, measuring vertical profiles of current velocity. The vessel mounted ADCP (75 kHz) was switched shortly before and recording throughout each CTD/L-ADCP cast, to provide an added reference for the future post-processing of the L-ADCP data. The vessel-mounted ADCP was also recording the current field for a longer continuous time while on the border of, and entering an anticyclonic ring (“Cynthia”) on March 26.

5 Moored instrumentation



5.1 Deploying mooring GLOW-1

On March 17, 2009, at 16:09 hours GMT, sediment trap mooring GLOW-1 was deployed at a depth of 1466 m at 09°47.02'S, 40°13'E on the continental margin off SE Tanzania. It was equipped with a single Salzgitter S/MT-230 sediment trap (baffled collecting area of 0.5 m²) at 238 m above the seafloor. The sediment trap was pre-programmed for sampling intervals of 18 days for each of the 20 collecting cups, starting on April 18, 2009 at 00:05 UTC, thus programmed to end sampling on April 13, 2010 (see appendix). Sample bottles were filled with seawater collected at the deployment site and depth of the trap, in which a biocide (16 g of HgCl₂; end-concentration 1.9 g l⁻¹) and a pH-buffer (16 g of Na₂B₄O₇•10H₂O; end concentration 1.9 g l⁻¹) were dissolved. A sample from the solution was kept for subsequent analysis of dissolved compounds to act as a blank. The trap was also equipped with a sensor package to record optical backscatter (OBS), mooring line motion (tilt in 2 directions), temperature and pressure every 12 minutes. The mooring also contained a current meter (RCM 011) at 20 m below the trap.

5.2 Recovering mooring MOZ-4

On March 22, 2009, at 6.41 hours GMT, sediment trap mooring MOZ-4 was released from a depth of 2239 m, at 16° 42.66'S, 40° 51.06'E directly underneath the path of the Mozambique eddies. It was originally deployed on January 26, 2008 at 10:03 hours GMT and equipped with two Technicap PS 5/2 sediment traps, one in a newly designed NASF-bottom frame, the other 238 m above, each with a collecting area of 1.0 m² and a 1.5 cm honeycomb baffle. Both sediment traps had pre-programmed sampling intervals of 17 days for each of the 24 collecting cups on both traps, starting on February 1, 2008 at 01:00 UTC, thus programmed to end sampling on March 15, 2009. Both traps were also equipped with a sensor package to record optical backscatter (OBS), mooring line motion (tilt in 2 directions), temperature and pressure every 12 minutes from March 3, 2006, 08:00 through to November 20, 2007, 08:00. The mooring also incorporated two current meters (RCM 011) at 15 m and 100 m above the top- and bottom traps, respectively, and a CTD (SBE) just below the lowest current meter, recording every 30 and 6 minutes, respectively.

Immediately after arrival on deck, the entire carousel with sample bottles was dismantled from each trap. Prior to deployment the sample cups had been filled with seawater collected at the deployment depth of each trap and from the actual deployment site, to which a biocide (HgCl₂; end-concentration 1.8 g l⁻¹) and a pH-buffer (Na₂B₄O₇•10H₂O; end concentration 1.8 g l⁻¹) had been added, supplemented by 600 ml of milliQ-water to a density slightly in excess of the ambient seawater. In order to prevent leakage of the biocide solution prior to mooring given the poor closure of the sample bottles against their connecting neck, the latter were not filled originally (30 ml). A blank sample had been taken for later comparison with the actual collecting cups to determine chemical dissolution fluxes.

Samples were processed as rapidly as possible in order to draw a time-series of subsamples from the supernate solution of each trap bottle for analysis of dissolved compounds released from the particulate matter. Within 3 hours after release (establishing t_0 subsampling at 13:40 shiptime), the sample carousel of the topmost trap (MOZ-4A) was manually rotated to the first sample position to remove the top 30 ml of supernate solution from the connecting neck using an acid-cleaned all-PP syringe and transferred to 50 ml acid-cleaned centrifuge vials. This procedure was repeated consecutively for each sample bottle, so that all bottles could then safely be removed from the carousel, capped, and stored at 4°C. The entire procedure was repeated for the bottom-most trap (MOZ-4B). For shore based analysis of silica, phosphate and ammonia 5 ml was pipetted off, after which the remainder was used to measure pH.

For a first order estimate of the mass flux, the height of the residue in the collecting bottles was measured to the nearest millimetre (H_{res} in mm) and converted into residue volumes (V_{res} in ml) using the bottle-specific equation ($V_{res} = 7.477 + 1.8773 * H_{res}$). Analysis at NIOZ and elsewhere will include the determination of salt-free dry weight to obtain the actual total mass flux and that of the major bulk compounds (organic carbon and nitrogen for organic matter, carbonate carbon for $CaCO_3$, opaline silica and the residual “lithogenic matter”). Follow-up analyses at NIOZ and elsewhere will include minor and trace elements (Fe, Mn, Mg, Sr, Ba, Al, Ti, K, Th, etc.), bulk organic matter isotopes ($\delta^{15}N$, $\delta^{13}C_{org}$) as well as the particle specific composition (e.g. foraminifera, dinoflagellates, coccolithophorids) and compound specific analysis (biomarkers, $\delta^{15}N$, $\delta^{13}C_{org}$, etc.).

5.3 Deploying mooring MUS-1

On March 25, 2009, at 07:42 hours UTC, sediment trap mooring MUS-1 was deployed at a depth of 1371 m, at 16°30.11'S, 40° 11.79'E on the Mozambique upper slope about 3 nm north of LCM4 on the Mozambique Channel continental margin. It was equipped with the newly acquired KUM4I sediment trap at 238 m above the bottom with a collecting area of 0.5 m² and a 1.5 cm honeycomb baffle, as well as a Technicap PPS-5/2 sediment trap (collecting area of 1.0 m and a 1.5 cm honeycomb baffle in a NASF bottom frame. The sediment traps were pre programmed for synchronised sampling intervals of 9 and 18 days for each of the 40 and 24 collecting cups, respectively, starting on March 27 and April 5, 2009 at 00:05 UTC, and thus programmed to end sampling on March 22 and June 11, 2010 (see appendix). Sample bottles were filled with seawater collected near the deployment site and depth of the trap, in which a biocide (16 g of $HgCl_2$; end-concentration 1.9 g l⁻¹) and a pH-buffer (16 g of $Na_2B_4O_7 \cdot 10H_2O$; end concentration 1.9 g l⁻¹) were dissolved. Two blank samples were taken from each trap solution (see above). The topmost trap was also equipped with a sensor package to record optical backscatter (OBS), mooring line motion (tilt in 2 directions), temperature and pressure every 12 minutes. The mooring also contained a current meter (RCM 011) at 20 m below the trap.

5.4 Redeploying mooring MOZ-5

On March 26, 2009, at 07:21 hours GMT, sediment trap mooring MOZ-5 was redeployed at a depth of 2231 m, at 16°42.69'S, 40° 51.32'E, almost exactly the position and water depth of the previous MOZ-4 mooring site, in order to continue sampling the particle flux for a subsequent time series of just over 1 year and extend the record to a total of 7 years. The mooring design was identical to that of MUS-1, except that only conventional floatation spheres were used. Also the Benthos releases were replaced, as well as both the motors and sensor packages, including new OBS sensors. Also both current meters and the CTD were exchanged in a configuration similar to the recovered mooring.

5.5 Deploying mooring ZAM-1

On March 28, 2009, at 09:12 hours GMT, sediment trap mooring ZAM-1 was deployed at a depth of 1329 m, at 18°14.44'S, 37° 52.21'E on the continental margin NE off the Zambezi River. It was equipped with a single Technicap PPS-5/2 sediment trap with a collecting area of 1.0 m² and a 1.5 cm honeycomb baffle, 238 m above the seafloor. The mooring design was identical to that of MUS-1, except that only conventional floatation spheres were used. Also the Benthos releases were replaced, as well as both the motors and sensor packages, including new OBS sensors. Also both current meters and the CTD were exchanged in a configuration similar to the recovered mooring.

6 Sediment coring

6.1 Monocoring

A novel coring device used during the cruise was the Monocorer, designed and constructed recently at NIOZ to take small 5.4 cm diameter cores of up to 30 cm in length from muddy sediments. It weighs about 15 kg and replaces the bottom switch weight on the CTD on an extended 12 m rope, penetrating the sediment as a gravity corer enhanced by the about 30 m/min lowering speed of the CTD as it approaches the ocean floor. It was derived from the Multicorer, in that two lids are closed upon tripping, one at the bottom to keep the core inside the liner, the other at the top to seal off the bottom water and thus to prevent flushing of the core during the upcast of the CTD and preserve the sediment-water interface. After its first successful test of the Monocorer at ocean depths in the North Atlantic, it was standardly fitted to the CTD to assess the variability in sediment accumulation and composition along the cruise trajectory.

Upon recovery, the topmost 1.0 cm of each core was sampled and transferred to plastic bags. All core tops were washed over a 63 µm sieve to recover the foraminiferal fraction, ultrasonified 3 times for 5 seconds to remove the internal fine material and exposed to an alkaline H₂O₂ solution (pH=8) to remove the organic matter. Finally samples were washed with milliQ and dried at 60°C and dry sieved and dry-split in

an archive and a work split. The latter was sieved over a 63-250-315 μm stack to isolate foraminifera in the 250-315 μm fraction for census counting as well as picking for stable isotope and size-normalised weight analysis at NIOZ.

6.2 Multicoring

At all coring stations, samples were taken with a Royal NIOZ multicorer, equipped with 8 6cm-id cores and 4 10cm-id cores. Upon arrival on deck, the cores were transferred entirely to new liners or sliced using a high-precision hydraulic slicer that positions up to four cores simultaneously.

6.3 Pistoncoring

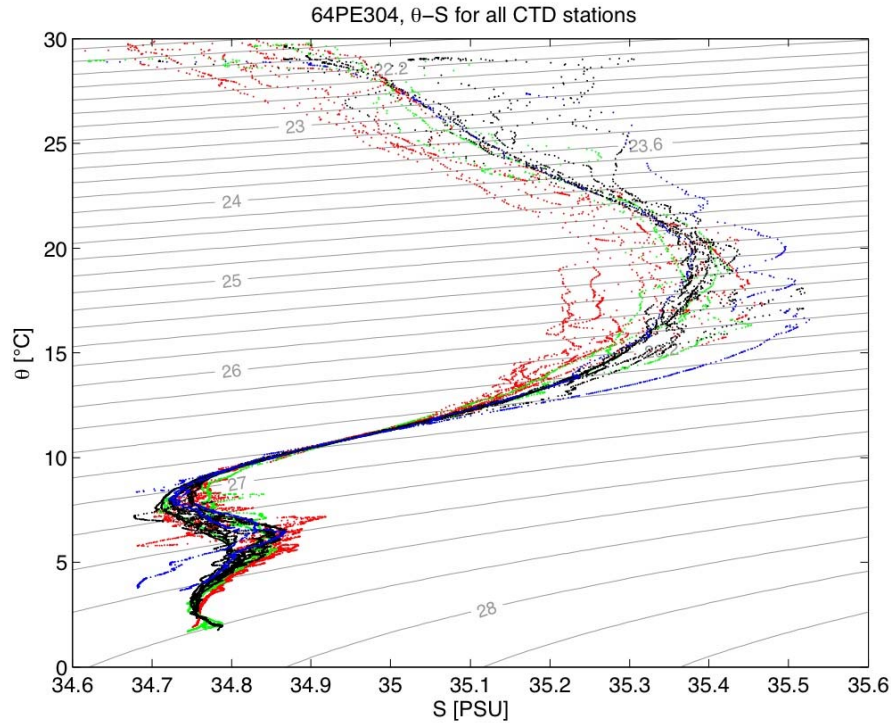
During the cruise 23 pistoncores were taken, generally using a 12 m, occasionally an 18 m core barrel, all with liners of 11 cm in diameter, using a NIOZ designed pistoncore system.

Magnetic susceptibility was measured shipboard on all pistoncores using a Bartington MS2C sensor. Cores were moved through the sensor and measured in steps of two centimeters, making a blank measurement every meter, i.e. compatible with the section length. Drift corrections and core diameter corrections have been applied automatically within in the Multisus program, and all data were stored digitally.

7 Preliminary Results

7.1 Hydrography

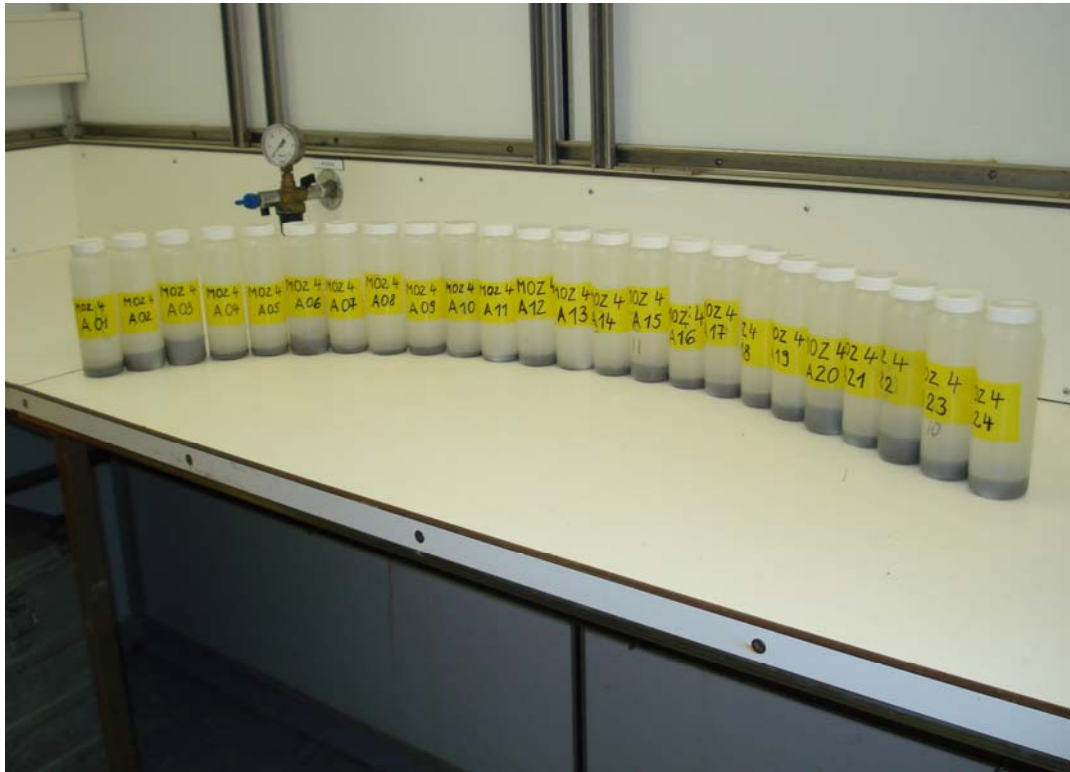
Figure 11 shows a T-S plot of all observations as obtained along the mooring section in the Mozambique Channel and Figure 8 shows oxygen concentrations as a function of depth. Salty and warm tropical surface water (Indian Central Water) is found in the upper few hundred meters. At intermediate levels relatively salt, low oxygen water of Red Sea origin is found. Below 2000 m, relatively high salinity and oxygen values are found which point to the presence of North Atlantic Deep Water. This is confirmed by high silica values (not shown) The density distribution along the slope at the western side of the channel suggests that two distinct cores of equatorward undercurrents are present, one centred around 1400 m depth and one in the deepest part of channel. In between the horizontal density gradient, associated with these currents is much weaker.



7.2 Particle fluxes

As for previous deployments, both sediment traps show a similar pattern in the amount of accumulated particulate material (the residue heights, fig. XXX), which reflects the particulate mass fluxes. The tri-weekly resolved time-series from April 1, 2006 through October 5, 2007 show maxima in late austral spring to early summer similar to earlier years (samples A/B-10 to A/B-12), as well as enhanced values in early austral winter (samples A/B-2 to A/B-4). Generally, values are higher in the bottom trap probably due to lateral input by sediment resuspension and rebound fluxes, extremely so in sample B-11, which filled the sample bottle completely. Further analysis should bear out to what extent such maxima are associated with the passage of strong eddies or storm events propagating downslope, or tidal effects.

As expected pH measurement of the samples showed lower values than the blank solution (pH = 8.7) and were generally lowest for the bottom trap samples (fig. xxx) by contributions of acidity from particulate matter decomposition. This is most obvious in sample B-11 which was completely filled (pH = 7.6). However, pH values stayed well above 7, indicating that carbonate dissolution did not occur.



7.3 Monocorer results

The Monocorer was used along the entire transect on each CTD cast, which resulted in a total of 14 short cores out of 16 CTD-casts that reached the bottom. The device failed in two cases whereas several cores yielded were oblique cores, in all probability due to the forcing by very high surface current velocities (up to 5 knots!) that forced the ship to drift in order to keep the wire straight. Nevertheless, it produced sufficiently good core top material to assess the variability in sediment accumulation and composition along the entire transect to complement the 7 Multicorer casts.

7.4 Multicorer results

The Multicorer was deployed along the transect at 23 stations. Out of 23 stations 2 stations failed probably due to failing of the tripping mechanism. All 21 sites which were successful yielded sufficient surface sample. At 18 stations two sediment core were collected varying in length between 1 and 60 cm. After collecting, the samples were stored a constant temperature of 4 °C for cooled container transport to NIOZ.

7.5. Pistoncores

A major result of the cruise was the recovery of 23 pistoncores of which several appear of high quality. For details see the appendix. During the cruise 4 pistoncores were taken, 3 with a 12 m and one with an 18 m core barrel, all with liners of 11 cm in diameter, using a NIOZ designed pistoncore system. At all sites one or two of the subcores

subcores collected by the Multicorer at the same position was taken to collect the topmost part of the sediment column, which is usually missing from the pistoncore itself. Pistoncores were cut in 1 m sections but otherwise remained closed during the cruise, as were all other cores, and will only be opened for core-scanning and description at NIOZ. After measurement the cores were stored a constant temperature of 4 °C for cooled container transport to NIOZ.

When possible subsamples were taken from the tripcore and the corehead, which were sieved for a first order qualitative assessment of their particle composition, specifically their foraminiferal content. The presence or absence of the planktonic foraminifer *Globigerinoides ruber* “pink” was taken to determine whether or not the sediment was older or younger than 120.000 years, respectively, when this species became extinct in the Indo-Pacific. This showed that all sediments collected from the pistoncore heads were younger than 120.000 year.

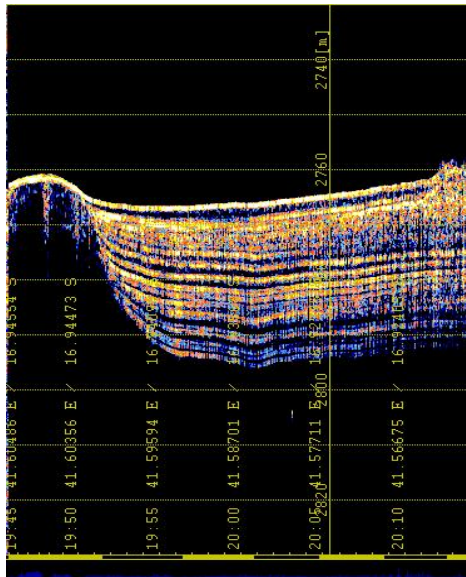


Figure 4. Parasound image of well layered sediment through in the central deepest parts of the Mozambique channel. Note the sharp contact with a more compact body on the left.

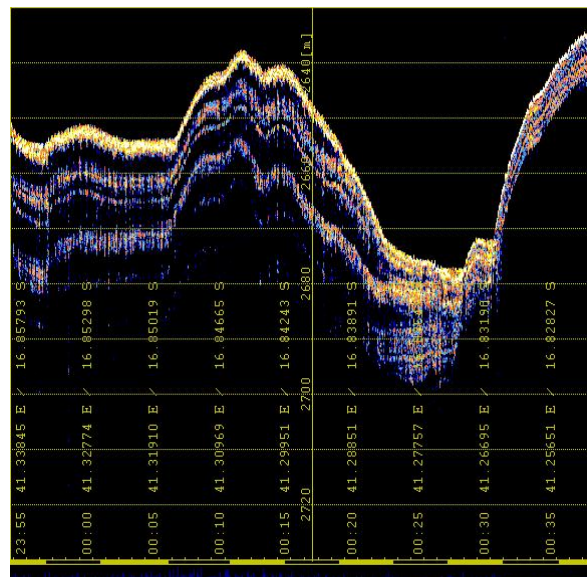


Figure 5. Layered sediments at the foot of the continental slope of Mozambique. Pistoncore 64PE304-79 was taken here.

7.6 Dinoflagellates (Willemijn Quaijtaal)

At the Eastern margin of Africa, there is hardly any data on the distribution of present day dinoflagellates and their resting cysts. Organic walled dinoflagellate cysts (dinocysts) have proven to be an excellent and sensitive proxy to reconstruct past sea surface water productivity, temperature, salinity, sea level change and other parameters. Therefore, assessment of

dinoflagellate composition can give additional information about environmental parameters of surface waters.

Analysis of the core tops (0-1 cm) gathered during the INATEX-GEO cruise will supply information about the geographic distribution of dinocysts and their correlation to several parameters. Comparing these data with material gathered from sediment traps will provide more insight in seasonal fluxes and preservation processes that determine the sedimentary record. Since dinocyst and living dinoflagellate taxonomy differ, two additional water samples have been taken and fixed in 5% formalin to assess their similarities and differences.

Sampling the long term record from piston cores for dinocysts will give additional information about the rapid climate changes INATEX aims to reveal.

7.7 Genetic profiling of planktonic foraminifers (Kate Darling)

Genetic studies indicate that many traditionally recognized individual morphospecies of planktonic foraminifers may represent several distinct cryptic species. There is growing evidence that they may have divergent environmental adaptations which could have significant repercussions for palaeoclimate reconstructions derived from their fossil assemblages. In order to assess the potential impact of the cryptic diversity for palaeo-climate proxy interpretation it is important to carry out extensive regional genotyping in parallel with image analysis in the regions of the oceans where major oceanographic and palaeoceanographic initiatives are currently being carried out. This study forms part of a series of genetic profiles of planktonic foraminifers being carried out within the Arabian Sea and southwestern Indian Ocean to determine whether cryptic types are present within the divergent marine ecosystems of these regions. The Agulhas current plays a key role in ocean circulation since it transports Indo-Pacific water, heat and salt into the Atlantic around Cape Agulhas. It is fed upstream by a complex system of strong eddies which are forced through the narrow Mozambique channel. The sediment traps deployed across this region are currently monitoring particulate matter flux which includes seasonal planktonic foraminiferal shell export from the water column. Some of the planktonic foraminiferal morphospecies in these waters are highly likely to represent species complexes with distinct ecologies and seasonality. Their genetic characterization should enhance interpretation for palaeoenvironmental reconstruction. In addition, Cape Agulhas also plays a major role in the regulation of gene flow between the Indo Pacific and the Atlantic planktonic foraminiferal populations. It is of considerable interest to understand the biogeographical connectivity of the palaeoenvironmentally important planktonic foraminiferal species between these major oceans.

One of the limitations to genetic profiling to date has been the inability to relate morphology to newly recognized genotypes across the full range of morphospecies. We have recently developed a new buffer in Edinburgh which extracts DNA while leaving even the small morphospecies shells intact and available for scanning microscopy and comparative morphometric analysis. This approach has considerably simplified procedures on board ship for

genotyping individual specimens as it does not require imaging individuals during processing. The most mature specimens were specifically selected for Small Sub-unit ribosomal RNA genotyping and were individually transferred into empty 0.5ml Eppendorf vials and 75µl of DNA extraction buffer was added. The extraction process takes up to 2 weeks before completion and the empty shells of the specimens from the first 4 stations were removed from the buffer and placed on slides before the end of the cruise. The remaining samples will be transported back to Edinburgh with their shells remaining in the buffer for processing later.

Eight non-quantitative deep vertical plankton hauls (500m) were carried out using a single plankton net with a 200µm mesh cod end Hydro Bios. Kiel). Six surface plankton samples were also collected by pumping sea water from 4m depth through the ships non-toxic sea water supply using a small 50µm mesh net attached to the hose. Details of all plankton net stations are shown in Table ???. The plankton net samples were retained in the -80°C freezer after removal of the planktonic foraminifers required for genotyping.

Over 500 individual specimens were successfully processed for genotyping along the INATEX GEO cruise track and included the full range of planktonic foraminiferal morphospecies found in the water column. We were also asked by members of the 64PE303 GLOW cruise members to search for the rare morphospecies of planktonic foraminifer *Globoquadrina conglomerata* for genetic characterisation. All nets were extensively searched for this morphospecies and a single specimen was eventually identified exhibiting a morphology similar to mature specimens from sediment core tops. A fine plankton net was also used to obtain specimens of two small biserial planktonic foraminiferal morphospecies of *Streptochilus* which is currently under study in Edinburgh. As a result 24 specimens were processed for genotyping and morphological investigations.

8. Acknowledgements

The research reported here was funded by the Netherlands Organisation for Scientific Research (NWO) within the ZKO-Oceans Programme INATEX and the ESF/EuroMarc Programme GLOW. I thank the ships crew for their professional and excellent support and active participation in the preparation and execution of the cruise reported here.

Appendix A: Cruise summary of Pelagia cruise 64PE304

Station/ Track	Cast/ Action	Type	Event	Datum/ Tijd	Lat	Lon	Diepte	Opmerking
4	1	Multibeam survey	Begin	11/03/2009 08:50	-9.02007	39.83502	2036	
1	1	Planktonnet	Begin	11/03/2009 12:40	-7.04233	39.88735	524	Station 1
1	1	Planktonnet	Bottom	11/03/2009 13:03	-7.02725	39.87552	500	
1	1	Planktonnet	End	11/03/2009 13:21	-7.01818	39.86663	396	
2	1	CTD met zout- nutriënten- en oxygen samples	Begin	11/03/2009 14:01	-7.03438	39.88647	487	Station 2
2	1	CTD met zout- nutriënten- en oxygen samples	Bottom	11/03/2009 14:14	-7.02738	39.88302	493	
2	1	CTD met zout- nutriënten- en oxygen samples	End	11/03/2009 14:27	-7.02097	39.88182	475	
3	1	Planktonnet	Begin	11/03/2009 14:38	-7.0157	39.88008	469	Station 3
3	1	Planktonnet	Bottom	11/03/2009 14:41	-7.01382	39.87922	475	
3	1	Planktonnet	End	11/03/2009 15:41	-7.01423	39.87997	469	
4	1	Multibeam survey	End	12/03/2009 08:50	-9.01217	39.82233	1971	Started at 07:04.5 S / 039:53.7 E (WD 567 m)(+3kC)
5	1	Multibeam survey	Begin	12/03/2009 09:14	-9.01573	39.83257	2036	Line count 0000 (+ 3kC)
5	1	Multibeam survey	End	12/03/2009 11:08	-8.93813	39.63447	481	Line count 0003
6	1	CTD met zout- nutriënten- en oxygen samples	Begin	12/03/2009 11:52	-8.95002	39.6656	750	Station 4 (CTD with monocoire)
6	1	CTD met zout- nutriënten- en oxygen samples	Bottom	12/03/2009 12:05	-8.95002	39.6656	750	
6	1	CTD met zout- nutriënten- en oxygen samples	End	12/03/2009 12:21	-8.94975	39.666	756	
7	1	Planktonnet	Begin	12/03/2009 12:49	-8.93767	39.633	479	Station 5 (Upto 500 m depth)
7	1	Planktonnet	Bottom	12/03/2009 13:11	-8.92853	39.62792	427	
7	1	Planktonnet	End	12/03/2009 13:35	-8.917	39.624	361	
8	1	Multicoire	Bottom	12/03/2009 14:25	-8.95067	39.6656	757	Station 6
9	1	Pistoncore	Bottom	12/03/2009 16:12	-8.95052	39.66543	754	Station 7
10	1	Multibeam survey	Begin	12/03/2009 17:13	-8.94318	39.64628	600	Survey: at_kilwa_island_12_maart / Line cnt. 0000 (+ 3kC)
10	1	Multibeam survey	End	12/03/2009 17:33	-8.93048	39.61327	340	line cnt. 0001
11	1	Multibeam survey	Begin	12/03/2009 17:46	-8.93917	39.61155	332	line cnt. 0001 (+ 3 kC)
11	1	Multibeam survey	End	12/03/2009 18:07	-8.95662	39.63893	516	line cnt. 0002
12	1	Multibeam survey	Begin	12/03/2009 18:23	-8.97197	39.62927	42	line cnt. 0002 (+ 3 kC)
12	1	Multibeam survey	End	12/03/2009 18:41	-8.94908	39.60702	363	line cnt. 0002

Station/ Track	Cast/ Action	Type	Event	Datum/ Tijd	Lat	Lon	Diepte	Opmerking
13	1	Multibeam survey	Begin	12/03/2009 18:48	-8.95613	39.59902	342	line cnt. 0003 (+ 3 kC)
13	1	Multibeam survey	End	12/03/2009 19:11	-8.9853	39.61922	603	line cnt. 0003
14	1	Multibeam survey	Begin	12/03/2009 19:41	-8.92507	39.65003	634	line cnt. 0004 (+ 3 kC)
14	1	Multibeam survey	End	12/03/2009 20:01	-8.92142	39.61677	304	line cnt. 0004
15	1	Multibeam survey	Begin	12/03/2009 20:03	-8.92145	39.6146	280	line cnt. 0005 (+3 kC)
15	1	Multibeam survey	End	12/03/2009 20:30	-8.96313	39.59147	341	line cnt. 0005
16	1	Multibeam survey	Begin	12/03/2009 20:41	-8.96175	39.58762	280	line cnt. 0006 (+ 3 kC)
16	1	Multibeam survey	End	12/03/2009 21:12	-8.91585	39.61687	298	line cnt. 0007
17	1	Multibeam survey	Begin	12/03/2009 21:25	-8.92428	39.6346	481	line cnt. 0008 (+ 3 kC)
17	1	Multibeam survey	End	12/03/2009 23:24	-8.9536	39.84337	2012	line cnt. 0011
18	1	Multibeam survey	Begin	13/03/2009 00:13	-9.0359	39.83155	1945	line cnt 0012 (+ 3 kC)
18	1	Multibeam survey	End	13/03/2009 02:09	-8.95448	39.6347	481	line cnt 0015
19	1	Multibeam survey	Begin	13/03/2009 02:24	-8.96642	39.62665	652	line cnt 0016 (+ 3 kC)
19	1	Multibeam survey	End	13/03/2009 04:05	-9.05045	39.78118	1573	line cnt 0019
20	1	Pistoncore	Bottom	13/03/2009 05:37	-8.95053	39.66545	752	Station 8
21	1	Multicore	Bottom	13/03/2009 07:42	-8.93555	39.61638	370	Station 9
22	1	Pistoncore	Bottom	13/03/2009 08:26	-8.93597	39.61665	367	Station 10
23	1	Multibeam survey	Begin	13/03/2009 09:03	-8.91192	39.61347	262	line cnt. 0020
23	1	Multibeam survey	End	13/03/2009 09:38	-8.95957	39.58295	237	line cnt. 0021
24	1	Multibeam survey	Begin	13/03/2009 09:45	-8.95735	39.57948	216	line cnt. 0022
24	1	Multibeam survey	End	13/03/2009 10:27	-8.90997	39.61055	134	line cnt. 0023
25	1	Multibeam survey	Begin	13/03/2009 10:37	-8.91088	39.62088	355	line cnt. 0024
25	1	Multibeam survey	End	13/03/2009 10:41	-8.91055	39.6265	401	line cnt. 0024
26	1	Multibeam survey	Begin	13/03/2009 11:10	-8.95767	39.58093	224	line cnt. 0025
26	1	Multibeam survey	End	13/03/2009 11:27	-8.97132	39.55505	160	line cnt. 0025
27	1	Multibeam survey	Begin	13/03/2009 11:29	-8.9719	39.55358	145	line cnt. 0026
27	1	Multibeam survey	End	13/03/2009 11:36	-8.96353	39.54905	188	line cnt. 0026
28	1	Multibeam survey	Begin	13/03/2009 11:39	-8.96262	39.54918	165	line cnt. 0027
28	1	Multibeam survey	End	13/03/2009 11:52	-8.95398	39.56668	172	line cnt. 0027

Station/ Track	Cast/ Action	Type	Event	Datum/ Tijd	Lat	Lon	Diepte	Opmerking
29	1	Multicore	Bottom	13/03/2009 12:12	-8.95895	39.5592	200	Station 11
30	1	Multicore	Bottom	13/03/2009 12:40	-8.95938	39.55822	195	Station 12
31	1	Pistoncore	Bottom	13/03/2009 13:23	-8.95898	39.55872	193	Station 13
32	1	Multibeam survey	Begin	13/03/2009 15:10	-8.95475	39.56523	194	line cnt 0028
32	1	Multibeam survey	End	13/03/2009 15:47	-8.9213	39.60017	206	line cnt 0029
33	1	Multibeam survey	Begin	13/03/2009 16:00	-8.9105	39.6155	302	
33	1	Multibeam survey	End	13/03/2009 16:42	-8.90935	39.68437	1009	line cnt.0031
34	1	Multibeam survey	Begin	13/03/2009 17:34	-9.00003	39.66747	1202	line cnt. 0032
34	1	Multibeam survey	End	13/03/2009 18:01	-9.05045	39.66687	624	line cnt. 0032
35	1	Multibeam survey	Begin	13/03/2009 18:12	-9.05325	39.6767	698	line cnt. 0033
35	1	Multibeam survey	End	13/03/2009 19:47	-8.96745	39.56915	389	line cnt. 0036
36	1	Multibeam survey	Begin	13/03/2009 19:54	-8.96598	39.57633	336	line cnt. 0037
36	1	Multibeam survey	End	13/03/2009 20:04	-8.96497	39.59547	422	line cnt. 0037
37	1	Multibeam survey	Begin	13/03/2009 20:11	-8.96582	39.59193	401	line cnt. 0038
37	1	Multibeam survey	End	13/03/2009 20:41	-9.02088	39.582	290	line cnt. 0039
38	1	Multibeam survey	Begin	13/03/2009 20:49	-9.02555	39.5921	385	line cnt. 0040
38	1	Multibeam survey	End	13/03/2009 21:23	-8.98827	39.6299	725	line cnt. 0042
39	1	Multibeam survey	Begin	13/03/2009 21:23	-8.98873	39.63022	731	line cnt. 0042
39	1	Multibeam survey	End	13/03/2009 21:52	-9.03317	39.651	591	
40	1	Multibeam survey	Begin	13/03/2009 21:58	-9.03887	39.66128	750	line cnt. 0043
40	1	Multibeam survey	End	13/03/2009 22:57	-9.07183	39.76572	1384	line cnt. 0044
41	1	Multibeam survey	Begin	13/03/2009 23:10	-9.04773	39.77958	1585	line cnt. 0045
41	1	Multibeam survey	End	13/03/2009 23:30	-9.06067	39.81502	1713	line cnt. 0045
42	1	Multibeam survey	Begin	13/03/2009 23:33	-9.06462	39.81525	1695	line cnt. 0046
42	1	Multibeam survey	End	13/03/2009 23:39	-9.07473	39.81182	1652	line cnt. 0046
43	1	Multibeam survey	Begin	13/03/2009 23:42	-9.07677	39.80925	1640	line cnt. 0047
43	1	Multibeam survey	End	14/03/2009 00:06	-9.05992	39.76633	1420	line cnt. 0048
44	1	Multibeam survey	Begin	14/03/2009 00:41	-8.98472	39.79783	1969	line cnt. 0048
44	1	Multibeam survey	End	14/03/2009 00:51	-8.96742	39.80777	1774	line cnt. 0048

Station/ Track	Cast/ Action	Type	Event	Datum/ Tijd	Lat	Lon	Diepte	Opmerking
45	1	Multibeam survey	Begin	14/03/2009 01:05	-8.93967	39.82228	1951	line cnt. 0049
45	1	Multibeam survey	End	14/03/2009 02:24	-8.90777	39.68198	1121	line cnt 0051
46	1	Multibeam survey	Begin	14/03/2009 03:22	-9.00082	39.60498	560	line cnt 0053
46	1	Multibeam survey	End	14/03/2009 03:40	-9.03648	39.60497	314	line cnt 0053
47	1	Multibeam survey	Begin	14/03/2009 03:48	-9.03212	39.6109	388	line cnt 0054
47	1	Multibeam survey	End	14/03/2009 04:15	-9.03625	39.65918	703	line cnt 0054
48	1	CTD met zout- nutriënten- en oxygen samples	Begin	14/03/2009 05:14	-8.98068	39.74855	1567	Station 14 (CTD with Monocore)
48	1	CTD met zout- nutriënten- en oxygen samples	Bottom	14/03/2009 05:50	-8.98062	39.74838	1567	
48	1	CTD met zout- nutriënten- en oxygen samples	End	14/03/2009 06:21	-8.98085	39.7491	1609	
49	1	Planktonnet	Begin	14/03/2009 06:36	-8.98068	39.74873	1567	Station 15 (Upto 500 m depth)
49	1	Planktonnet	Bottom	14/03/2009 06:57	-8.97195	39.7483	1451	
49	1	Planktonnet	End	14/03/2009 07:19	-8.96235	39.74863	1414	
50	1	Multicore	Bottom	14/03/2009 08:06	-8.97867	39.74915	1536	Station 16
51	1	Pistoncore	Bottom	14/03/2009 09:34	-8.9792	39.74872	1542	Station 17
52	1	Multibeam survey	Begin	14/03/2009 11:22	-9.0238	39.63353	853	line cnt. 0055
52	1	Multibeam survey	End	14/03/2009 11:50	-8.98477	39.62658	731	line cnt. 0056
53	1	Multibeam survey	Begin	14/03/2009 12:22	-8.95152	39.5739	182	Survey: Kilwa_Kisiwani_hr / line cnt. 0000 (+ 3 kC)
53	1	Multibeam survey	End	14/03/2009 13:23	-8.9458	39.50092	17	line cnt 0002
54	1	Multibeam survey	Begin	15/03/2009 05:12	-8.94677	39.50085	18	line cnt. 0003 (river survey eastwards)
54	1	Multibeam survey	End	15/03/2009 05:59	-8.94495	39.55012	64	line cnt 0004
55	1	Multibeam survey	Begin	15/03/2009 06:02	-8.94685	39.55185	73	line cnt 0005 (river survey westwards)
55	1	Multibeam survey	End	15/03/2009 06:50	-8.94537	39.50063	15	line cnt 0006
56	1	Multibeam survey	Begin	15/03/2009 06:56	-8.94537	39.49922	11	line cnt 0007 (river survey eastwards)
56	1	Multibeam survey	End	15/03/2009 07:03	-8.9496	39.50807	33	line cnt 0007
57	1	Multibeam survey	Begin	15/03/2009 07:07	-8.9482	39.50823	34	line cnt 0008 (river survey harbour)
57	1	Multibeam survey	End	15/03/2009 07:13	-8.94428	39.50413	43	line cnt 0008
58	1	Multibeam survey	Begin	15/03/2009 07:42	-8.94365	39.50502	43	line cnt 0009 (river survey east wards)
58	1	Multibeam survey	End	15/03/2009 08:08	-8.94747	39.52255	34	line cnt 0009
59	1	Multibeam survey	Begin	15/03/2009 08:14	-8.9416	39.52898	10	line cnt 0010 (river survey westwards)

Station/ Track	Cast/ Action	Type	Event	Datum/ Tijd	Lat	Lon	Diepte	Opmerking
59	1	Multibeam survey	End	15/03/2009 08:43	-8.94795	39.50028	15	line cnt 0010
60	1	Multibeam survey	Begin	15/03/2009 10:35	-8.9495	39.51438	23	line cnt 0011 (river survey eastwards)
60	1	Multibeam survey	End	15/03/2009 11:18	-8.9375	39.5652	29	line cnt 0012
61	1	Multibeam survey	Begin	15/03/2009 11:20	-8.93885	39.56642	50	line cnt 0013 (river survey westwards)
61	1	Multibeam survey	End	15/03/2009 11:36	-8.94315	39.54387	28	line cnt 0013
62	1	Multibeam survey	Begin	16/03/2009 04:04	-8.9453	39.4997	14	line cnt 0014 (harbour survey)
62	1	Multibeam survey	End	16/03/2009 04:10	-8.95027	39.50567	27	line cnt 0014
63	1	Multibeam survey	Begin	16/03/2009 04:16	-8.95097	39.50498	36	line cnt 0015 (harbour survey)
63	1	Multibeam survey	End	16/03/2009 04:25	-8.9463	39.50232	20	line cnt 0015
64	1	Multibeam survey	Begin	16/03/2009 04:30	-8.94585	39.50023	16	line cnt 0016 (harbour survey)
64	1	Multibeam survey	End	16/03/2009 04:36	-8.94073	39.50615	28	line cnt 0016
65	1	Multibeam survey	Begin	16/03/2009 04:41	-8.9411	39.5067	20	line cnt 0017 (harbour survey)
65	1	Multibeam survey	End	16/03/2009 04:46	-8.94508	39.50673	29	line cnt 0017
66	1	Multibeam survey	Begin	16/03/2009 04:50	-8.94432	39.5059	36	line cnt 0018 (harbour survey)
66	1	Multibeam survey	End	16/03/2009 04:52	-8.94233	39.50627	26	line cnt 0018
67	1	Pistoncore	Bottom	16/03/2009 05:13	-8.94995	39.50428	27	Station 18 (Gravity core !)
68	1	Pistoncore	Bottom	16/03/2009 05:51	-8.94157	39.50393	40	Station 19 (Gravity Coring with Bomb of Hydr. Winchlet)
69	1	Pistoncore	Bottom	16/03/2009 06:13	-8.95357	39.51065	16	Station 20 (Gravity Coring with Bomb of Hydr. Winchlet)
70	1	Pistoncore	Bottom	16/03/2009 06:18	-8.95252	39.51012	16	Station 21 (Gravity Coring with Bomb of Hydr. Winchlet)
71	1	Pistoncore	Bottom	16/03/2009 06:30	-8.95258	39.5101	16	Station 22 (Gravity Core!)
72	1	Pistoncore	Bottom	16/03/2009 07:20	-8.95233	39.51838	16	Station 23 (Gravity Coring with Bomb of Hydr. Winchlet)
73	1	Multibeam survey	Begin	16/03/2009 07:40	-8.94143	39.52227	16	line cnt 0019 (river survey missing piece)
73	1	Multibeam survey	End	16/03/2009 07:43	-8.93795	39.5257	16	line cnt 0019
74	1	Multibeam survey	Begin	16/03/2009 07:57	-8.94308	39.55233	44	line cnt 0020 (bay survey east wards)
74	1	Multibeam survey	End	16/03/2009 08:17	-8.93487	39.58193	198	line cnt 0020
75	1	Multibeam survey	Begin	16/03/2009 08:20	-8.93392	39.57973	186	line cnt 0021 (bay survey westwards)
75	1	Multibeam survey	End	16/03/2009 08:28	-8.93762	39.56513	35	line cnt 0021
76	1	Multibeam survey	Begin	16/03/2009 08:35	-8.93703	39.57033	66	line cnt 0022 (bay survey westwards)
76	1	Multibeam survey	End	16/03/2009 08:50	-8.94287	39.54815	27	line cnt 0022

Station/ Track	Cast/ Action	Type	Event	Datum/ Tijd	Lat	Lon	Diepte	Opmerking
77	1	Multibeam survey	Begin	16/03/2009 08:54	-8.94713	39.54935	80	line cnt 0023 (bay survey eastwards)
77	1	Multibeam survey	End	16/03/2009 09:01	-8.95272	39.56092	155	line cnt 0023
78	1	Multibeam survey	Begin	16/03/2009 09:06	-8.95792	39.55582	144	line cnt 0024 (bay survey westwards)
78	1	Multibeam survey	End	16/03/2009 09:14	-8.9486	39.54708	55	line cnt 0024
79	1	Multibeam survey	Begin	16/03/2009 09:16	-8.94813	39.54617	57	line cnt 0025 (bay survey eastwards)
79	1	Multibeam survey	End	16/03/2009 09:24	-8.95875	39.55272	139	line cnt 0025
80	1	Multibeam survey	Begin	16/03/2009 09:33	-8.94635	39.56473	100	line cnt 0026 (bay survey fill-in)
80	1	Multibeam survey	End	16/03/2009 09:35	-8.94428	39.56768	119	line cnt 0026
81	1	Multibeam survey	Begin	16/03/2009 10:52	-9.06718	39.67068	16	Survey: 16-3-09 / Line cnt. 0000
81	1	Multibeam survey	End	16/03/2009 17:22	-9.82423	39.90977	391	line cnt. 0014
82	1	CTD met zout- nutriënten- en oxygen samples	Begin	16/03/2009 17:36	-9.82203	39.9067	382	Station 24
82	1	CTD met zout- nutriënten- en oxygen samples	Bottom	16/03/2009 17:43	-9.82188	39.90653	382	
82	1	CTD met zout- nutriënten- en oxygen samples	End	16/03/2009 17:52	-9.82242	39.90675	382	
83	1	Multibeam survey	Begin	16/03/2009 18:03	-9.81182	39.91728	428	line cnt. 0015
83	1	Multibeam survey	End	16/03/2009 18:21	-9.77202	39.90957	485	line cnt. 0015
84	1	Multicore	Bottom	16/03/2009 18:37	-9.76978	39.91057	482	Station 25
85	1	Pistoncore	Bottom	16/03/2009 19:16	-9.76985	39.91055	482	Station 26
86	1	Multibeam survey	Begin	16/03/2009 19:58	-9.76845	39.90425	449	line cnt. 0015
86	1	Multibeam survey	End	16/03/2009 21:33	-9.9245	39.98918	351	line cnt. 0018
87	1	Multibeam survey	Begin	16/03/2009 21:40	-9.92925	39.98698	339	line cnt. 0019
87	1	Multibeam survey	End	16/03/2009 23:37	-9.7492	40.1239	1691	line cnt. 0022
88	1	Multibeam survey	Begin	16/03/2009 23:44	-9.74487	40.12053	1776	line cnt. 0023
88	1	Multibeam survey	End	17/03/2009 01:39	-9.92508	40.20207	1040	line cnt 0026
89	1	Multibeam survey	Begin	17/03/2009 01:59	-9.93112	40.19078	979	line cnt 0027
89	1	Multibeam survey	End	17/03/2009 04:54	-9.82432	40.49862	1896	line cnt 0032
90	1	CTD met zout- nutriënten- en oxygen samples	Begin	17/03/2009 05:15	-9.82677	40.49147	1943	Station 27
90	1	CTD met zout- nutriënten- en oxygen samples	Bottom	17/03/2009 05:48	-9.82658	40.49162	1943	
90	1	CTD met zout- nutriënten- en oxygen samples	End	17/03/2009 06:29	-9.8266	40.4915	1938	
91	1	Planktonnet	Begin	17/03/2009 06:36	-9.82647	40.491	1938	Station 28

Station/ Track	Cast/ Action	Type	Event	Datum/ Tijd	Lat	Lon	Diepte	Opmerking
91	1	Planktonnet	Bottom	17/03/2009 06:53	-9.82693	40.48937	1938	Lowered till 500 m.
91	1	Planktonnet	End	17/03/2009 07:13	-9.8264	40.48173	1900	
92	1	Multicore	Bottom	17/03/2009 07:55	-9.82737	40.48863	1938	Station 29
93	1	Multibeam survey	Begin	17/03/2009 08:59	-9.82438	40.488	1933	line cnt. 0033
93	1	Multibeam survey	End	17/03/2009 11:00	-9.78475	40.22422	1476	line cnt. 0038
94	1	Multicore	Bottom	17/03/2009 11:27	-9.78565	40.22365	1471	Station 30
95	1	Pistoncore	Bottom	17/03/2009 12:50	-9.78515	40.22397	1471	Station 31
96	1	Mooring Deployment	Deployment	17/03/2009 16:09	-9.784	40.21647	1466	Station 32
97	1	Multibeam survey	Begin	17/03/2009 16:16	-9.79465	40.21497	1443	line cnt 0038
97	1	Multibeam survey	End	17/03/2009 17:02	-9.9063	40.20422	1108	line cnt. 0039
98	1	Multicore	Bottom	17/03/2009 17:36	-9.92432	40.20082	1037	Station 33
99	1	Pistoncore	Bottom	17/03/2009 18:26	-9.92497	40.20202	1037	Station 34
100	1	Multibeam survey	Begin	17/03/2009 18:57	-9.9235	40.19673	1028	line cnt. 0040
100	1	Multibeam survey	End	18/03/2009 00:57	-9.94927	40.96595	2839	line cnt. 0052
101	1	Multibeam survey	Begin	18/03/2009 01:44	-9.94612	41.06308	2811	line cnt 0053
101	1	Multibeam survey	End	18/03/2009 05:28	-9.91433	41.48477	2339	line cnt. 0061
102	1	CTD met zout- nutriënten- en oxygen samples	Begin	18/03/2009 05:41	-9.91532	41.47773	2349	Station 35 (CTD with Monocore)
102	1	CTD met zout- nutriënten- en oxygen samples	Bottom	18/03/2009 06:22	-9.91495	41.47657	2349	
102	1	CTD met zout- nutriënten- en oxygen samples	End	18/03/2009 07:06	-9.9149	41.47655	2349	
103	1	Multicore	Bottom	18/03/2009 07:54	-9.91615	41.47317	2349	Station 36 (failed)
104	1	Multicore	Bottom	18/03/2009 09:35	-9.91573	41.47625	-4	Station 37
105	1	Pistoncore	Bottom	18/03/2009 11:14	-9.9155	41.47555	-4	Station 38 (failed)
106	1	Planktonnet	Begin	18/03/2009 12:17	-9.9315	41.46655	-4	Station 39
106	1	Planktonnet	Bottom	18/03/2009 12:36	-9.93537	41.463	-4	
106	1	Planktonnet	End	18/03/2009 12:53	-9.94223	41.45988	-4	
107	1	Pistoncore	Bottom	18/03/2009 14:02	-9.91518	41.4781	2349	Station 40
108	1	Multibeam survey	Begin	18/03/2009 15:02	-9.936	41.46877	2353	line cnt 0062
108	1	Multibeam survey	End	18/03/2009 16:50	-10.2316	41.43528	2778	line cnt 0066
109	1	CTD met zout- nutriënten- en oxygen samples	Begin	18/03/2009 17:05	-10.2296	41.43628	2778	Station 41 (CTD with Monocore)

Station/ Track	Cast/ Action	Type	Event	Datum/ Tijd	Lat	Lon	Diepte	Opmerking
109	1	CTD met zout- nutriënten- en oxygen samples	Bottom	18/03/2009 17:55	-10.2296	41.43632	2778	
109	1	CTD met zout- nutriënten- en oxygen samples	End	18/03/2009 18:48	-10.2295	41.43417	2778	
110	1	Multibeam survey	Begin	18/03/2009 18:55	-10.2303	41.43148	2773	Survey: 18_maart_2009 / line cnt. 0000
110	1	Multibeam survey	End	18/03/2009 20:17	-10.2607	41.55062	1863	line cnt. 0002
111	1	Multibeam survey	Begin	18/03/2009 20:38	-10.2709	41.50845	2292	line cnt. 0003
111	1	Multibeam survey	End	19/03/2009 00:24	-10.6739	41.4726	2858	line cnt. 0010
112	1	Multibeam survey	Begin	19/03/2009 00:29	-10.676	41.47663	2853	line cnt. 0011
112	1	Multibeam survey	End	19/03/2009 04:34	-10.2522	41.48205	2754	line cnt 0019
113	1	Multicore	Bottom	19/03/2009 05:51	-10.2295	41.43452	2778	Station 42
114	1	Pistoncore	Bottom	19/03/2009 07:55	-10.2302	41.43612	2778	Station 43
115	1	Multibeam survey	Begin	19/03/2009 09:07	-10.2601	41.43267	2816	
115	1	Multibeam survey	End	19/03/2009 11:49	-10.5355	41.47208	2863	
116	1	Pistoncore	Bottom	19/03/2009 14:50	-10.8987	41.4193	2849	Station 44
117	1	Multibeam survey	Begin	20/03/2009 09:14	-13.8433	41.15588	2201	Survey: 20_maart_2009 / Line cnt. 0000
117	1	Multibeam survey	End	20/03/2009 09:56	-13.8763	41.15985	2225	line cnt. 0001
118	1	Pistoncore	Bottom	20/03/2009 11:06	-13.8824	41.16165	2231	Station 45
119	1	Multibeam survey	Begin	20/03/2009 12:29	-13.8948	41.16293	2225	line cnt. 0002 (+3 kC)
119	1	Multibeam survey	End	20/03/2009 18:51	-14.5808	41.32827	2804	line cnt. 0015
120	1	Pistoncore	Bottom	20/03/2009 20:03	-14.5697	41.33097	2804	Station 46
121	1	Multicore	Bottom	20/03/2009 22:06	-14.5753	41.32963	2804	Station 47
122	1	CTD met zout- nutriënten- en oxygen samples	Begin	20/03/2009 23:05	-14.5811	41.34557	2804	Station 48
122	1	CTD met zout- nutriënten- en oxygen samples	Bottom	21/03/2009 00:01	-14.5761	41.33253	2804	
122	1	CTD met zout- nutriënten- en oxygen samples	End	21/03/2009 00:56	-14.5835	41.33608	2804	
123	1	Multibeam survey	Begin	21/03/2009 01:10	-14.5761	41.3421	2804	line cnt 0017
123	1	Multibeam survey	End	21/03/2009 04:00	-14.5753	41.6894	2573	line cnt 0022
124	1	Multibeam survey	Begin	21/03/2009 04:18	-14.5747	41.68343	2567	line cnt 0023
124	1	Multibeam survey	End	21/03/2009 06:03	-14.4551	41.59127	2737	line cnt. 0026
125	1	CTD met zout- nutriënten- en oxygen samples	Begin	21/03/2009 06:20	-14.472	41.5968	2774	station 49 (CTD with Monocore)
125	1	CTD met zout- nutriënten- en oxygen samples	Bottom	21/03/2009 07:10	-14.4737	41.59823	2774	

Station/ Track	Cast/ Action	Type	Event	Datum/ Tijd	Lat	Lon	Diepte	Opmerking
125	1	CTD met zout- nutriënten- en oxygen samples	End	21/03/2009 07:57	-14.4736	41.5975	2774	
126	1	Planktonnet	Begin	21/03/2009 08:15	-14.4736	41.59773	2786	station 50
126	1	Planktonnet	Bottom	21/03/2009 08:22	-14.4763	41.60032	2792	lowered till 500 m
126	1	Planktonnet	End	21/03/2009 08:43	-14.4822	41.60602	2835	
127	1	Multicore	Bottom	21/03/2009 09:45	-14.4763	41.60108	2792	station 51
128	1	Multibeam survey	Begin	21/03/2009 16:41	-15.4099	41.53943	2558	line cnt 0027
128	1	Multibeam survey	End	21/03/2009 17:08	-15.4327	41.52132	2762	line cnt. 0027
129	1	Pistoncore	Bottom	21/03/2009 18:11	-15.4335	41.52393	2762	station 52
130	1	CTD met zout- nutriënten- en oxygen samples	Begin	21/03/2009 19:20	-15.4334	41.52608	2762	station 53 (CTD with monocoore)
130	1	CTD met zout- nutriënten- en oxygen samples	Bottom	21/03/2009 20:08	-15.4327	41.52268	2762	
130	1	CTD met zout- nutriënten- en oxygen samples	End	21/03/2009 20:58	-15.4319	41.52175	2762	
131	1	Mooring Recovery	Recovery	22/03/2009 07:24	-16.707	40.84293	2225	Station 54 - Rel.: 09.16 hrs / Spotted:10.06 hrs (MOZ4)
132	1	CTD met zout- nutriënten- en oxygen samples	Begin	22/03/2009 10:28	-16.7302	41.07912	2384	Station 55 (CTD with Monocoore)
132	1	CTD met zout- nutriënten- en oxygen samples	Bottom	22/03/2009 11:14	-16.7357	41.08005	2390	
132	1	CTD met zout- nutriënten- en oxygen samples	End	22/03/2009 12:14	-16.7435	41.0789	2390	
133	1	Multibeam survey	Begin	22/03/2009 14:04	-16.844	41.30453	2640	line cnt 0028
133	1	Multibeam survey	End	22/03/2009 14:26	-16.8545	41.328	2652	line cnt 0028
134	1	Multicore	Bottom	22/03/2009 15:22	-16.8513	41.31943	2652	Station 56
135	1	Pistoncore	Bottom	22/03/2009 17:19	-16.8502	41.31887	2652	Station 57
136	1	CTD met zout- nutriënten- en oxygen samples	Begin	23/03/2009 05:48	-17.1869	42.97445	1560	Station 58 (CTD with Monocoore)
136	1	CTD met zout- nutriënten- en oxygen samples	Bottom	23/03/2009 06:15	-17.1866	42.97353	1560	
136	1	CTD met zout- nutriënten- en oxygen samples	End	23/03/2009 06:59	-17.1862	42.97318	1560	
137	1	CTD met zout- nutriënten- en oxygen samples	Begin	23/03/2009 11:18	-17.1212	42.55043	2134	Station 59 (CTD with Monocoore)
137	1	CTD met zout- nutriënten- en oxygen samples	Bottom	23/03/2009 11:54	-17.1223	42.54848	2134	
137	1	CTD met zout- nutriënten- en oxygen samples	End	23/03/2009 12:35	-17.1219	42.54863	2134	
138	1	CTD met zout- nutriënten- en oxygen samples	Begin	23/03/2009 20:15	-16.9878	41.98955	2018	station 60 (CTD with Monocoore)
138	1	CTD met zout- nutriënten- en oxygen samples	Bottom	23/03/2009 20:50	-16.9876	41.99005	2018	
138	1	CTD met zout- nutriënten- en oxygen samples	End	23/03/2009 21:08	-16.988	41.98943	2012	
139	1	CTD met zout- nutriënten- en oxygen samples	Begin	24/03/2009 04:05	-16.8335	41.4415	2664	Station 61 (CTD with Monocoore)

Station/ Track	Cast/ Action	Type	Event	Datum/ Tijd	Lat	Lon	Diepte	Opmerking
139	1	CTD met zout- nutriënten- en oxygen samples	Bottom	24/03/2009 04:51	-16.8335	41.44125	2664	
139	1	CTD met zout- nutriënten- en oxygen samples	End	24/03/2009 05:38	-16.8341	41.44187	2664	
140	1	CTD met zout- nutriënten- en oxygen samples	Begin	24/03/2009 11:32	-16.6514	40.67908	2060	station 62 (CTD with Monocore)
140	1	CTD met zout- nutriënten- en oxygen samples	Bottom	24/03/2009 12:09	-16.6513	40.67905	2067	
140	1	CTD met zout- nutriënten- en oxygen samples	End	24/03/2009 12:44	-16.6511	40.67908	2060	
141	1	Multibeam survey	Begin	24/03/2009 12:52	-16.6518	40.67687	2060	line cnt. 0029
141	1	Multibeam survey	End	24/03/2009 16:01	-16.5881	40.35907	1695	line cnt 0035
142	1	Multicore	Bottom	24/03/2009 16:37	-16.5887	40.3608	1695	Station 63
143	1	CTD met zout- nutriënten- en oxygen samples	Begin	24/03/2009 18:37	-16.5572	40.19845	1445	station 64 (CTD with Monocore)
143	1	CTD met zout- nutriënten- en oxygen samples	Bottom	24/03/2009 19:02	-16.5567	40.197	1445	
143	1	CTD met zout- nutriënten- en oxygen samples	End	24/03/2009 19:46	-16.5565	40.19773	1445	
144	1	Multibeam survey	Begin	24/03/2009 19:50	-16.5563	40.19675	1445	line cnt. 0036
144	1	Multibeam survey	End	24/03/2009 20:07	-16.5515	40.16655	1384	line cnt. 0036
145	1	Multibeam survey	Begin	24/03/2009 20:13	-16.5493	40.15552	1359	line cnt. 0037
145	1	Multibeam survey	End	24/03/2009 21:51	-16.5018	39.98417	664	line cnt. 0040
146	1	Multibeam survey	Begin	24/03/2009 21:55	-16.4987	39.98418	682	line cnt. 0041
146	1	Multibeam survey	End	24/03/2009 22:36	-16.4333	40.03107	670	line cnt. 0042
147	1	Multibeam survey	Begin	24/03/2009 22:39	-16.4328	40.0334	603	line cnt. 0043
147	1	Multibeam survey	End	24/03/2009 23:31	-16.5043	40.01617	719	line cnt. 0044
148	1	Multibeam survey	Begin	24/03/2009 23:33	-16.5038	40.0179	725	line cnt. 0045
148	1	Multibeam survey	End	25/03/2009 00:12	-16.4421	40.0648	713	line cnt. 0046
149	1	Multibeam survey	Begin	25/03/2009 00:19	-16.4401	40.07363	707	line cnt. 0047
149	1	Multibeam survey	End	25/03/2009 01:10	-16.5196	40.03753	951	line cnt 0048
150	1	Multibeam survey	Begin	25/03/2009 01:37	-16.5272	40.07455	1128	line cnt 0049
150	1	Multibeam survey	End	25/03/2009 02:26	-16.4523	40.10305	1054	line cnt 0050
151	1	Multibeam survey	Begin	25/03/2009 02:44	-16.4598	40.13008	1103	line cnt 0051
151	1	Multibeam survey	End	25/03/2009 03:33	-16.5315	40.10165	1213	line cnt 0052
152	1	Multibeam survey	Begin	25/03/2009 03:48	-16.5387	40.12863	1286	line cnt 0053
152	1	Multibeam survey	End	25/03/2009 04:36	-16.4652	40.15687	1231	line cnt 0054

Station/ Track	Cast/ Action	Type	Event	Datum/ Tijd	Lat	Lon	Diepte	Opmerking
153	1	Multibeam survey	Begin	25/03/2009 04:52	-16.4749	40.18702	1323	line cnt 0055
153	1	Multibeam survey	End	25/03/2009 05:48	-16.5656	40.15392	1378	line cnt. 0057
154	1	Mooring Deployment	Deployment	25/03/2009 07:42	-16.5019	40.19663	1371	station 65 (MUS1)
155	1	Multicore	Bottom	25/03/2009 09:42	-16.5342	40.05458	1103	Station 66
156	1	Pistoncore	Bottom	25/03/2009 10:58	-16.5352	40.05452	1103	Station 67
157	1	Multibeam survey	Begin	25/03/2009 11:40	-16.5339	40.04715	1073	Survey: 25_maart_2009_test / line cnt. 0000
157	1	Multibeam survey	End	25/03/2009 12:03	-16.5053	40.02657	780	line cnt. 0001
158	1	Multicore	Bottom	25/03/2009 12:29	-16.5029	40.02523	756	Station 68
159	1	Pistoncore	Bottom	25/03/2009 13:15	-16.5027	40.02205	737	Station 69
160	1	Multibeam survey	Begin	25/03/2009 13:26	-16.5031	40.02212	743	line cnt 0001
160	1	Multibeam survey	End	25/03/2009 15:42	-16.535	40.0551	1103	line cnt 0005
161	1	Multibeam survey	Begin	25/03/2009 15:56	-16.5347	40.054	1103	line cnt 0006
162	1	Pistoncore	Bottom	25/03/2009 16:19	-16.5358	40.05468	1103	Station 70 (18m)
163	1	Mooring Deployment	Deployment	26/03/2009 07:21	-16.7109	40.85065	2231	station 71 (MOZ5)
164	1	Planktonnet	Begin	26/03/2009 07:35	-16.7155	40.8485	2231	station 72
164	1	Planktonnet	Bottom	26/03/2009 07:51	-16.7107	40.84583	2225	lowered till 500 m
164	1	Planktonnet	End	26/03/2009 08:10	-16.7105	40.8435	2225	
165	1	Multibeam survey	End	26/03/2009 10:47	-16.8015	41.16475	2493	line cnt. 0045
166	1	Multibeam survey	Begin	26/03/2009 10:54	-16.8055	41.17908	2518	Survey: 26_maart_2009 line cnt. 0000
166	1	Multibeam survey	End	26/03/2009 14:03	-16.9251	41.57418	2767	line cnt 0006
168	1	Planktonnet	Begin	26/03/2009 14:38	-16.9243	41.57197	2767	Station 73
167	1	Pistoncore	Bottom	26/03/2009 14:59	-16.9245	41.5722	2767	Station 74
168	1	Planktonnet	End	26/03/2009 15:35	-16.9241	41.57228	2767	
169	1	Multibeam survey	Begin	26/03/2009 15:59	-16.921	41.57398	2767	Survey Across Cynthia Ring / line cnt 0000
170	1	CTD met zout- nutriënten- en oxygen samples	Begin	26/03/2009 19:58	-17.138	41.13532	2597	station 75
170	1	CTD met zout- nutriënten- en oxygen samples	Bottom	26/03/2009 20:28	-17.1384	41.13435	2590	lowered till 1500 m
170	1	CTD met zout- nutriënten- en oxygen samples	End	26/03/2009 20:55	-17.1384	41.13338	2590	
171	1	Multibeam survey	End	27/03/2009 09:01	-17.143	40.28832	2133	line cnt. 0034
172	1	Multibeam survey	Begin	27/03/2009 13:48	-17.4842	39.61598	2067	Survey:27_maart_2009 : line cnt 0000

Appendix B: Moorings of Pelagia cruise 64PE304

Mooring ID	Latitude		Longitude		water depth	measurement type	instrument type	ID	meters below surface	recording interval	DSU number	Start		deployment		releases			Argos code							
	deg S	min S	deg E	min E								date UTC	time UTC	date	time	type	number	code								
GLOW1	9	47.02	40	13	1466	Currentmeter	RCM-8	11831	1256	1200	12227	17/03/2009	12:40	17/03/2009	16:09	Benthos	784	5H-enable								
						Sampling supplies	HDW-trap	S/MT230	1231																	
						Sampling supplies	Trap-motor	S/MT241	1231												948	4B-enable				
						Mooring supplies	Sediment trap HDW-S/MT230	860028	1231														4A-release			
						Measuring device	OBS	11906	1231																	
																			Novatech Beacon	V05-096						
MUS1	16	30.11	40	11.79	1371	Currentmeter	RCM-8	11487	1158	1200	13526	24/03/2009	16:45	25/03/2009	07:42	Benthos	594	2G-enable								
						Float	Synt. spherical buoy 49 Inch,	ADCP49/1090	1035																	
						Mooring supplies	Anker-Sediment-Frame Ankersedimentframe	ASF-010	1371														750	7H-enable		
						Mooring supplies	Sediment trap Technicap PPS5/2	9-06	1371															7F-release		
						Sampler	Sediment Trap PPS	0-212	1371																	
						Sampling supplies	K/MT 246 Sediment-trap	2009401	1123															Beacon	CML	60673
MOZ 5	16	42.69	40	51.32	2231	CTD moored	C en T recorder SBE 37-SM Microcat	2959	1971					26/03/2009	07:21											
						Currentmeter	RCM-11	45	2207	1200	7318	26/03/2009	05:45													
						Currentmeter	RCM-8	12052	1996	1200	13529	26/03/2009	05:25													
						Measuring device	NIOZ 4MB Data-logger	ID:B9	1981															Benthos	950	2B-enable
						Mooring supplies	Anker-Sediment-Frame Ankersedimentframe	ASF-011	2231																	
						Sampler	Sediment Trap PPS	9-202	2231																1001	7C-enable
						Sampling supplies	K/MT 246 Sediment-trap	2009402	1981																	
						Sampling supplies	Sed Trap Carousel PPS 5	46	2231																	
						OBS			1981																	
						Motor S.Trap	TECHNICAP	7212	2231																Novatech Beacon	V05-099
Sampling supplies	Sediment-trap 070	70	2231																							
ZAM1	18	14.44	37	52.21	1329	Currentmeter	RCM_11, extra batter	205	1119	1200	10034	27/03/2009	17:25	28/03/2009	09:12	Benthos	949	1C-enable								
						Measuring device	NIOZ 4MB Data-logger	ID:B3	1094																	
						Mooring supplies	Sediment trap Technicap PPS5/2	51	1094															557	8C-enable	
						Motor trap	Sediment Trap PPS	9-203	1094																	
						OBS			1094																	
						Carousel	PPS/5/2		1094										Beacon	Model 3721	ID: 1770					

Mooring rotation schedule

rotation schedule PP55		plus days/end	startdate
position #	time begin	18	3/15/09 0:05
1	3/18/09 0:05	4/5/09 0:05	MOZ5 - A1/B1
2	4/5/09 0:05	4/23/09 0:05	MOZ5 - A2/B2
3	4/23/09 0:05	5/11/09 0:05	MOZ5 - A3/B3
4	5/11/09 0:05	5/29/09 0:05	MOZ5 - A4/B4
5	5/29/09 0:05	6/16/09 0:05	MOZ5 - A5/B5
6	6/16/09 0:05	7/4/09 0:05	MOZ5 - A6/B6
7	7/4/09 0:05	7/22/09 0:05	MOZ5 - A7/B7
8	7/22/09 0:05	8/9/09 0:05	MOZ5 - A8/B8
9	8/9/09 0:05	8/27/09 0:05	MOZ5 - A9/B9
10	8/27/09 0:05	9/14/09 0:05	MOZ5 - A10/B10
11	9/14/09 0:05	10/2/09 0:05	MOZ5 - A11/B11
12	10/2/09 0:05	10/20/09 0:05	MOZ5 - A12/B12
13	10/20/09 0:05	11/7/09 0:05	MOZ5 - A13/B13
14	11/7/09 0:05	11/25/09 0:05	MOZ5 - A14/B14
15	11/25/09 0:05	12/13/09 0:05	MOZ5 - A15/B15
16	12/13/09 0:05	12/31/09 0:05	MOZ5 - A16/B16
17	12/31/09 0:05	1/18/10 0:05	MOZ5 - A17/B17
18	1/18/10 0:05	2/5/10 0:05	MOZ5 - A18/B18
19	2/5/10 0:05	2/23/10 0:05	MOZ5 - A19/B19
20	2/23/10 0:05	3/13/10 0:05	MOZ5 - A20/B20
21	3/13/10 0:05	3/31/10 0:05	MOZ5 - A21/B21
22	3/31/10 0:05	4/18/10 0:05	MOZ5 - A22/B22
23	4/18/10 0:05	5/6/10 0:05	MOZ5 - A23/B23
24	5/6/10 0:05	5/24/10 0:05	MOZ5 - A24/B24

rotation schedule HDW		plus days/end	startdate
position #	time begin	18	3/15/09 0:05
1	3/18/09 0:05	4/5/09 0:05	MOZ5 - A1/B1
2	4/5/09 0:05	4/23/09 0:05	MOZ5 - A2/B2
3	4/23/09 0:05	5/11/09 0:05	MOZ5 - A3/B3
4	5/11/09 0:05	5/29/09 0:05	MOZ5 - A4/B4
5	5/29/09 0:05	6/16/09 0:05	MOZ5 - A5/B5
6	6/16/09 0:05	7/4/09 0:05	MOZ5 - A6/B6
7	7/4/09 0:05	7/22/09 0:05	MOZ5 - A7/B7
8	7/22/09 0:05	8/9/09 0:05	MOZ5 - A8/B8
9	8/9/09 0:05	8/27/09 0:05	MOZ5 - A9/B9
10	8/27/09 0:05	9/14/09 0:05	MOZ5 - A10/B10
11	9/14/09 0:05	10/2/09 0:05	MOZ5 - A11/B11
12	10/2/09 0:05	10/20/09 0:05	MOZ5 - A12/B12
13	10/20/09 0:05	11/7/09 0:05	MOZ5 - A13/B13
14	11/7/09 0:05	11/25/09 0:05	MOZ5 - A14/B14
15	11/25/09 0:05	12/13/09 0:05	MOZ5 - A15/B15
16	12/13/09 0:05	12/31/09 0:05	MOZ5 - A16/B16
17	12/31/09 0:05	1/18/10 0:05	MOZ5 - A17/B17
18	1/18/10 0:05	2/5/10 0:05	MOZ5 - A18/B18
19	2/5/10 0:05	2/23/10 0:05	MOZ5 - A19/B19
20	2/23/10 0:05	3/13/10 0:05	MOZ5 - A20/B20

rotation schedule KUM41		plus days/end	startdate
position #	time begin	9	3/15/09 0:05
1	3/18/09 0:05	3/27/09 0:05	MOZ5 - A1/B1
2	3/27/09 0:05	4/5/09 0:05	MOZ5 - A2/B2
3	4/5/09 0:05	4/14/09 0:05	MOZ5 - A3/B3
4	4/14/09 0:05	4/23/09 0:05	MOZ5 - A4/B4
5	4/23/09 0:05	5/2/09 0:05	MOZ5 - A5/B5
6	5/2/09 0:05	5/11/09 0:05	MOZ5 - A6/B6
7	5/11/09 0:05	5/20/09 0:05	MOZ5 - A7/B7
8	5/20/09 0:05	5/29/09 0:05	MOZ5 - A8/B8
9	5/29/09 0:05	6/7/09 0:05	MOZ5 - A9/B9
10	6/7/09 0:05	6/16/09 0:05	MOZ5 - A10/B10
11	6/16/09 0:05	6/25/09 0:05	MOZ5 - A11/B11
12	6/25/09 0:05	7/4/09 0:05	MOZ5 - A12/B12
13	7/4/09 0:05	7/13/09 0:05	MOZ5 - A13/B13
14	7/13/09 0:05	7/22/09 0:05	MOZ5 - A14/B14
15	7/22/09 0:05	7/31/09 0:05	MOZ5 - A15/B15
16	7/31/09 0:05	8/9/09 0:05	MOZ5 - A16/B16
17	8/9/09 0:05	8/18/09 0:05	MOZ5 - A17/B17
18	8/18/09 0:05	8/27/09 0:05	MOZ5 - A18/B18
19	8/27/09 0:05	9/5/09 0:05	MOZ5 - A19/B19
20	9/5/09 0:05	9/14/09 0:05	MOZ5 - A20/B20
21	9/14/09 0:05	9/23/09 0:05	MOZ5 - A21/B21
22	9/23/09 0:05	10/2/09 0:05	MOZ5 - A22/B22
23	10/2/09 0:05	10/11/09 0:05	MOZ5 - A23/B23
24	10/11/09 0:05	10/20/09 0:05	MOZ5 - A24/B24
25	10/20/09 0:05	10/29/09 0:05	MOZ5 - A23/B24
26	10/29/09 0:05	11/7/09 0:05	MOZ5 - A24/B25
27	11/7/09 0:05	11/16/09 0:05	MOZ5 - A23/B25
28	11/16/09 0:05	11/25/09 0:05	MOZ5 - A240/B26
29	11/25/09 0:05	12/4/09 0:05	MOZ5 - A23/B26
30	12/4/09 0:05	12/13/09 0:05	MOZ5 - A240/B27
31	12/13/09 0:05	12/22/09 0:05	MOZ5 - A23/B27
32	12/22/09 0:05	12/31/09 0:05	MOZ5 - A240/B28
33	12/31/09 0:05	1/9/10 0:05	MOZ5 - A23/B28
34	1/9/10 0:05	1/18/10 0:05	MOZ5 - A240/B29
35	1/18/10 0:05	1/27/10 0:05	MOZ5 - A23/B29
36	1/27/10 0:05	2/5/10 0:05	MOZ5 - A240/B30

rotation schedule KUM41		plus days/end	startdate
position #	time begin	9	3/15/09 0:05
37	1/9/00 0:00	1/18/00 0:00	MOZ5 - A23/B30
38	1/18/00 0:00	1/27/00 0:00	MOZ5 - A240/B31
39	1/27/00 0:00	2/5/00 0:00	MOZ5 - A23/B31
40	2/5/00 0:00	2/14/00 0:00	MOZ5 - A240/B32
41	2/14/00 0:00	2/23/00 0:00	MOZ5 - A23/B32

recover	expected		
MOZ5	3/15/09 0:05	PPS5	PPS5
deploy	expected		
GLOW1	3/13/09 0:05	PPS4	
MOZ5	3/18/09 0:05	PPS5	KUM41
MUS1	3/19/09 0:05	PPS5	KUM41
ZAM1	3/31/09 0:05	HDW	
ship	Nov-09		
	late 2010		