Reference:
van Haren, H., 2007. Cruise report bsik/LOCO-IW07: R.V. Pelagia cruise 64PE279, 20 November - 16 December 2007, NIOZ, 48 pp.

Cruise Report

bsik/LOCO-IW07

R.V. Pelagia cruise 64PE279
20 November – 16 December 2007
Funchal (Madeira, P) – Fortaleza (Ceara, B)

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(with contributions from participants)

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(Photo: F. Overes)

0. Contents

1. Summary of R/V Pelagia LOCO-IW07 cruise

In November/December 2007 the R/V Pelagia (NIOZ, The Netherlands) sailed to the Canary, Cape Verde and Brazil (Ceara) Basins (North-Atlantic Ocean), mainly to recover and deploy long-term moorings within Long-term Ocean-Climate Observations (‘LOCO’) and BSIK. LOCO is a large investment program funded by N.W.O., the Netherlands Organization for the advancement of scientific research. It aims to investigate ocean physics process variations on time scales of years using long-term moorings. In the deep North-Atlantic basins we study detailed variations in waves in the ocean interior (‘internal waves‘, IW), especially the most energetic ‘near-inertial’ waves, and their impact on deep-ocean mixing and the large-scale ocean circulation. In some details, tidal IWs are studied above underwater seamounts. A portion of BSIK-funding is reserved for earth climate systems and the influence of variations in the ocean therein.

The main working area of LOCO-IW is the abyssal plain in the Canary Basin near 30º N, 23º W (~5200 m depth), with extensions to the Cape Verde Basin and, during this cruise, to the Brazil Basin. In May/June 2006 eight long moorings were deployed for the duration of 1.5 years between 15º and 33º N, roughly along 23º W. The long moorings reached up to 4000 m above the bottom. They consisted of 5 current meters sampling generally once per 15 minutes. Five moorings also carried a 75 kHz acoustic Doppler current profiler (ADCP) in the top buoyancy element. During LOCO-IW07 all moorings were successfully recovered and with some instrumental failure, the net result was 80-85% good data. A special result was obtained from NIOZ-built accurate thermistor string #3 sampling at 1 Hz: 49 out of 53 sensors sampled 1 year of data providing very detailed internal wave information.

The eight long moorings were re-deployed. Three remained in the Canary Basin and five were deployed near the equator in the Brazil Basin to study internal waves and other near-equatorial current variations in a region of dramatic Coriolis force change. Three short-term moorings were put on two ridges in the Brazil Basin. During the cruise several conductivity-temperature-depth (CTD) profiles were obtained in conjunction with lowered-ADCP (LADCP) to map the finescale and background hydrography. CTD-LADCP and ship’s winches worked flawlessly. Some problems were encountered using Multibeam, the detailed mapper of the seafloor. Finally, seismics airguns and receiver-array was towed over an underwater seamount to monitor small-scale internal waves and wave-beams, but final results require extensive post-processing.

The cruise was successful. Weather conditions were reasonably good causing no delays. All overboard operations went well, including the recovery and deployment of the long moorings. Their re-deployment was never further than 100 m from the intended latitude, very well within the aim. And, the R/V Pelagia arrived for the first time ever in South-America.

2. General research aim.

LOCO

The N.W.O.-financed large investment program Long-term Ocean-Climate Observations (LOCO) aims to carry out some regional experiments which are required for the development of an ocean observation system for CLIVAR and other related global monitoring programmes. The instruments will be used to obtain long-term observations of the current field and transport of heat and fresh water in some critical areas of the global ocean circulation and of processes in the ocean interior providing energy for diapycnal mixing, for example due to internal waves, a key parameter in controlling the large scale circulation. In order to observe low-frequency variations these moorings will be deployed for periods of at least 3 to 7 years, so that also variations due to the El-Niño cycle and the North Atlantic Oscillation may be covered. The experiments with moored sub-surface measuring systems build upon previous WOCE (World Ocean Circulation Experiment) and CLIVAR projects, carried out by Dutch oceanographers. It will extend existing time series and/or monitoring programs and will be carried out in the framework of internationally coordinated research.

LOCO-IW

Within LOCO two sets of four moorings will be used to study in more detail the climatological mean of spatial and temporal variability of internal-wave intensity. This will be done for different types of basins (above sloping topography and far away from boundaries in deep-ocean basins). The first set of these moorings will be located for medium-long periods (~1½ years) at mid-latitudes in the North Atlantic Ocean, and the second set near the LOCO-throughflow sites in the Irminger Basin, the Cape Verde Basin towards the Equator to study specific processes like near-inertial wave propagation. Together these sites are exemplary for most internal wave appearances.

LOCO-IW Canary Basin

The purpose of the LOCO-IW07 cruise is to study the climatologic effects of internal waves on the deep-ocean. Specifically, we study near-inertial internal motions generated by atmospheric disturbances and those by diurnal tides (~30° N). During the cruise 8 moorings are recovered and 11 (re)deployed. Most moorings extend 3.7 km above the bottom (~1.5 km below the sea surface). These moorings contain current meters and temperature sensors. The moorings will remain in position for 1.5 years. In addition, short-term hydrographic and mixing information will be collected using CTD, LADCP and fast-sampling moored instruments. New for NIOZ are attempts of seismic oceanography.

3. LOCO-IW07 overview.

Internal wave mixing is thought to be the key in maintaining the general ocean circulation, induced about half by tidal motions and half by atmospheric (wind) induced (inertial) motions. As sinusoidal waves do not mix, non-linear interaction between internal waves is assumed to transfer energy to smaller scales, eventually leading to wave breaking, and mixing. Near-inertial internal waves are considered to be important because of their strong shear, tidal motions because of persistent generation and focusing in basins. Recent observations over the abyssal plain in the Bay of Biscay (van Haren et al., 2002) suggest that non-linear interaction between internal waves occurs not only in topographically-dominated areas, but, due to the presence of strong, deep-ocean near-inertial motions, also well away from sloping boundaries. During this cruise of LOCO the aim is on studying the variability with time of deep-ocean near-inertial and internal tidal motions in an area (Fig. 1) where deterministic (diurnal tidal) forcing of near-inertial motions may be important. Also, at these ‘diurnal critical latitudes’ energy at the diurnal tidal/inertial frequency may be enhanced due to transfer of energy from semidiurnal tidal frequencies to smaller scales at half their frequency via parametric subharmonic instability (PSI). The associated reduction in vertical scales may imply larger shear-induced mixing. Secondly, an important focus is on the equatorial region where important ocean dynamics change because the vertical component of the Earth’s rotation (Coriolis force) becomes very small.

Most moorings are above the abyssal plain, but some of the attention is focused on near-equatorial underwater mounts using short-term moorings equipped with high-sampling rate instruments. There, vigorous non-linear breaking waves can occur (van Haren, 2005a).

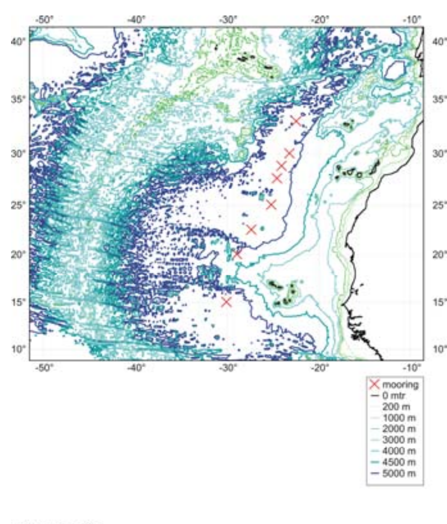

Fig. 1. Map of the Canary-Cape Verde Basin with 8 moorings to be recovered during LOCO-IW07.

LOCO-IW moorings

An array of eight long (~3.7 km) moorings LOCO11-18 were deployed during previous cruise LOCO-IW06 along the central axis of the Canary-Cape Verde Basin (~5 km deep) halfway between the continental slope and seamounts of the Mid-Atlantic Ridge (Fig. 1; Table 1). During the LOCO-IW07 cruise 3 are re-deployed in the Canary Basin and 5 moorings are relocated to positions close to the equator, north of Brazil.

Table 1. Mooring positions LOCO-IW06, ARGOS and local inertial frequencies f (with harmonic diurnal tidal names between brackets). Depths are echo sounder estimates.

Mooring	*Latitude*	*Longitude*	*depth*	*f*
LOCO11/3	33°00.010'N	022°24.406'W	5274 m	1.092260 cpd
LOCO12/3	29°59.948'N	023°04.841'W	5139 m	1.002711 cpd (K_1)
LOCO13/3	27°36.737'N	024°29.802'W	5146 m	0.929510 cpd (O_1)
LOCO14/3	28°47.992'N	023°59.620'W	5110 m	0.966142 cpd (M_1)
LOCO15/3	25°29.958'N	024°52.696'W	5158 m	0.863367 cpd
LOCO16/3	22°29.615'N	027°18.965'W	5396 m	0.767255 cpd
LOCO17/3	19°59.977'N	028°48.383'W	4908 m	0.685900 cpd
LOCO18/3	14°59.870'N	030°00.304'W	5390 m	0.518981 cpd

As part of the aim is to study inertial internal wave motions near the latitude where their frequency is close to diurnal tidal frequencies, some of the moorings are located sharply at and very close to those corresponding to tidal harmonic frequencies (Table 1). The distances between moorings and inertial-half-tidal latitudes are less than theoretical predictions on near-inertial wave propagation from the surface down- and equatorward in a flat ocean (Garrett, 2001; ~300 km) or prediction on down- and poleward propagation of near-inertial waves focusing on a spherical shell (Maas, 2001). The former theory seems an overestimate as it predicts a shift of ~5-9% in inertial frequency between surface and bottom, whilst preliminary analysis on data from IfM Kiel (Siedler and Paul, 1991) shows vertical frequency shifts much less than this (van Haren, 2005b).

The moorings are designed to have minimal deflection in the vertical and horizontal, using ellipse shaped main buoyancy elements and a thin (6.5 mm diameter) mooring cable. For typical speeds of 0.15 m s^{-1} the expected maximum deflection will be 3-4 m in the vertical and ~100 m in the horizontal (or <0.01%f when in latitudinal direction, well within the frequency resolution of 0.002 cpd or 0.2%f after 500 days of deployment). See Fig. 2.

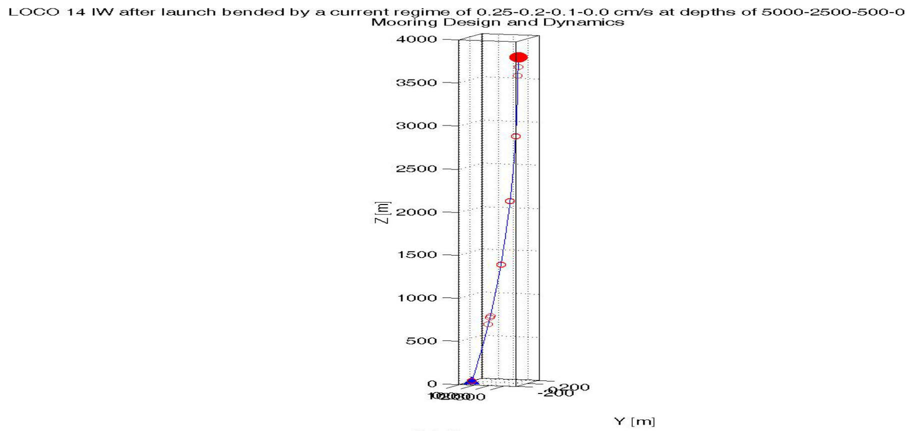

Fig. 2 Mooring deflection as computed by T. Hillebrand using program package designed by R. Dewey (UVic, Canada).

The moorings basically contain ~5 current meters that are more or less evenly distributed along the mooring line, so that currents and temperature can be monitored across a large range in the vertical (Appendix A). For the Canary Basin, the distribution of the current meters is chosen after inspection of deep CTD-data obtained during previous cruises (Fig. 3). These profiles show a strong pycnocline near 100 m, a nearly constant intermediate stratification between 100-1000 m, steplike density profile (partially due to double diffusive mixing) between 800-2000 m and decreasing stratification below 2000 m, with sometimes negligible stratification (N = 0) between 4000 and 5000 m. Current meters are planned in the step-profile layer and in the N → 0 layer, besides the even distribution over the mooring line.

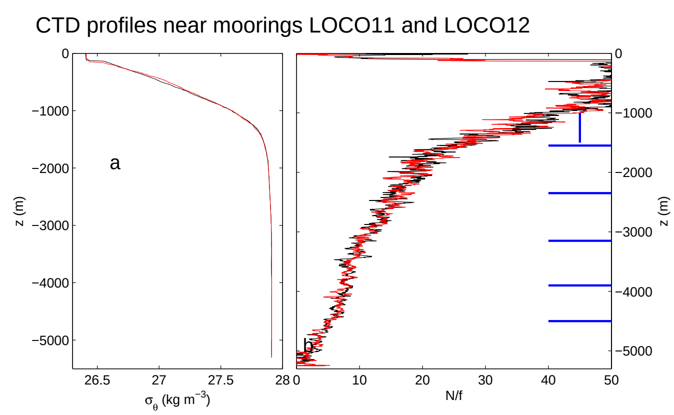

Fig.3. a. Density anomaly and b. 40 m smoothed stratification with depth. Horizontal lines indicate proposed current meter locations; vertical line shows the range of the ADCP.

In the top of two moorings a 75 kHz ADCP is deployed, so that ~20 m vertical shear (relevant for mixing induced by shear instability) is resolved over a range of ~500 m.

The instruments are adapted for long-term monitoring (extra batteries and, for some, extra memory). They are programmed to last 1.5 years whilst sampling relatively fast, at least once/30 min, generally once/15 min, to resolve most of high-frequency internal wave motions in the deep ocean (where the buoyancy period is typically 60 min or more below 1500 m (and ~30 min at 1000 m). The bulk of the current meters are acoustic measurement devices, like the ADCP. All such devices rely for good data on particles (plankton, suspended sediments) in the water for sufficient s/n ratio. Presently, these instruments are reasonably robust in their performance, but, unfortunately, their deep-ocean s/n allows some limited internal wave band resolution of only up to 5(10) cpd (cycles per day). In contrast, mechanical current meters can resolve frequencies up to about their Nyquist frequency (~20-40 cpd), but these instruments do rely on sufficiently strong currents (>0.02 m s^{-1}) and risk entanglements with floating material like lines etcetera.

Additional measurements

CTD and lowered-ADCP (LADCP) measurements provide indirect estimates of deep-ocean shear and mixing (eddy diffusivity) all the way to the bottom, albeit to a limited vertical resolution (~25 m) and, of course, limited temporal resolution. These measurements are made near most moorings, on a transect along 38°W (0-2°N) near the equator and when crossing the Mid-Atlantic Ridge.

Along the transect in the near-equatorial region a detailed geostrophic balance study is performed on the breakdown of classic thermal wind (traditional Coriolis force) balance. Across small underwater mounts in the area attempts are made to monitor small-scale internal wave motions and beams using ‘seismic oceanography’ equipment, a novelty for NIOZ and relatively new internationally. Here, it is specifically also used to monitor changes in mixing and internal wave propagation in the narrow equatorial band. During these measurements fast-sampling instruments are moored near the top of two other seamounts on a bottom lander with a 2GB-300 kHz ADCP, an accurate pressure sensor, NIOZ thermistorstring #3, NIOZ1 prototype of differential pressure sensors, 2 current meters, and, on separate moorings, a 600 kHz ADCP and two 75 kHz ADCP’s.

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NIOZ departments

FYS	physical oceanography
MTE	electronics
MTM	sea technology
DMG	data management group

5. Data acquisition and instrumentation.

a. LOCO-IW07 (/4) moorings (Appendix A for diagrams).

All eight large moorings **(LOCO11/4-18/4)** have two ellipse-shaped buoyancy elements near the top, of which the upper also holds an ARGOS-satellite beacon. About 5 m above the steel weight (500-700 kg) two IXSea acoustic releases are mounted. Most current meters (CM) are acoustic Aanderaa RCM-11 and Nortek AquaDopp, with the upper mainly being a mechanical Valeport BFM308. We had problems with this current meter in the past (leakage, explosion, but after modification and re-guarantee to 2000 m only one exploded and some impellors were blocked). As the moorings will be in position for 1.5 years, the RCM-11 sample at once per 900 s (15 min; if machines are not modified to have this option they run at once per 20 min), the Valeport at once per 5 min and the AquaDopp at once per 15 min, with burst sampling at 1 Hz once per day.

Moorings **LOCO11/4, 12/4, 14/4, and 18/4** contain an upward looking 75 kHz ADCP in the top buoy whilst **16/4** a downward looking. The range of the ADCPs will cover 500 m of the water column every 10 m vertically, between 1000-1500 m (**11/4 and 12/4**) and 500-1000 m (**14/4 and 18/4**). It samples once per 900 s (15 min). Mooring **LOCO16/4** holds 51 NIOZ-3 sensors on a 285 m long cable between the two ellipse buoys. Therefore, the ADCP is mounted downward looking, with a range between ~1000-1500 m.

Positioning of moorings is done like during LOCO-IW03, IW04 and IW06: starting about 3-4 km East or West of the intended longitude and sailing along a fixed latitude at a speed varying between ~0.5 knot (when instruments are attached and put overboard) and ~1.5 knots (when line is paid out). Release of anchor can be suspended by continuing to sail to the intended position. On average, the final position of the anchor is about 300 m behind the ship's position at the moment of release of the anchor, because of the retarded swing and the bent line during towing (Fig. 4), and within ±100 m north/south of the sailed latitude. The drop speed of the weight reaches nearly 3 m s^{-1}, before slowing down to just over 1 m s^{-1} when the buoys are pulled under water, so that the bottom landing is fairly smooth.

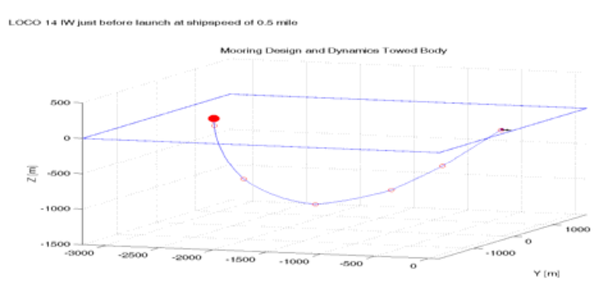

Fig. 4. Estimated mooring line at moment of release of anchor (acc. progr. R. Dewey,Uvic Canada).

Photo (F. Overes): Elliptically shaped buoy with ADCP and ARGOS beacon.

b. DOC07 moorings

DOC07-1 is a separate mooring with the NIOZ-3 high-sampling rate thermistor string, which is moored at ~1100 m on the northern slope of a near-equatorial Seamount (~0.7°N, 39.9°W). The instrument, below a ~200 kg elliptic buoy and a Nortek CM is attached to NIOZ mix-BB002 bottom lander holding a 300 kHz RDI Sentinel, with 2 GB memory and 2 extra battery containers, a precision SBE53 pressure sensor, a prototype NIOZ1 differential pressure sensor and a Nortek CM. The purpose of the equipment is to sample during 10 days at a fairly high temporal (1 Hz) and spatial (0.5 m) resolution the water temperature, pressure and currents above the top of a deep steep slope. In order to associate the temperature variations to density variations a proper estimate of the temperature-density relationship is required by some local CTD calibration sampling.

DOC07-2 is a separate mooring with two 75 kHz ADCP's, one upward looking, the other downward, to monitor the high-frequency shear variability over a large range (nearly surface-bottom). This mooring is located near DOC07-1, but slightly deeper (~1450 m; ~0.8°N, 39.8°W).

DOC07-3 is a separate mooring with a 600 kHz ADCP, to observe the high-frequency shear variability at high resolution above another Seamount. This mooring is located 100 m above the bottom, at 1700 m; ~1.3°N, 39.2°W).

Photo(F. Overes): NIOZ bottom lander mixBB-002.

c. Shipborne sampling

The Pelagia CTD/Rosette system contains a Seabird 911-*plus* Conductivity Temperature Depth sensor, with a Seapoint STM Optical BackScatterer (OBS). The CTD samples at a 24 Hz rate. The Rosette frame holds a down- and an upward looking 0.3 MHz RDI ADCP, together forming the LADCP. On this frame NIOZ3 high-sampling rate thermistor string is mounted four times for its in-situ calibrations.

d. Seismic oceanography

A relatively new tool for oceanographic semi-synoptic observations is the use of seismic reflections in the water column (Fig. 5). Such reflections on density (temperature) variations are weak, but in principle detectable when a multi-receiver array is used. If so, they provide a resolution of about 10x10 m. The NIOZ 5-airguns array will be used, totaling ~100 inch^3, together with a 24-receivers streamer array. Using this tool for oceanographic purposes is new for NIOZ. In its test-phase we use it to study internal waves over the Mid-Atlantic Ridge and near the equator.

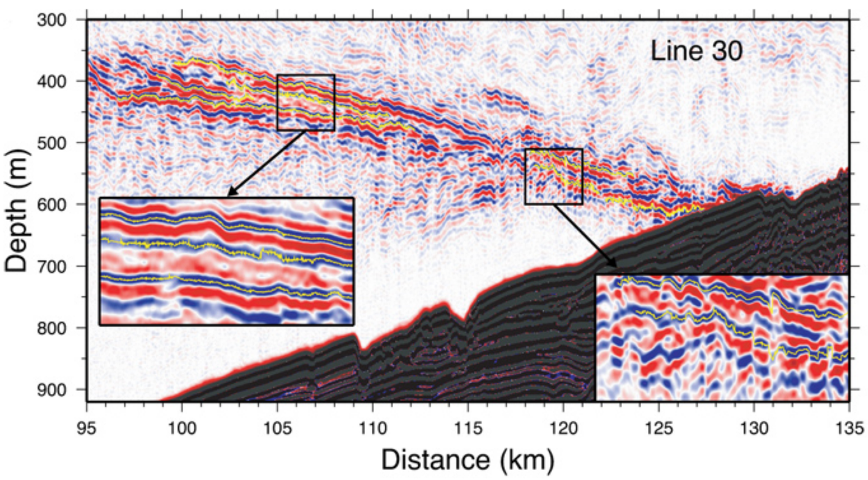

Fig. 5. Internal "wave" observations using seismic oceanography (Holbrook and Fer, 2005).

e. Argo floats

Four deep Argo floats will be dropped for KNMI (Royal Netherlands Meteorological Institute). Argo floats drift freely and autonomously measure a T/S profile between 0-2000 m every 10 days.

6. Daily summary of LOCO-IW07.

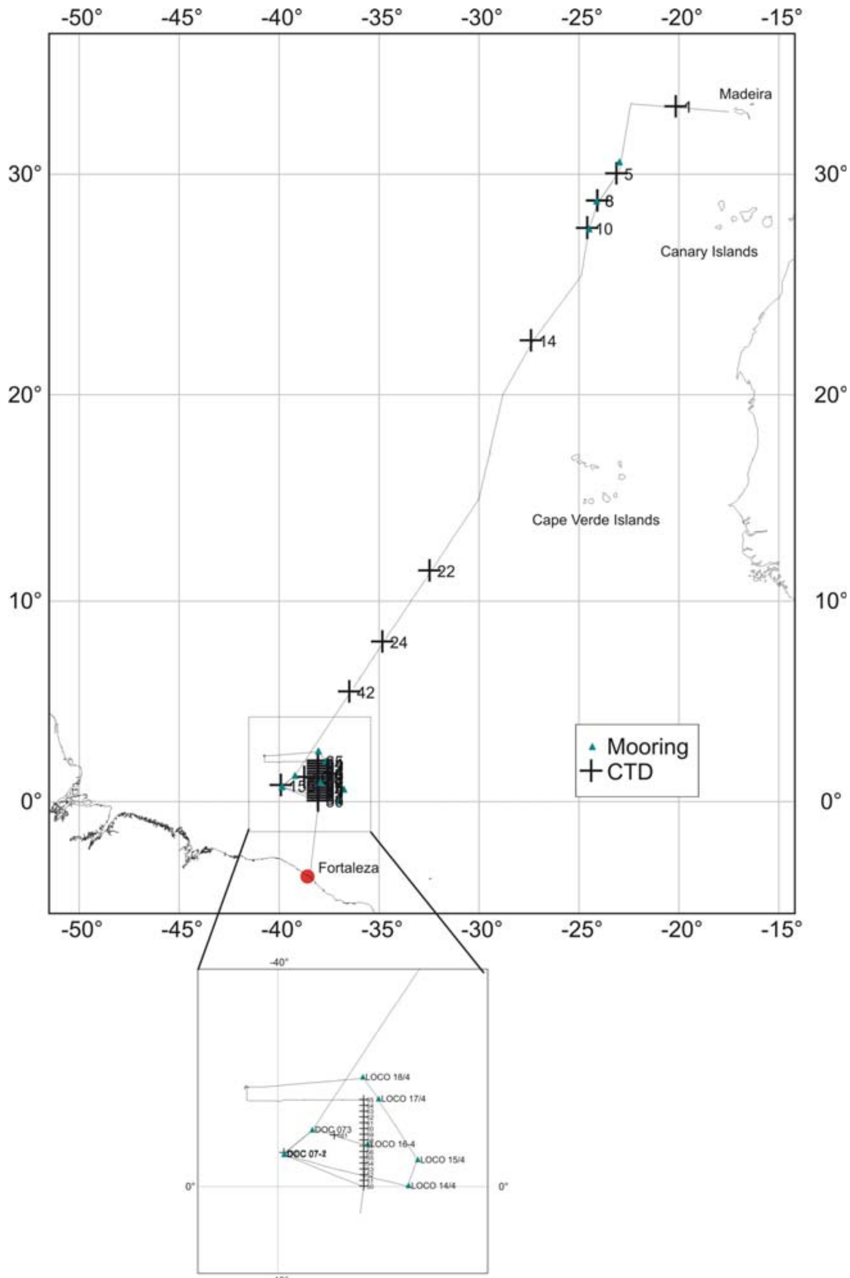

Fig. 6. LOCO-IW07 cruise track and activity locations (M. Hiehle).

Tuesday 20 November

20 UTC. Departure from Funchal, Madeira. WNW4, some swell and showers.

Wednesday 21 November

N3. Transit to Canary Basin. 14 UTC first CTD/LADCP.

Thursday 22 November

N3-5. Successful recovery of mooring LOCO11/3.

Friday 23 November

NE3-4. 08 UTC Successful deployment of mooring LOCO11/4. In the afternoon followed by successful recovery of LOCO12/3 and CTD/LADCP. ARGO float (KNMI) deployed near 30N, 24W. 20 UTC calibration thermistorstrings. Of each string about 10% of the sensors fail (90% good).

Saturday 24 November

ENE4-6. Springtide. 08 UTC. Successful deployment of mooring LOCO12/4. In the afternoon followed by successful recovery of LOCO14/3 and CTD/LADCP with calibration of thermistor string.

Sunday 25 November

E5. 08 UTC. Successful recovery of LOCO13/3, followed by CTD/LADCP and successful deployment of LOCO13/4.

Monday 26 November

ENE5. 08 UTC. Successful recovery of LOCO15/3.

Tuesday 27 November

E6. 10 UTC. Successful recovery of LOCO16/3. CTD/LADCP. Test seismics shows the signal clearly at an underwater hydrophone. Fine-tuning of guns.

Wednesday 28 November

E5. 13 UTC. Successful recovery of LOCO17/3. ARGO float (KNMI) deployed near 20N, 29W. Regular flying fish sightings.

Thursday 29 November

ENE5. 08 UTC. Test seismics. Problems with streamer-array, only 12 of 24 channels (hydrophones) operational.

Friday 30 November

ENE4-5. 08 UTC. Successful recovery of LOCO18/3. ARGO float (KNMI) deployed near 15N, 30W. 24 UTC change shiptime to UTC-2 h, scientific time remains UTC.

Saturday 01 December

ENE4-6. 12 UTC. CTD/LADCP.

Sunday 02 December

E3-5. 02 UTC. Argo float (KNMI) put overboard 10N, 33W. 17 UTC CTD/LADCP.

Monday 03 December

Var1-2. 08 UTC. Seismics, successful track. 16 XBT launched. 21 CTD/LADCP+ calibration thermistor string. 23 UTC. Argo float (KNMI) put overboard 05N, 36W.

Tuesday 04 December

SSE2-6. Steaming (<9 knots).

Wednesday 05 December

SE3-5. 09 UTC. Deployment of mooring DOC07-3. Multibeam map of small underwater ridge. 16 UTC Deployment of DOC07-2, DOC07-1. Sinterklaas pays us a visit.

Thursday 06 December

ENE2-4. 12:42 UTC. Start CTD-transect [0, 2]°N along 38°W, 16 stations at 8' distance.

Friday 07 December

ENE4-5. Continue CTD-transect. Some winch problems, lower set of wheels of heave-compensator make cracking sounds. 22-01 UTC. Stop CTD-transect for dismantling cable from heave-compensator.

Saturday 08 December

ENE4-5. Continue CTD-transect.

Sunday 09 December

E3-5, springtide. 01:30 UTC. End CTD-transect. Steam in direction of unknown seamount, dubbed Mont Louis. 17 UTC start seismics work, three times crossing Mont Louis (summit at 02° 17.7'N, 40° 44.7'W, 1250 m in 4500 m flat surroundings as nicely visible in Multibeam-data).

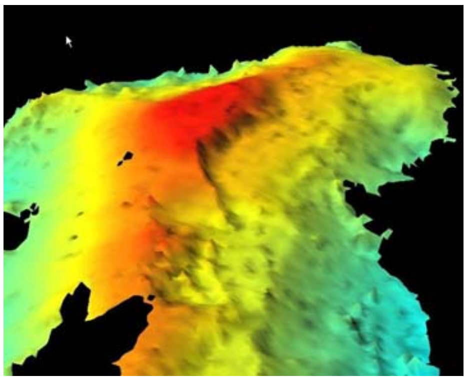

Fig. 7. Mont Louis, vu de sud-est, données Multi-beam (M. Hiehle).

Monday 10 December

ESE3-7., heavy rainshowers. 13 UTC. End seismics.

Tuesday 11 December

SE4-5. 08:30 UTC. Deployment mooring LOCO18/4, in afternoon followed by deployment of mooring LOCO17/4.

Wednesday 12 December

ESE4. 10 UTC. Deployment mooring LOCO15/4 which is being filmed from zodiac for the first time. Afternoon deployment of mooring LOCO14/4.

Thursday 13 December

ESE3-5. 14 UTC. Recovery of mooring DOC07-1. Initially the lander remains at position, which is not well noticed as ship drifts away swiftly during pinging. Lander drops weight only after second release decoupling. Later it turns out that the lander was on a 20° slope, unfortunately. No ADCP data. Late-afternoon quick recovery of mooring DOC07-2, followed by a CTD-calibration of thermistor string.

Friday 14 December

E6-7, wind is picking up, few showers where many are predicted. 08:15 UTC. Successful recovery of mooring DOC07-3. Mid-day CTD-calibration of thermistor string. Late-night deployment of mooring LOCO16/4, the last action of this cruise.

Saturday 15 December

NW3. 15 UTC. Neptune pays us a visit.

Sunday 16 December

16 UTC (13 LT). Arrival Fortaleza, R/V Pelagia for the first time in Brazil, also for the first time ever in South-America.

7. Scientific summary and preliminary results

a. Long-term mooring recoveries.

All recoveries were done by approaching the buoy from the starboard side, with a line from the stern-winch laid out on the starboard side to the side-winch. From the side-winch deck a small dredge was thrown to catch the line between a small float and the surface buoy. This 20 m line was sufficient and easy to catch. The detachment of the large elliptical buoys from the mooring line was fairly easy due to the chain below the upper buoy and on both sides of the inline buoy. This chain could be shorter than the ~2 m used (preferably ~1 m).

All eight moorings deployed during LOCO-IW06 were successfully recovered. The instrumental performance was good (see Table 2). No bio-fouling was found, only one ARGOS-satellite beacon flooded and no corrosion was observed at IXSea (Oceano) acoustic releases. Of most moorings only one release responded immediately, the other only after several attempts or not at all.

The mooring design will not be changed, as the present taught-wire design is very successful: we learned from the tilt- and pressure sensors in ADCP’s and AquaDopp’s that the moorings never tilted more than 2°. As a result maximum deviations due to current drag were 2 m in the vertical and 130 m in the horizontal, which is extremely good and much better than model estimates (cf, Fig. 3). In addition, pressure decreased some 1-4 m gradually over time. This is attributed to stretching of the mooring, by about 1 mm/m, over a period of ~100 days.

Of the 47 instruments deployed, 46 current devices and one thermistor string, 37.5 worked more or less flawlessly, as intended and 6 definitely failed. Of the remaining 3.5, the half stands for about half of the themistor string sensors, the data were noisy, but repairable to within certain limits. Counting this for 1 failure, we arrive at a result of 85% good data, a high percentage. Conservatively estimated, a result better than 80% is obtained.

Of the different types of current meter devices, the mechanical Valeport BFM-300 series gave better data, but the instrument is not enticingly reliable. Again, one instrument exploded and at least 2, perhaps 3, of 6, showed impellor problems, making intercomparison difficult. All acoustic instruments were noisier than the mechanical current meter. Of these, Aanderaa RCM-11 was least noisy and only 1 of 23 instruments failed. Moderately noisy was the more attractive Nortek Aquadopp, with unacceptable large noise in 1-3 instruments, of 13 used. Most noise was encountered at the deepest instruments. All AquaDopp’s showed variable levels of necessary amplitude corrections, with a minimum factor of 1.16. On the other hand, the advantage of this instrument remains in: better clocks, vertical currents (upper instruments only) and indispensable tilt and pressure information besides a better temperature resolution.

Strangely, its echo information is useless. The most noisy 75 kHz RDI-ADCP failed once, due to a failing circuit-board, and provided basically only good horizontal current data in half a decade internal wave band, with additional data on near-buoyancy frequency vertical currents and echo intensity data. The important feature of 10-m shear extended only above noise level in the inertial band.

Table 2. Data return of IW06 moorings.
CM-abbreviations: A=Aanderaa; N=Nortek; R=RDI; V=Valeport.
Sensors, A:C,R,T; R: C,R,T,p,tilt.
(C=speed, R=direction, T=temperature, p=pressure).

Moorings deployed May/June 2006, recovered during LOCO-IW07

Mooring	**Instrument**	**Serial#**	**depth [m]**	**sampl. int. [s]**	**remarks**
LOCO11/3	R 75 kHz ADCP	3174	1350	1800	TML 10m; DOWNL.
	54 s. NIOZ3	1	1353	1	49 1yr
	A RCM11	188	1460	900	T low
	N AqDop	286-4/2	2300	900	
	A RCM11	189	3050	900	T arctic
	A RCM11	190	3800	900	T arctic
	N AqDop	286-1/2	4550	900	*very noisy*
LOCO12/3	R 75 kHz ADCP	5945	1250	1800	*Failed*
	A RCM11	200	1350	1200	T low
	A RCM11	48	2150	1200	T arctic
	A RCM11	240	2900	1200	T arctic
	A RCM11	123	3650	1200	T arctic
	A RCM11	36	4250	1200	T arctic
LOCO13/3	VBFM308	20643	1150	300	many 0 speed
	VBFM308	20636	1650	300	*too many 0 speed*
	N AqDop	252-2/4	2350	900	
	A RCM11	406	3100	900	T arctic
	A RCM11	415	3850	900	T arctic
	N AqDop	286-2/2	4450	900	
LOCO14/3	R 75 kHz ADCP	3175	1650	1800	TML 10m
	VBFM308	23121	1750	300	*exploded*
	N AqDop	252-1/4	2450	900	
	A RCM11	416	3200	900	T arctic
	A RCM11	414	3950	900	T arctic
	N AqDop	286-3/2	4550	900	noisy
LOCO15/3	VBFM308	23120	1500	300	many 0 speed
	VBFM308	20637	1502.5	300	impellor bit stiff
	N AqDop	286-8/2	2200	900	
	A RCM11	202	2950	1200	T arctic
	A RCM11	132	3700	1200	T arctic
	N AqDop	286-7/2	4450	900	noisy

LOCO16/3	R 75 kHz ADCP	3550	1500	1800	TML 10m
	A RCM9	341	1600	1200	*3 days data*
	N AqDop	20126-3	2300	900	
	A RCM11	404	3050	900	T arctic
	A RCM11	405	3800	900	T arctic
	N AqDop	286-6/2	4600	900	noisy
LOCO17/3	VBFM308	20641	1550	300	
	N AqDop	20126-4	2250	900	
	A RCM11	408	3750	900	T arctic
	A RCM11	417	4350	900	T arctic
LOCO18/3	R 75 kHz ADCP	6778	1400	1800	TML 10m
	A RCM11	44	1500	1200	T low
	N AqDop	20126-1	2200	900	
	A RCM11	192	2950	900	T arctic
	A RCM11	193	3800	900	T arctic
	N AqDop	20126-2	4600	900	noisy

The perfect positioning of the moorings, so that anchor locations are known to within 10 m horizontally and less than 100 m from intended latitude, makes any changes in inertial frequency easily verifiable to within the spectral resolution. Also, the 2 s per day variation in RCM-11 clocks falls well within the spectral resolution. Nevertheless it is nicer to have more precise clocks, like in other instruments. Clock variations are verified using the major semidiurnal tidal constituent M_2. Sample spectra show common internal wave kinetic energy spectra with familiar large peaks at tidal, inertial and higher harmonic frequencies (Fig. 8a). With increasing depth, stratification decreases and so does the kinetic energy across the entire spectrum (down to the white noise level). This is accompanied by a shift in inertial peak frequency. In general the known internal wave polarization was well-measured (Fig. 8b), the shift near the inertial frequency is unlikely due to barotropic diurnal tidal currents and continues to be investigated. Peculiar is the large change in semidiurnal tidal polarization between the two depths that is probably related to topography.

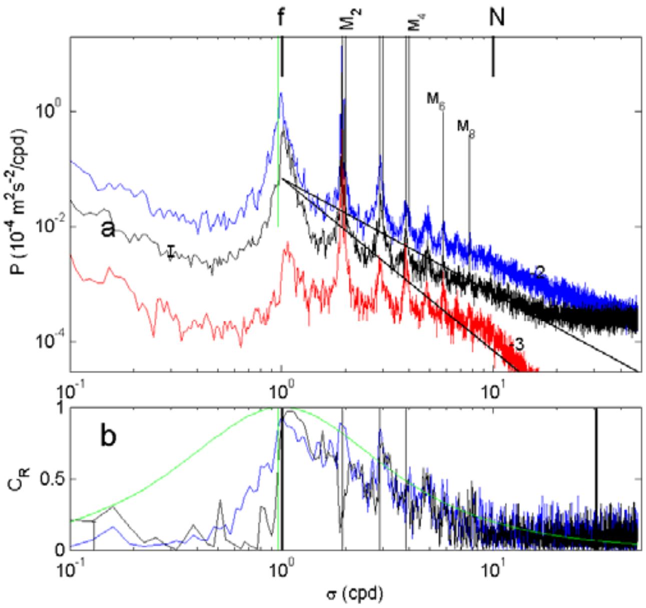

Fig. 8. a. Kinetic energy spectra of current meters near 1400 m (blue) and 3000 m (black) in mooring LOCO11/2. In red temperature from 3000 m. b. Smoothed rotational spectrum of currents in a. In green the symmetric theory for symmetrically forced waves, in the internal wave band for frequencies larger than f (van Haren, 2003 for definitions).

b. NIOZ3 thermistor data

For the first time, 1.5 years of deep- and open-ocean temperature data have been obtained, sampled at a rate of 1 Hz and resolving 2.5 m over a range of 135 m in the vertical. The results are in some respects amazing (Fig. 9). Of the 54 sensors, 22 continued perfectly on time throughout the entire period. Only 5 sensors provided records shorter than 1 year. Although, and somewhat disappointing, turbulent events are scarce and probably not well resolved vertically, the most eye-catching features are i) the non-linearity, steppiness in individual temperature time series, ii) (low)mode-1 in all motions that are dominated by a) near-buoyancy and b) tidal motions, iii) regular, but all of a sudden occurring, splitting of layers with apparent static instabilities in temperature (Fig. 10), probably compensated by salinity, a few moments later again resuming their appearance as before, perhaps due to advection, iv) typical layering, v) a one-two decades extension of the ocean spectrum, vi) a different set of spectral slopes, none of them matching a -2 slope: the IW-band is narrow, one decade, and slopes at -1, followed by -5/3, then about -3 and again -5/3 before the Nyquist frequency. These slopes match the slopes observed in kinetic energy by Valeport current meters. In NIOZ3 temperature series, a weak inertial peak is observed(?) and tidal and far sub-inertial peaks dominate. At larger scales an enormous warming is found at some point in record:

Mediterranean water? This will be one of the subjects requiring further investigations also using ADCP-data.

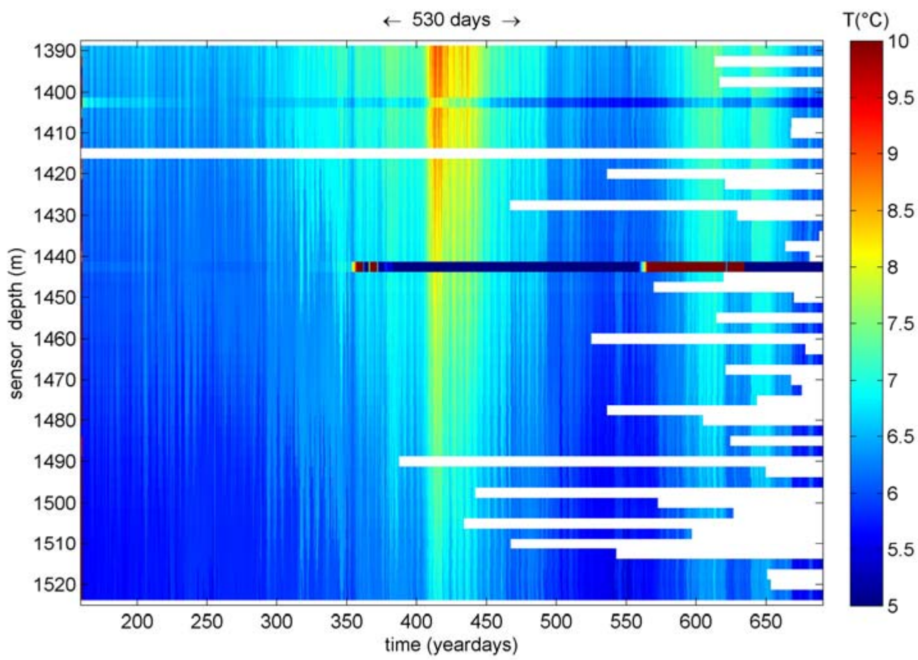

Fig. 9. Overview of 1.5 years of NIOZ3 temperature data from mooing LOCO11/3. In white no data.

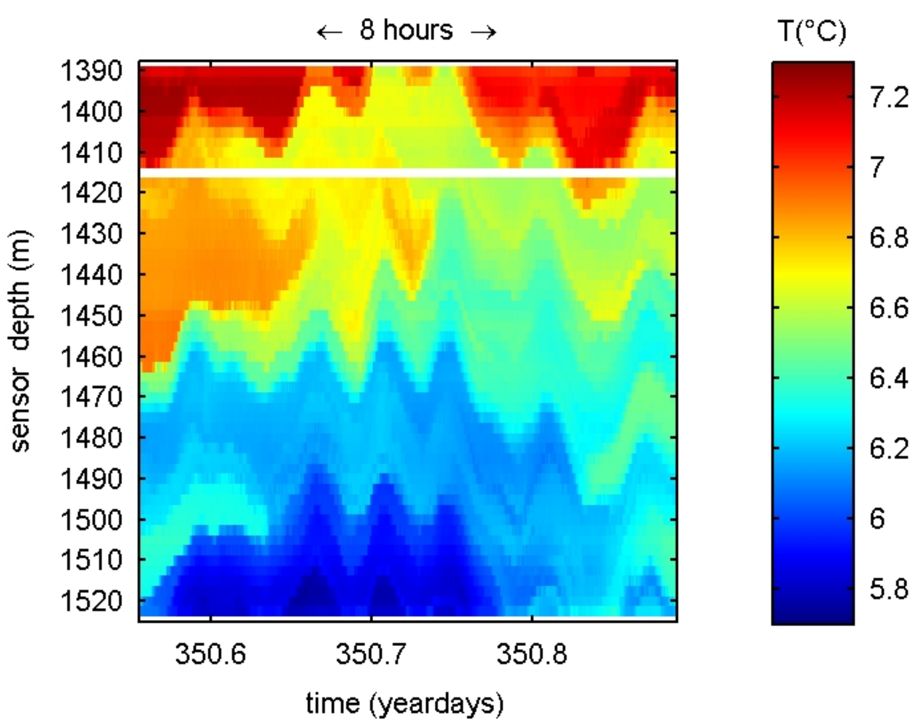

Fig. 10. Detail from Fig. 9.

c. Short-term mooring deployment and retrieval

Bottom lander **DOC07-1** was moored for 8 days near the top of the eastern slope of a little Searidge (Table 3). All instruments worked pretty well, except for the ADCP: the lander was on a 20°-slope, unintended, and the instrument shut down during most of the time. The NIOZ-3 thermistor string (90 sensors at 0.6 m intervals plus another 10 at 15 m intervals) returned 95% good data during the entire period, but problems occurred with the calibration (Fig. 11). The data are somewhat bizarre as warm water is moving under cold water (Fig. 11), an inversion problem. Note the small temperature range whilst still all details visible. The CM and the pressure sensor provided the full suite of data. The test-seaguard worked well, except that the battery expired one day too early.

The two instruments on mooring **DOC07-3** seemed to have worked well, except that the upward looking instrument stopped a day short of the intended period. Batteries were not flat, however. Closer inspection demonstrated that this instrument also has a coordinate transformation problem, and it turned out that both instruments were always in UP looking mode even though the lower was pointing down. The downlooking instrument was noisier, but seemed alright otherwise.

Unfortunately, the 600 kHz ADCP on mooring **DOC07-3** failed as soon as it was lifted from the deck, because the batteries were not properly fixed to the power board and slit downward. It is recommended to use this instrument only in downward looking mode, in the future.

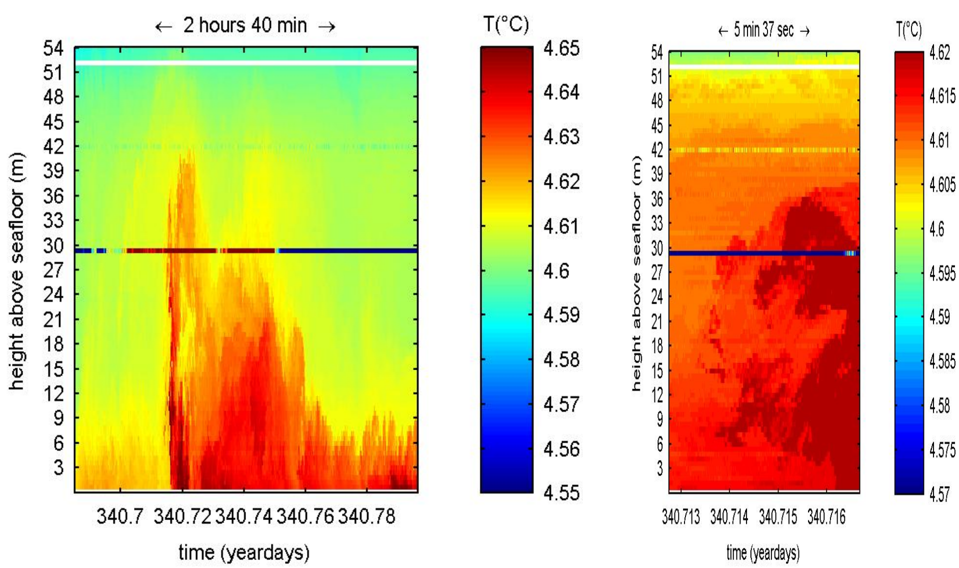

Fig. 11.Left: Example 160 minutes of NIOZ-3 data up to 54 m above the bottom, showing passage of large overturning wave passing near-equatorial ridge. Right: frontal detail, note the (different) scale!.

Table 3. Moored instruments details short-term deployment (A=Aanderaa; N=Nortek).

LOCO-IW07 mooring between **05/12/07 - 13/12/07 at** 00°44.154'N 039°51.178'W 1150 m

Mooring	Instrument	depth [m]	sampl. int. [s]	remarks
DOC07-1	N AquaDopp	960	5	
	FT-string#3	1149.5(lows.)	1	100 sens.; 5% sens. fail; 5% need recal.
	300 kHz ADCP	1144.5(fb)	2	TM3.0 m BAD most of time
	N AquaDopp	1148.25	5	
	SBE53 BPR	1148.25	3	modified version
	dprN1	1148.25	4	test phase: 11.2 m length tube
	SeaguardCM	1148.25	5	test- 1 day too short

LOCO-IW07 mooring between **05/12/07 - 14/12/07 at** 00°45.348'N 039°51.016'W 1440 m

Mooring	Instrument	depth [m]	sampl. int. [s]	remarks
DOC07-2	75 kHz ADCP	616(fb)	30	TM14 m Uplook coordinates?
	75 kHz ADCP	667(fb)	30	TM14 m Downlook noisier

LOCO-IW07 mooring between **05/12/07 - 14/12/07 at** 01°17.994'N 039°12.079'W 1690 m

Mooring	Instrument	depth [m]	sampl. int. [s]	remarks
DOC07-3	600 kHz ADCP	1587(fb)	5	TM1.9 m failed

d. Long-term mooring deployments LOCO11/4-18/4 (Appendix A for mooring diagrams)

The mooring deployment from the stern worked again fine due to proper preparation and good weather conditions.

Three long (~3.7 km) moorings were deployed between 28-30ºN roughly along 28ºW and five near the equator 0-2.5ºN, ~37ºW (Fig. 6; Table 4). Positioning of moorings is done as during LOCO-IW04,06: starting ~3-4 miles East or West of the intended longitude and sailing along a fixed latitude at a speed varying between ~0.5 knots (when instrument is attached and put overboard) and ~2.5 knots (when line is paid out). Release of anchor is sometimes suspended by continuing to sail to an intended position. On average, the final position of the anchor was about 300 m behind the ship's position at the moment of release of the anchor due to the retarded swing and the bent line during towing (Fig. 12). The final position was always well within ±100 m north/south of the sailed latitude.

Table 5 gives an overview of the instruments, their sampling rates and their positions in the moorings.

Table 4. Mooring positions LOCO-IW07, ARGOS and local inertial frequencies f (with harmonic diurnal tidal names between brackets). Depths are echo sounder estimates.

Mooring	*Latitude*	*Longitude*	*depth*	*f*	*ARGOS*
LOCO11/4	29°59.980'N	022°59.594'W	5115 m	1.0027 cpd (K_1)	22686
LOCO12/4	28°48.037'N	024°05.915'W	5140 m	0.9662 cpd (M_1)	22621
LOCO13/4	27°36.756'N	024°31.240'W	5152 m	0.9295 cpd (O_1)	23007
LOCO14/4	00°00.013'N	036°59.466'W	4492 m	$7.6 \cdot 10^{-6}$ cpd	21467

LOCO15/4	00°36.050'N	036°45.651'W	4504 m	0.0210 cpd	22179
LOCO16/4	00°57.052'N	037°54.258'W	4475 m	0.0333 cpd	22312
LOCO17/4	02°00.106'N	037°40.822'W	4420 m	0.0701 cpd	20378
LOCO18/4	02°30.171'N	038°01.640'W	4450 m	0.0876 cpd	22580

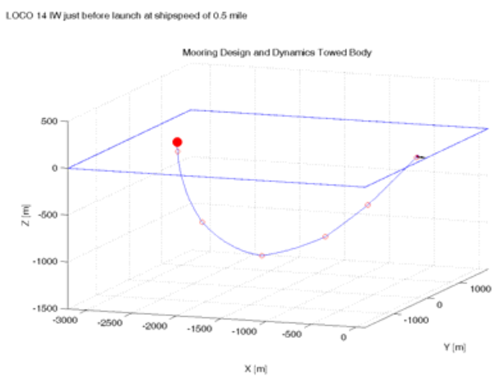

Fig. 12. Estimated mooring line at moment of release of anchor (computed by T. Hillebrand using program by R. Dewey,Uvic Canada).

***Table 5. Long-term mooring details IW07** (**A=Aanderaa; R=RDI; N = Nortek; V=Valeport**)*.
Moorings deployed between **23 November – 14 December 2007**

Mooring	**Instrument**	**BC**	**depth [m]**	**sampl. int. [s]**	**remarks**
LOCO11/4	R 75 kHz ADCP	888	1350	900	50 10m bins. UP look
	V BFM308	5333	1450	450	18x5, 5
	A RCM11	1793	2150	900	T-arctic
	N AquaDopp	2271	2900	900	30 sam diag/day
	A RCM11	1823	3650	900	T-arctic
	A RCM11	1816	4400	900	T-arctic
	Samplers at ~1500,2100,2500,3000,3400,4500 m				
LOCO12/4	R 75 kHz ADCP	1854	1250	900	50 10m bins; UP look.
	A RCM11	4138	1350	1200	T-LOW
	A RCM11	1861	2150	1200	T-arctic
	A RCM11	4114	2900	1200	T-arctic
	A RCM11	1960	3650	1200	T-arctic
	A RCM11	2356	4250	1200	T-arctic
	Samplers at ~1500,2100,2500,3000,3400,4500 m				
LOCO13/4	V BFM-308	5234	1150	300	24x5 s.,5; Impellor?
	V BFM-308	5241	1650	300	24x5 s.,5; Impellor?
	N AquaDopp	11471	2350	900	30 sam diag/day
	A RCM11	765	3100	900	T-arctic
	A RCM11	758	3850	900	T-arctic
	N AquaDopp	2288	4450	900	30 sam diag/day

LOCO14/4	R 75 kHz ADCP	5302	1000	900	50 10m bins; UP look.
	V BFM-308	5265	1200	300	12x5 s,5.
	V BFM-308	5357	1202.5	300	12x5 s,5.
	N AquaDopp	11488	1800	900	30 sam diag/day
	N AquaDopp	12850	2500	900	30 sam diag/day
	A RCM11	1915	3200	900	T-arctic
	A RCM11	2363	3900	900	T-arctic
LOCO15/4	N AquaDopp	2295	1200	900	30 sam diag/day
	N AquaDopp	2264	1800	900	30 sam diag/day
	N AquaDopp	2318	2500	900	30 sam diag/day
	A RCM11	789	3200	900	T-arctic
	A RCM11	1946	3900	900	T-arctic
LOCO16/4	R 75 kHz ADCP	1342	975	900	50 10m bins; DOWN look.
	FT-string	NIOZ3	1225(ls)	1	51 sensors at 0.5, 6 m intervals
	V BFM-308	5227	1275	300	12x5 s,5.
	N AquaDopp	2325	1850	900	30 sam diag/day
	N AquaDopp	2301	2550	900	30 sam diag/day
	A RCM11	703	3250	900	T-arctic
	A RCM11	772	3950	900	T-arctic
LOCO17/4	V BFM-308	5340	1200	300	12x5 s,5
	N AquaDopp	13185	1800	900	30 sam diag/day
	N AquaDopp	13208	2500	900	30 sam diag/day
	A RCM11	734	3200	900	T-arctic
	A RCM11	2028	3202.5	1200	T-arctic
	A RCM11	710	3900	900	T-arctic
LOCO18/4	R 75 kHz ADCP	1953	1000	1800	50 10m bins; UP look.
	V BFM-308	5319	1200	300	12x5 s,5.
	N AquaDopp	13192	1800	900	30 sam diag/day
	A RCM11	4107	2500	1200	T-arctic
	A RCM11	727	3200	900	T-arctic
	A RCM11	30045	3900	900	T-arctic

e. CTD sampling

The CTD operations were ‘normal’. The instrument, deck unit and the winch generally worked very fine. Once, CTD-operations had to be suspended for a period of 3 hours, because one of the wheels of the heave-compensator blocked and the line had to be dismantled from it.

The density-depth profiles were quite simple as before, with a main pycnocline between 100-1100 m and weak stratification below 1500 m (Fig. 3). In detail down- and upcast occasionally showed differences in steppiness of the profiles (with typical step sizes of about 10 m only), evidence of high-frequency wave activity or short-scale layering. In the salinity profiles (not shown) Mediterranean Sea water was visible between 1000-1500 m, evidence of remnants of ‘Meddies’ in the Canary Basin. Below this depth down to about 2000 m rather frequently varying stepstructures and overturning were observed. Along a North-South transect the small-scale variations show a weak tendency for enhancement at 29 and 30°N (between 2000-3000 m). Variations are also small when the present profiles are compared with those obtained during LOCO-IW03, 04 and 06. Extremely weak stratification (N ~ f; ~0.7 10^{-4} s^{-1}) was only found very near the bottom. Details of variation in N and steppiness across the critical diurnal latitude require further investigation.


Photo (W. vd Put): Heave-compensator repair.

f. LADCP (by C. Veth)

The LADCP-system has been applied during all CTD-casts. The system normally consists of two RDI Workhorse ADCP's in so-called "Janus configuration", which gives a velocity profile over maximally two times 120 m in 15 8m bins in water with ample scatterers and about two times 60 m in clearer water. Therefore the Workhorses are positioned in such a way that one is down looking and one is up looking. Regretfully, one of the Workhorses broke down fairly soon in the cruise and the rest of the casts were done with just one down-looking ADCP. The LADCP measurements were completed with vessel-mounted ADCP (VM-ADCP) measurements that compensated the absence of the up-looking LADCP. The first impression of the determined velocity profiles obtained with only one instrument looked quite satisfactory.

The CTD/LADCP-casts can be grouped in several series. In the first place CTD/LADCP-casts have been done near the freshly deployed LOCO moorings, the second series were a small number of casts underway over the Mid-Atlantic Ridge from the Canary Basin to the Brazil Basin and in the third place a CTD/LADCP section was made along the 38°W meridian from 0° to 2° N, with intervals of 8' (rationale see Section 7.f). The VM-ADCP collected data over the whole traject of the section to obtain current velocity information between stations.

The CTD/LADCP-measurements will be used to determine current velocity profiles over the whole water column. To calculate the current profiles from the LADCP-data, the software distributed by M. Visbeck through the LADCP Working Group is applied. From the velocity profiles in combination with the CTD-profiles estimates will be made for the turbulent diffusion coefficient K_z and the rate of turbulent kinetic energy dissipation rate ε. Parallel to these calculations both K_z and ε will be estimated from Thorpe, or overturning, scales.

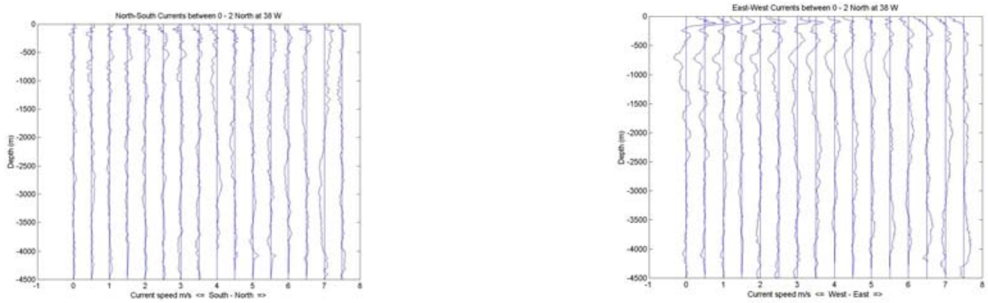

Fig. 13. Series of current velocity profiles between 0° and 2° N over the 38° meridian. Left: North-South components, Right. East-West components.

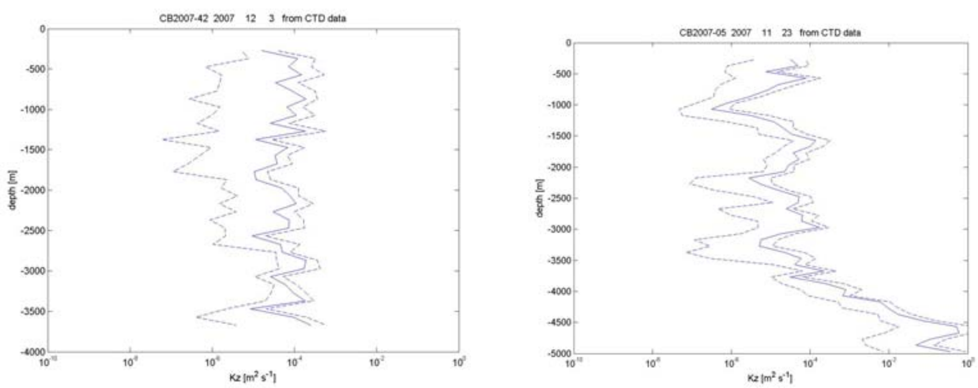

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Fig. 14. Examples of K_z estimates. Left: Mid-Atlantic Ridge, Right: Canary Basin.

g. CTD/LADCP measurements at a transect near the equator (by T. Gerkema)

At 38˚00'W, a series of CTD/LADCP measurements was made, each covering the whole water column. The transect comprised 16 stations in a meridional band stretching from 0˚00' to 2˚00'N, at intervals of 8' (Fig. 15). Measurements started at the equator on December 6th (at 12:45 UTC) and ended at latitude 2˚N on December 9th (at about 1:30 UTC). At the stations, water depth was fairly constant, ranging from about 4 to 4.5 km.

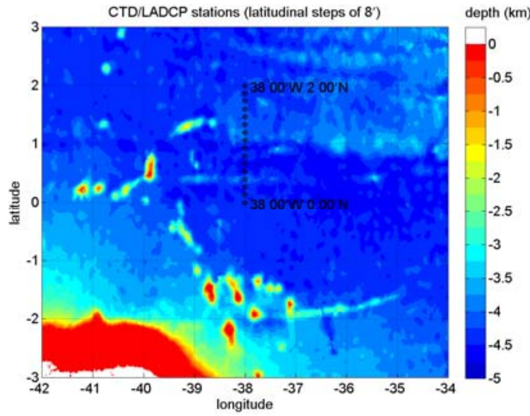
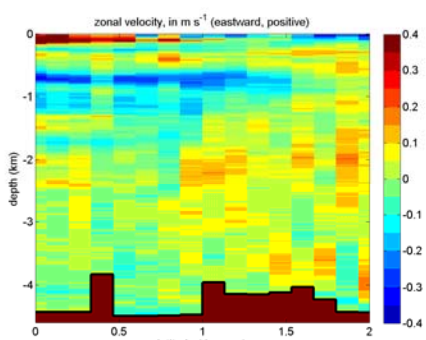


Fig. 15. Near-equatorial region with topography and CTD/LADCP transect.

The goal of these measurements is to test theories on the "thermal-wind balance" (geostrophy), which states that large-scale currents obey a balance between the Coriolis terms, in terms of velocity gradients, and horizontal density gradients. The classical formulation of this balance breaks down near the equator, where the "traditional" Coriolis terms vanish. This calls for an extended approach in which the Coriolis force is fully taken into account. At the equator, horizontal gradients of velocity then come into play (Colin de Verdière and Schopp, 1994). Specifically, a superposition of meridional and vertical gradients of the zonal velocity component is then balanced by the meridional gradient of density. In principle, the measurements as carried out here provide all these terms, and thus allow for an evaluation of the importance of the "non-traditional" term. However, as is usually the case in attempts to establish large-scale patterns, the ubiquitous internal waves are a nuisance in that they "pollute" the signal by their short-scale oscillations. The present measurements are no exception to this rule; further analysis is required to remove the noisiness as much as possible.



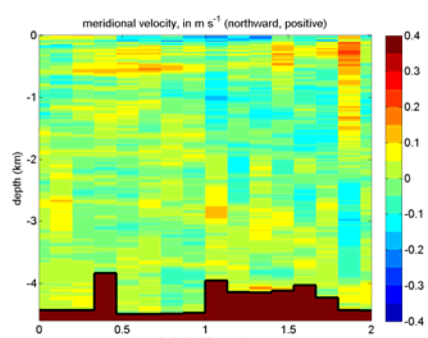


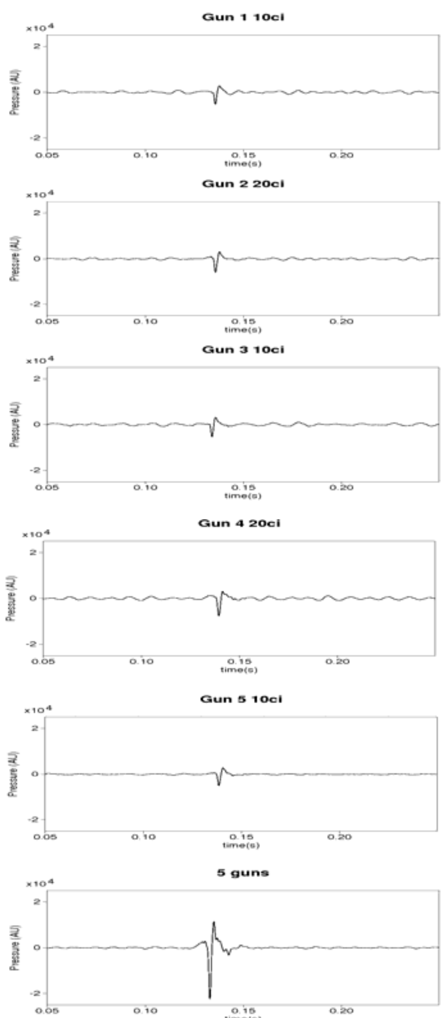
Fig. 16. Zonal current from LADCP (stations, Fig. 15). *Fig. 17. Meridional current.*

Preliminary results show clear equatorial deep jets, revealing not only their vertical but also their meridional structure of zonal flow (Fig. 16); the meridional flow is shown in Fig. 17. Apart from testing the abovementioned ideas, the profiles will also be used to obtain vertical profiles of eddy diffusivity (see Section 7.e).

h. Seismics of internal waves (by L. Gostiaux)

h.1. Air-guns signature

In order to explore the very weak reflections of sound by the thermo-haline structures of the water-column, it is necessary to know precisely the signature of the air-gun array. The direct signal arriving on the streamer is strongly distorted by surface waves and refraction effects, it is thus necessary to record the sound signal below the guns.



To do so, we used a hydrophone, that we mounted on the CTD cable with a 200kg weight. This hydrophone is self-amplified, it needs power supply that can be sent through the CTD cable using a current source and a small modification of the circuit (see below).

We were sailing 1.5 knots, and we assumed the drag on the CTD cable brought the hydrophone almost under the air-guns. The signal was sent to the seismics container on a coax cable, and recorded on the 6ch PC.

Doing so, we could first record each gun signature separately, and then tune them to have the best signal/noise ratio. The best tuning is obtained when the guns open simultaneously, which corresponds to the tuning using the observation of the coils signal on the scope.

This was also the first use of the 5 guns frame, which works well. Two guns of 10ci (1 and 5) had to be fed by the same hose, but had independent triggering. The air-guns

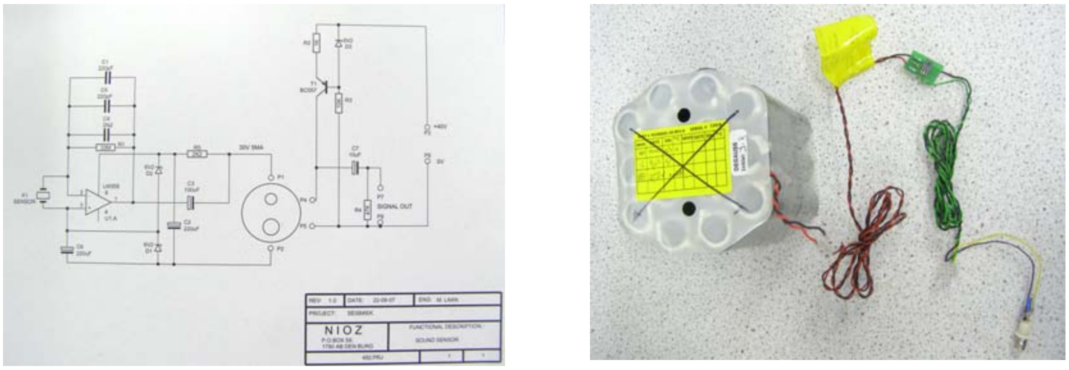


Fig. 18. Modifications to circuit for hydrophone use.

were 1.5 m below the surface.

The sharpness of the guns array signature is relatively good, at least much better than for individual air-guns. Bubbles oscillations are weak and rapidly vanish, which could not be inferred from the direct signal measurement.

We hope we can use this signal shape to perform correlation processing to see weak reflectors in the water-column.

h.2. Seismic oceanography

The objective of using seismics in physical oceanography is to try to obtain information on horizontal dimensions of thermo-haline steps that are almost always present in the stratified water-column. These steps generate sound velocity discontinuities on which sound waves reflect, at a very weak but potentially measurable level. The use of seismics equipment theoretically allows to increase signal to noise ratio of the measurement and to identify reflectors at different depths.

To do so, we launched a large number of XBT (eXpandable Bathy-Thermograph) during the seismic lines acquisition, in order to later compare the observed reflections with the fine structures of the temperature profile. We performed measurements in deep basins, in order to have as less noise as possible coming from multiples of the seabed, and also close to topographies where strong mixing and internal waves can affect the water-column structures.

These last measurements were performed above a sea-mount predicted in Smith and Sandwell bathymetric database, although it did not figure on any marine chart on board. The expected depth was of 2100 meters, we had the surprise to find a summit at 1200 meters on the multi-beam.

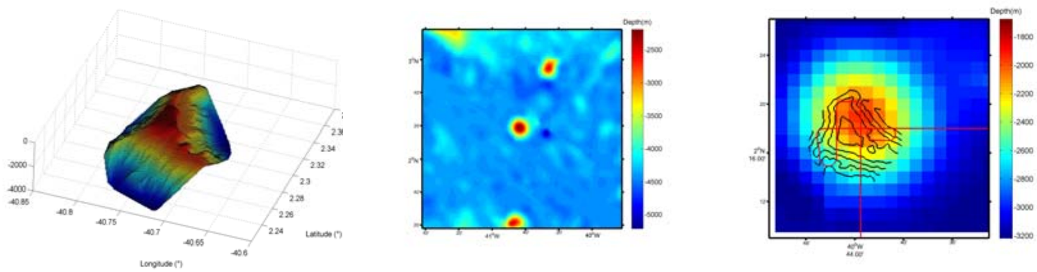


Fig. 19. From left to right: 3D view of the sea-mount where seismics were performd as mapped using Multibeam; map using Smith and Sandwell Bathymetry, centered on the sea-mount. The same, magnified, superimposed with multi-beam contour (black) and ship track during seismic lines (red).

The required processing of the data doesn't allow to conclude anything yet on the presence of reflectors in the water-column. At least, the acquisitions could be realized in good conditions and without major difficulties.

More References

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8. Achnowledgments

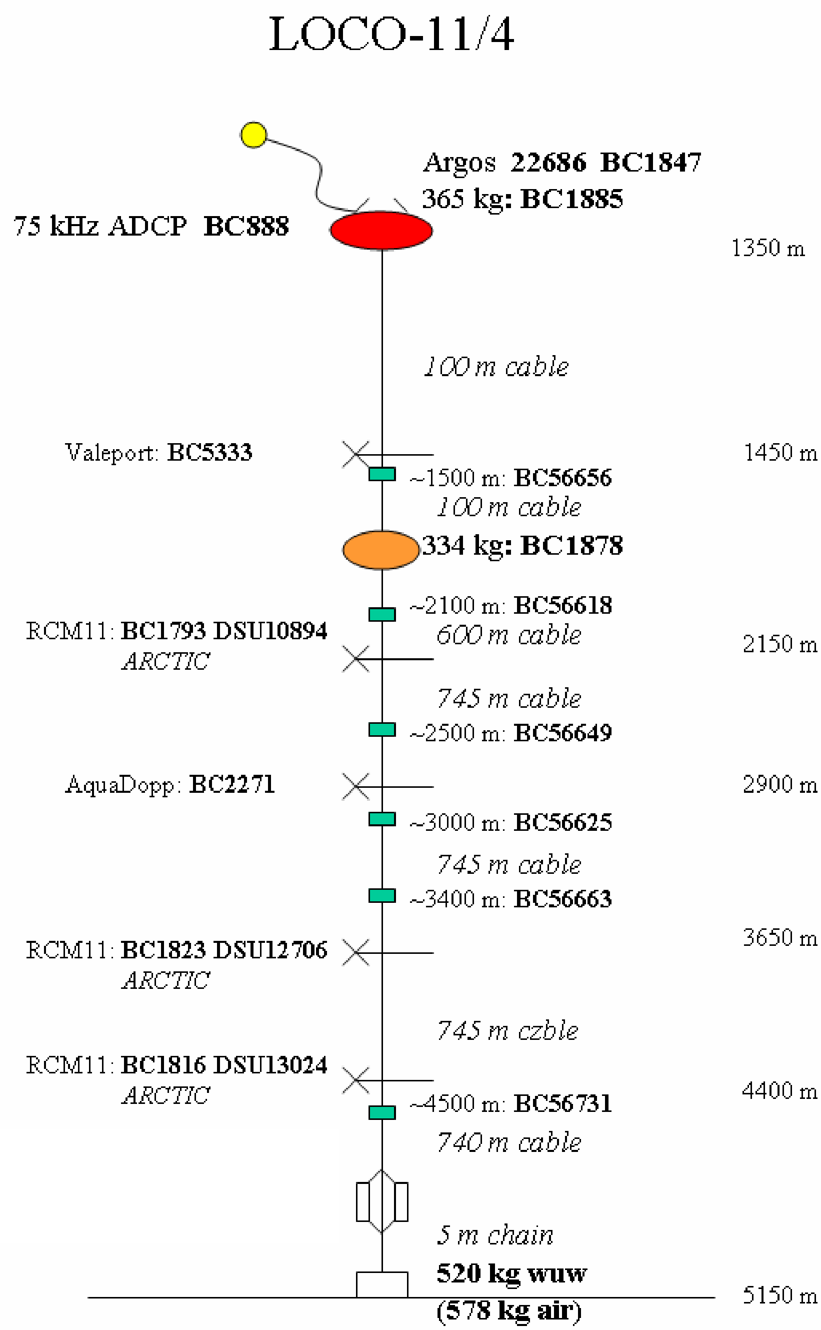
On behalf of the participants, I would like to thank captain Kees de Graaff and the crew of R.V. Pelagia for the very pleasant cooperation. Funding by the Netherlands Organization for the advancement of Scientific Research and BSIK is gratefully acknowledged.

December 2007,

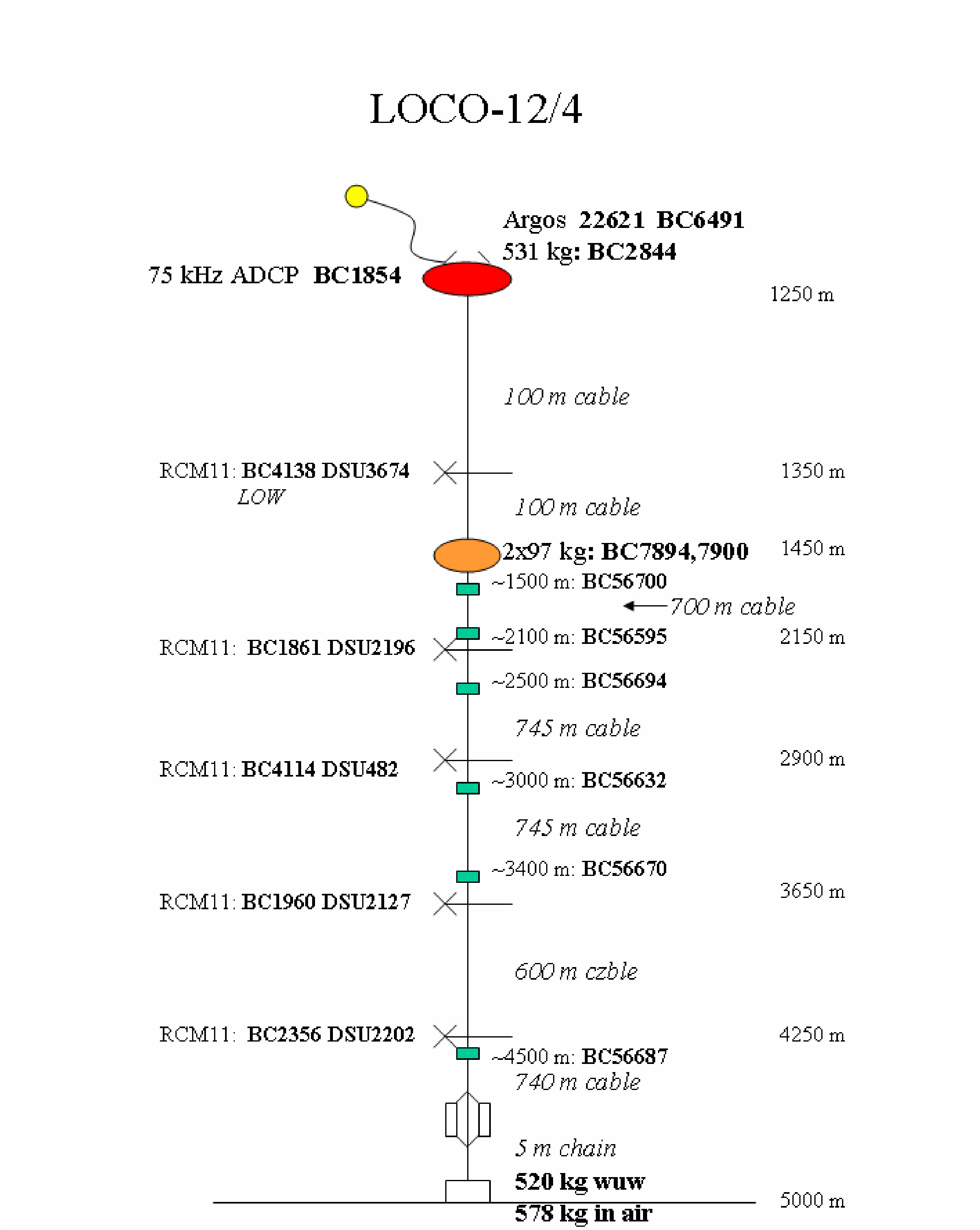
Hans van Haren

Appendix A Mooring diagrams LOCO-IW07 (*by Dept. MTM & T. Hillebrand*)

LOCO11/4

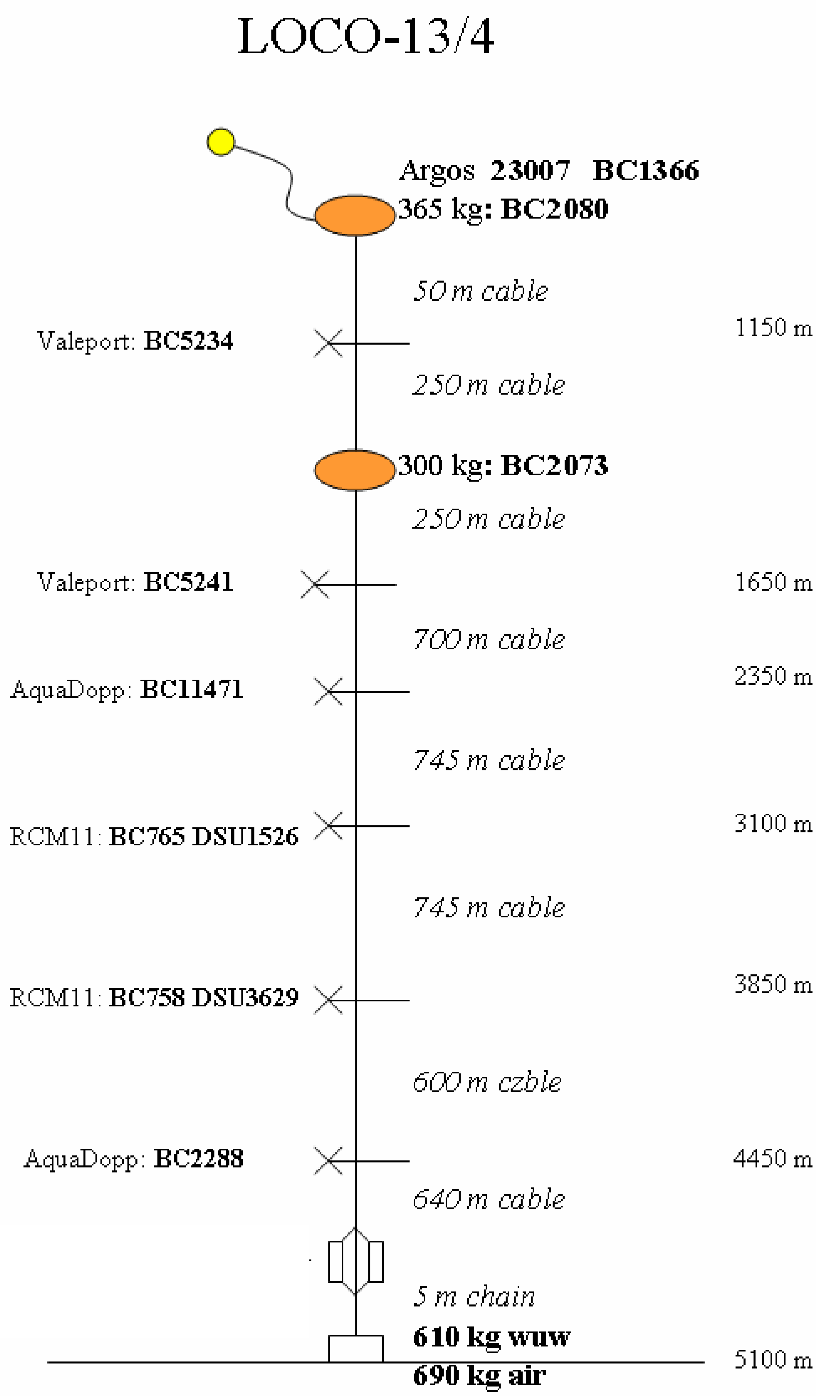


LOCO12/4

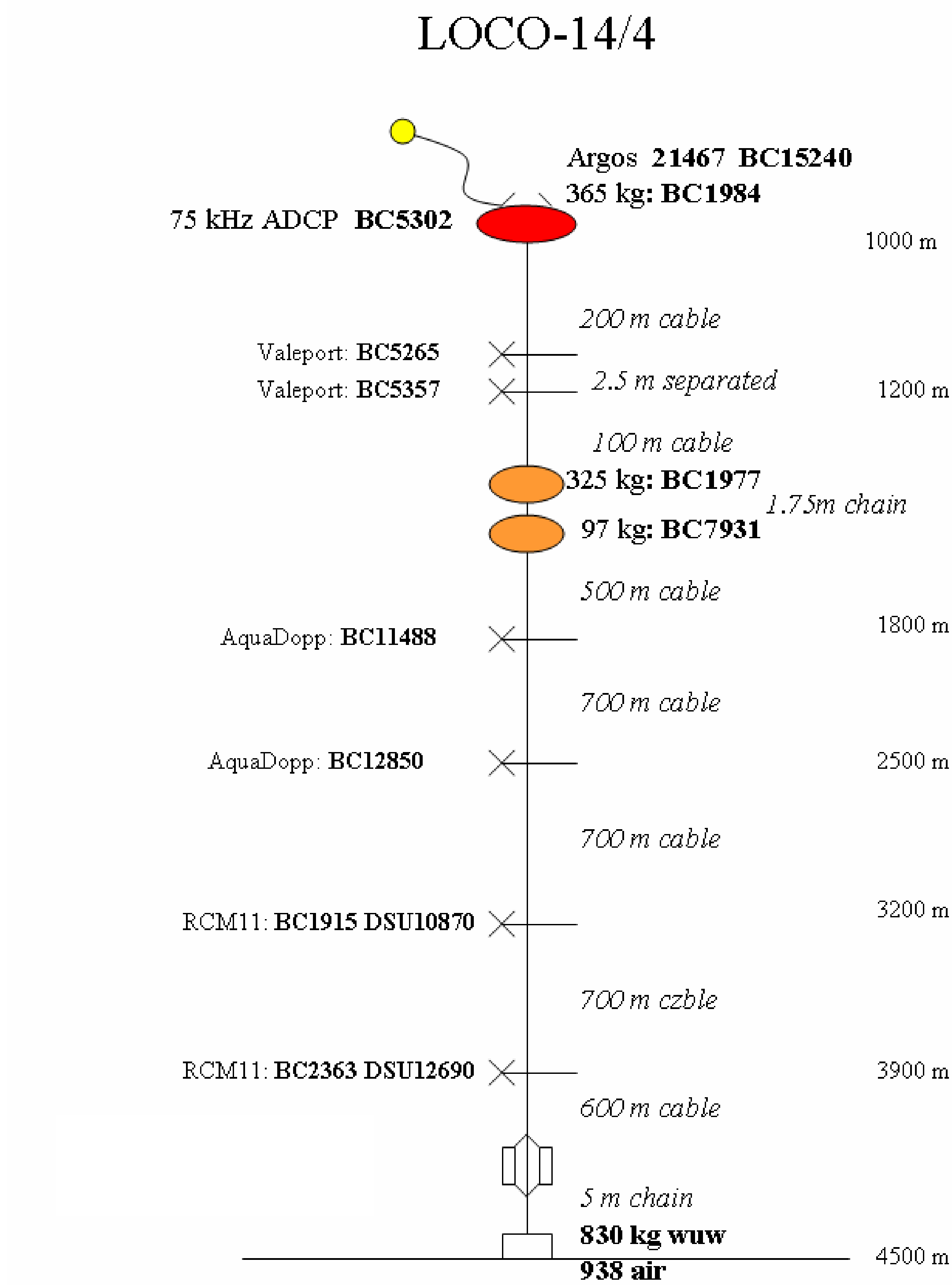


LOCO-12/4
Argos 22621 BC6491
531 kg: BC2844
75 kHz ADCP BC1854
1250 m
100 m cable
RCM11: BC4138 DSU3674
LOW
1350 m
100 m cable
2x97 kg: BC7894,7900
1450 m
~1500 m: BC56700
700 m cable
~2100 m: BC56595
RCM11: BC1861 DSU2196
2150 m
~2500 m: BC56694
745 m cable
RCM11: BC4114 DSU482
2900 m
~3000 m: BC56632
745 m cable
~3400 m: BC56670
RCM11: BC1960 DSU2127
3650 m
600 m czble
RCM11: BC2356 DSU2202
4250 m
~4500 m: BC56687
740 m cable
5 m chain
520 kg wuw
578 kg in air
5000 m

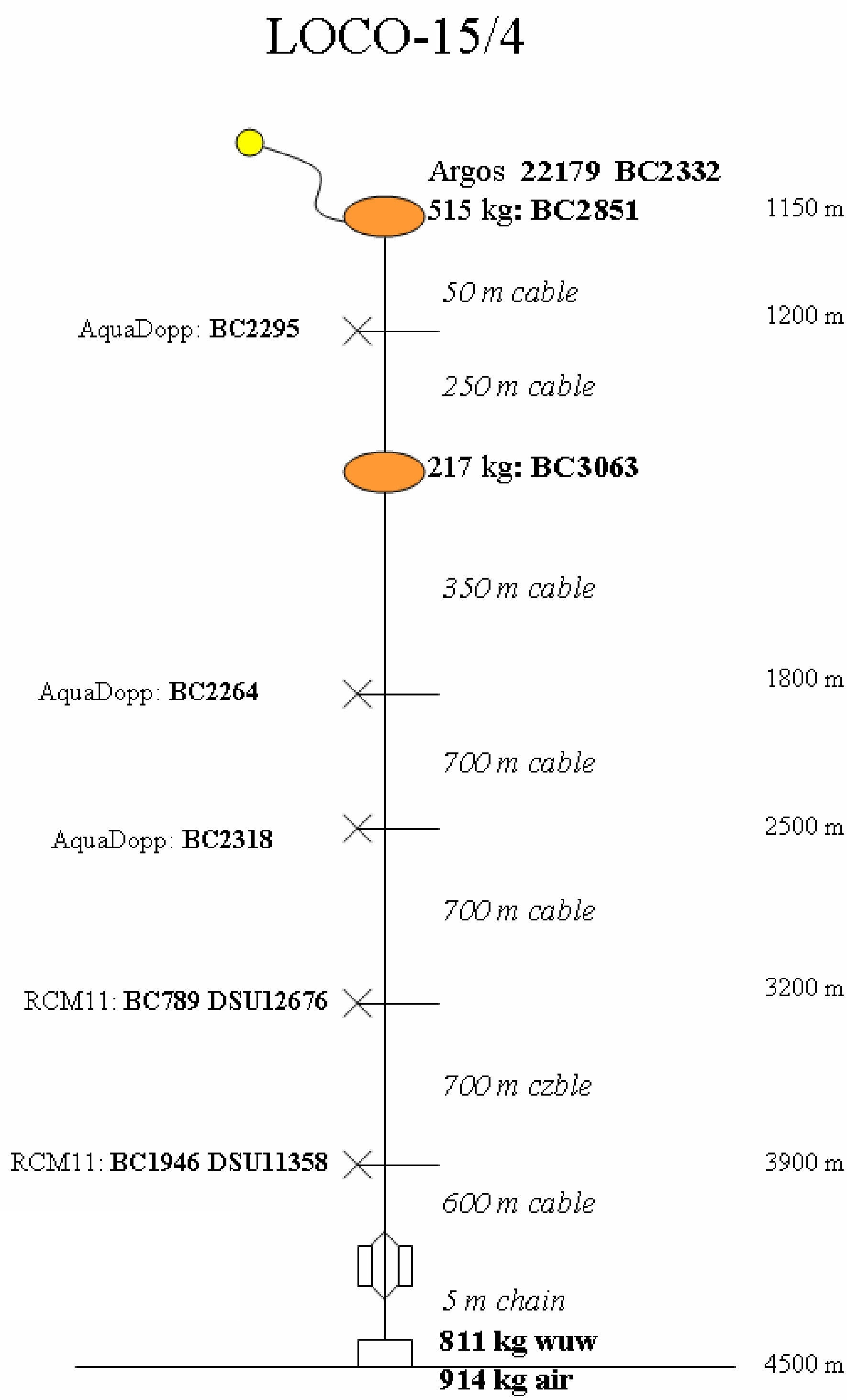
LOCO13/4


LOCO-13/4
Argos 23007 BC1366
365 kg: BC2080
50 m cable
Valeport: BC5234
1150 m
250 m cable
300 kg: BC2073
250 m cable
Valeport: BC5241
1650 m
700 m cable
AquaDopp: BC11471
2350 m
745 m cable
RCM11: BC765 DSU1526
3100 m
745 m cable
RCM11: BC758 DSU3629
3850 m
600 m czble
AquaDopp: BC2288
4450 m
640 m cable
5 m chain
610 kg wuw
690 kg air
5100 m

LOCO14/4

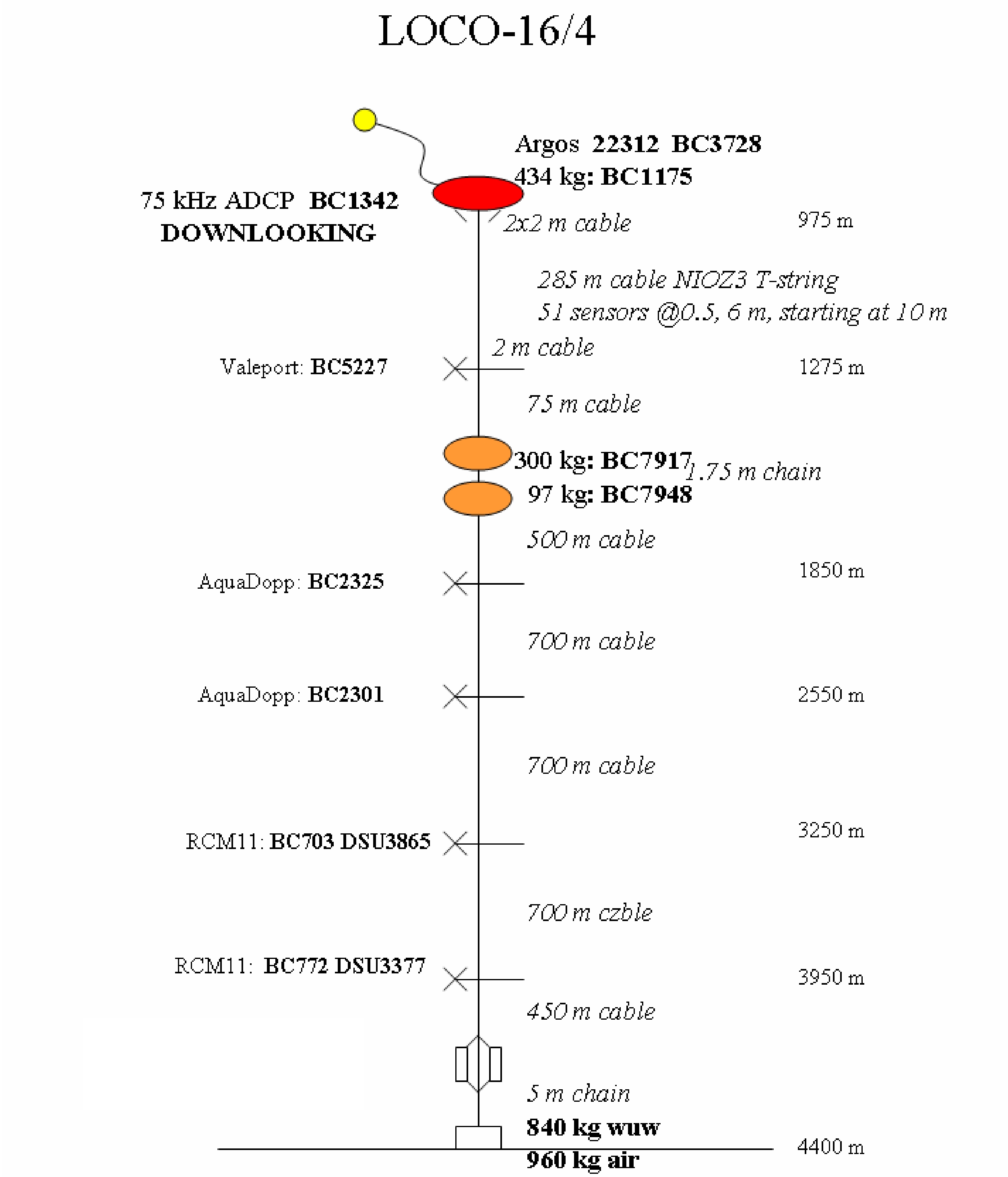

LOCO-14/4
Argos 21467 BC15240
365 kg: BC1984
75 kHz ADCP BC5302
1000 m
200 m cable
Valeport: BC5265
Valeport: BC5357
2.5 m separated
1200 m
100 m cable
325 kg: BC1977
1.75m chain
97 kg: BC7931
500 m cable
AquaDopp: BC11488
1800 m
700 m cable
AquaDopp: BC12850
2500 m
700 m cable
RCM11: BC1915 DSU10870
3200 m
700 m czble
RCM11: BC2363 DSU12690
3900 m
600 m cable
5 m chain
830 kg wuw
938 air
4500 m

LOCO15/4



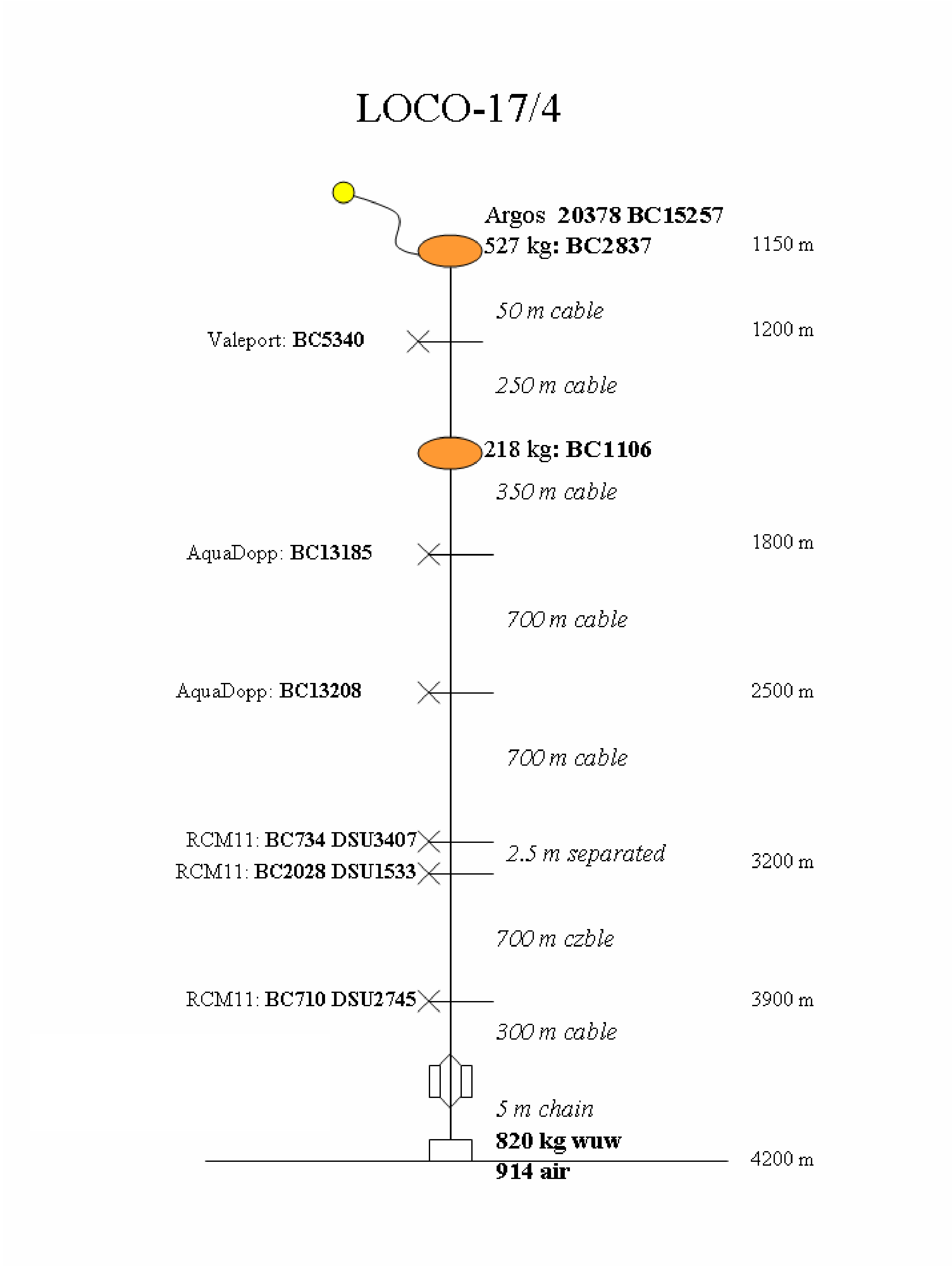
LOCO-15/4
Argos 22179 BC2332
515 kg: BC2851
1150 m
50 m cable
AquaDopp: BC2295
1200 m
250 m cable
217 kg: BC3063
350 m cable
AquaDopp: BC2264
1800 m
700 m cable
AquaDopp: BC2318
2500 m
700 m cable
RCM11: BC789 DSU12676
3200 m
700 m czble
RCM11: BC1946 DSU11358
3900 m
600 m cable
5 m chain
811 kg wuw
914 kg air
4500 m

LOCO16/4

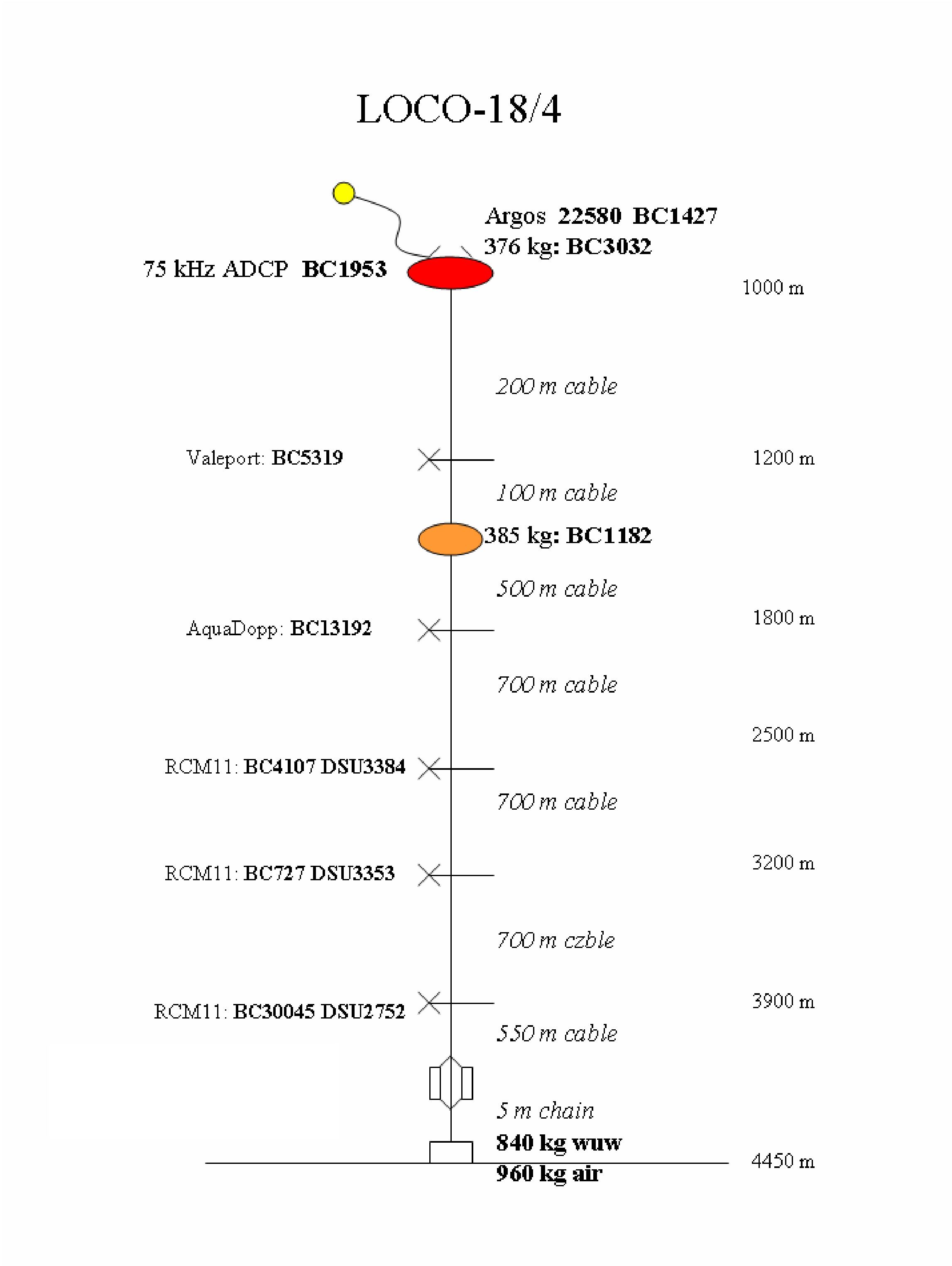


LOCO-16/4
Argos 22312 BC3728
434 kg: BC1175
75 kHz ADCP BC1342
DOWNLOOKING
2x2 m cable
975 m
285 m cable NIOZ3 T-string
51 sensors @0.5, 6 m, starting at 10 m
2 m cable
Valeport: BC5227
1275 m
75 m cable
300 kg: BC7917
1.75 m chain
97 kg: BC7948
500 m cable
AquaDopp: BC2325
1850 m
700 m cable
AquaDopp: BC2301
2550 m
700 m cable
RCM11: BC703 DSU3865
3250 m
700 m czble
RCM11: BC772 DSU3377
3950 m
450 m cable
5 m chain
840 kg wuw
960 kg air
4400 m

LOCO17/4

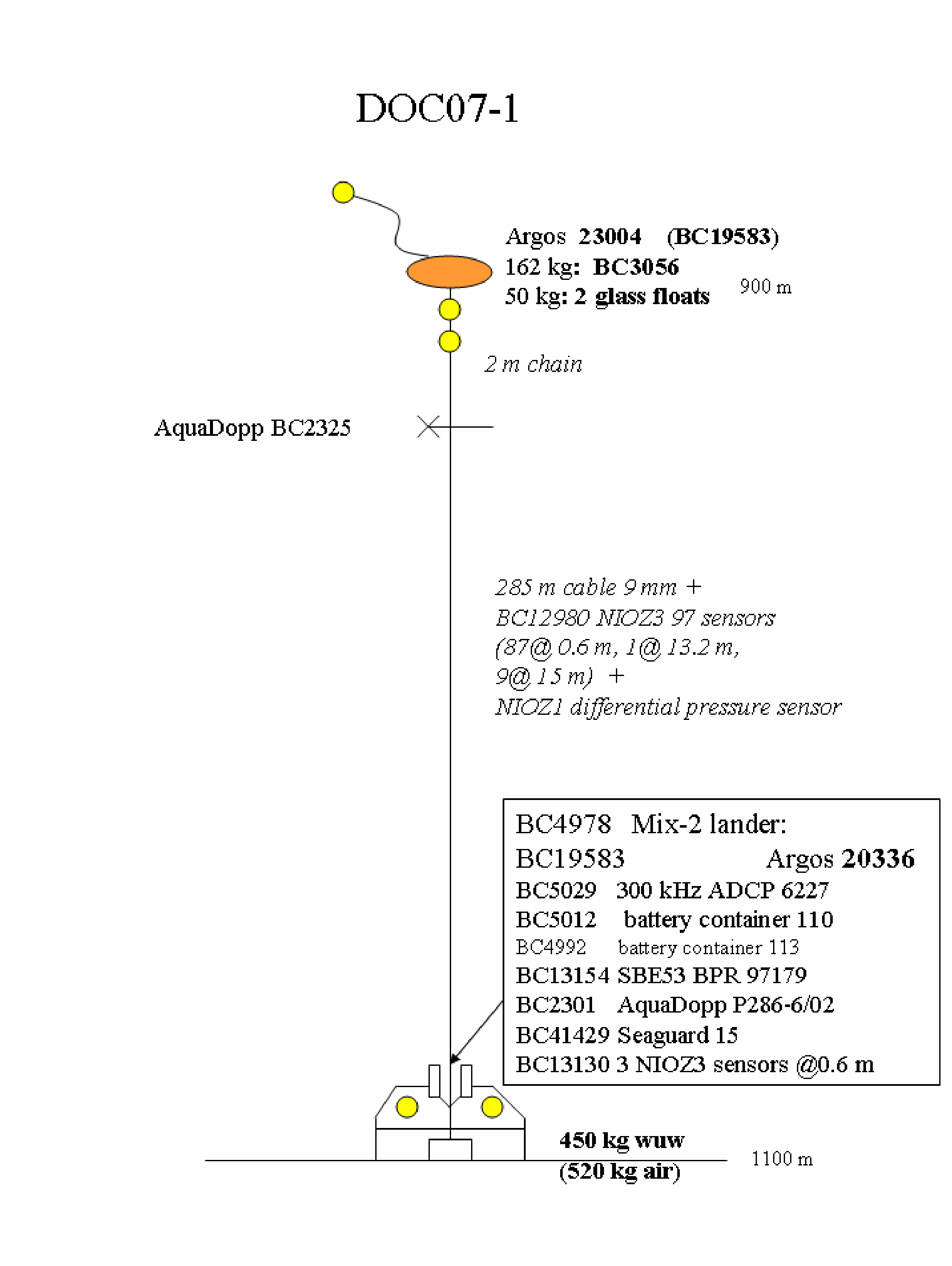

LOCO-17/4
Argos 20378 BC15257
527 kg: BC2837
1150 m
50 m cable
Valeport: BC5340
1200 m
250 m cable
218 kg: BC1106
350 m cable
AquaDopp: BC13185
1800 m
700 m cable
AquaDopp: BC13208
2500 m
700 m cable
RCM11: BC734 DSU3407
RCM11: BC2028 DSU1533
2.5 m separated
3200 m
700 m czble
RCM11: BC710 DSU2745
3900 m
300 m cable
5 m chain
820 kg wuw
914 air
4200 m

LOCO18/4

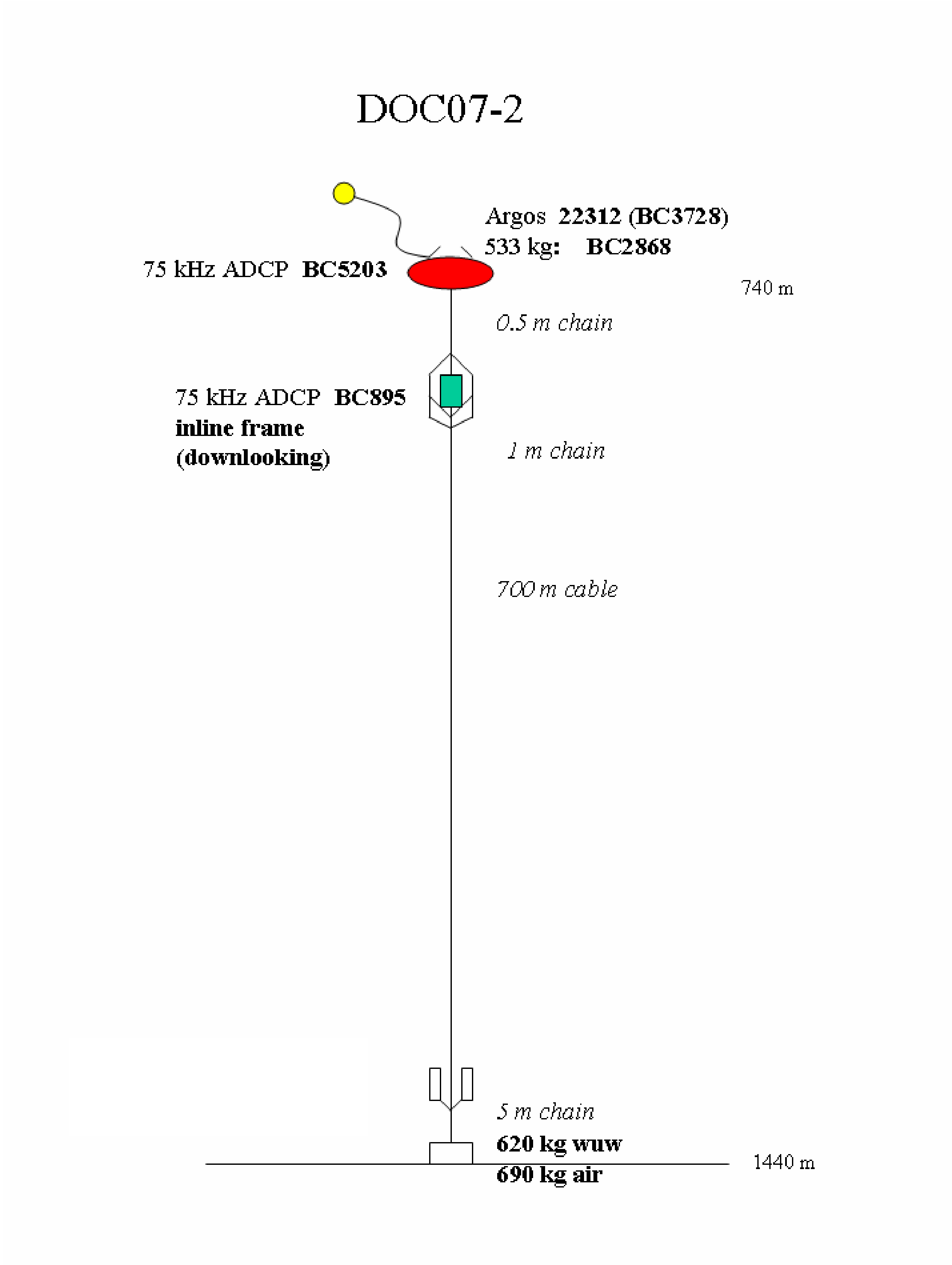


LOCO-18/4
Argos 22580 BC1427
376 kg: BC3032
75 kHz ADCP BC1953
1000 m
200 m cable
Valeport: BC5319
1200 m
100 m cable
385 kg: BC1182
500 m cable
AquaDopp: BC13192
1800 m
700 m cable
2500 m
RCM11: BC4107 DSU3384
700 m cable
RCM11: BC727 DSU3353
3200 m
700 m czble
RCM11: BC30045 DSU2752
3900 m
550 m cable
5 m chain
840 kg wuw
960 kg air
4450 m

DOC07_1

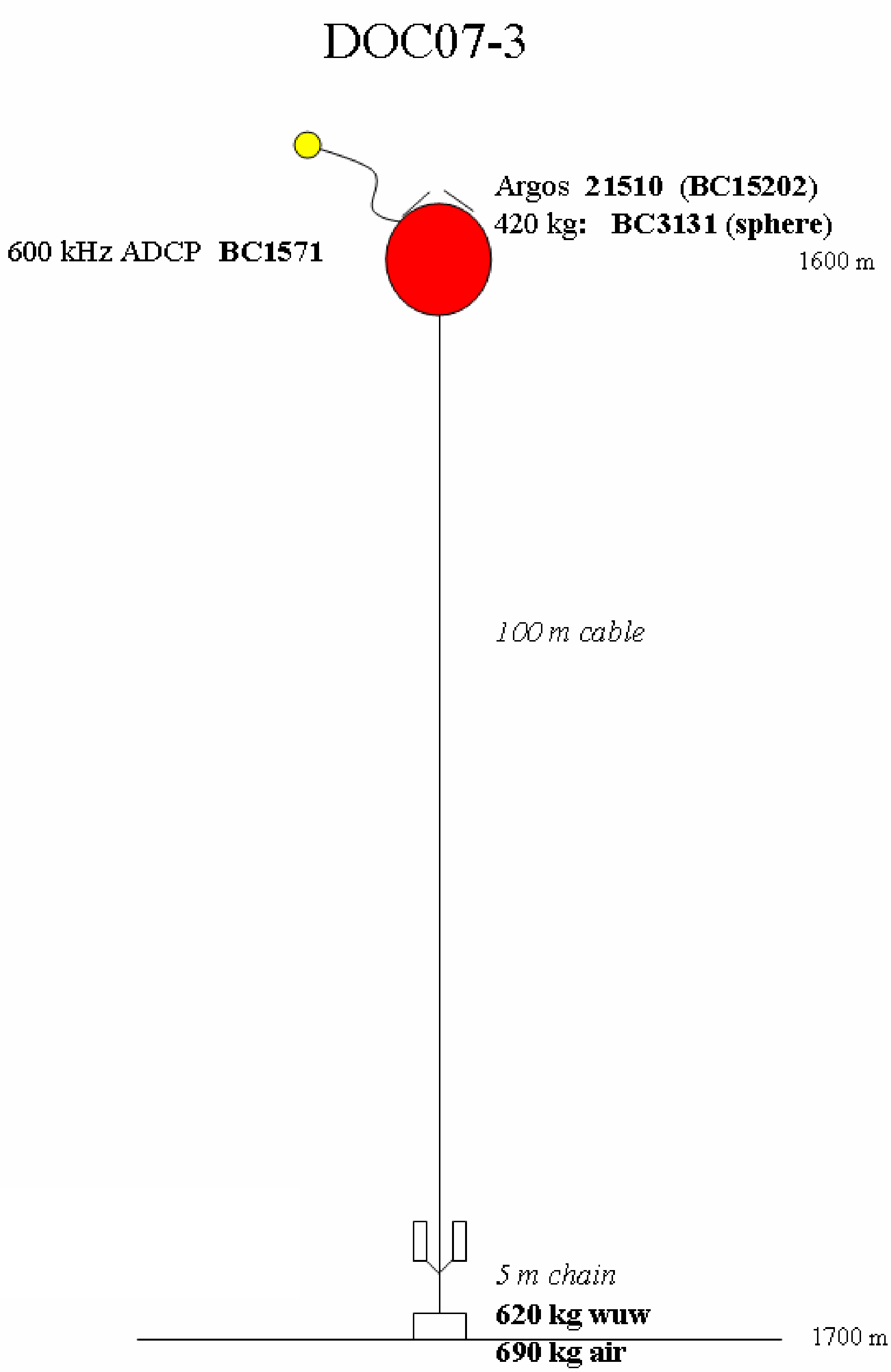

DOC07-1
Argos 23004 (BC19583)
162 kg: BC3056
50 kg: 2 glass floats
900 m
2 m chain
AquaDopp BC2325
285 m cable 9 mm +
BC12980 NIOZ3 97 sensors
(87@ 0.6 m, 1@ 13.2 m,
9@ 15 m) +
NIOZ1 differential pressure sensor
BC4978 Mix-2 lander:
BC19583 Argos 20336
BC5029 300 kHz ADCP 6227
BC5012 battery container 110
BC4992 battery container 113
BC13154 SBE53 BPR 97179
BC2301 AquaDopp P286-6/02
BC41429 Seaguard 15
BC13130 3 NIOZ3 sensors @0.6 m
450 kg wuw
(520 kg air)
1100 m

DOC07_2



DOC07-2
Argos 22312 (BC3728)
533 kg: BC2868
75 kHz ADCP BC5203
740 m
0.5 m chain
75 kHz ADCP BC895
inline frame
(downlooking)
1 m chain
700 m cable
5 m chain
620 kg wuw
690 kg air
1440 m

DOC07_3


DOC07-3
Argos 21510 (BC15202)
420 kg: BC3131 (sphere)
600 kHz ADCP BC1571
1600 m
100 m cable
5 m chain
620 kg wuw
690 kg air
1700 m

Appendix B Cruise summary of stations (activities) of LOCO-IW07 (M. Hiehle*)*

STAT NO	CAS NO	CAST TYPE	EVENT	DATE / TIME dd-mmm-yyyy	LATITUDE	LONGITUD	Echo Dep Uncorr	COMMENTS
1	1	CTD + water	Begin	Nov 21 2007 14:42:05	32.84467	-20.10052	4695	
1	1	CTD + water	Bottom	Nov 21 2007 15:57:51	32.84448	-20.1005	4695	
1	1	CTD + water	End	Nov 21 2007 17:29:21	32.8445	-20.10035	4695	
2	1	Mooring recovery	released	Nov 22 2007 08:20:36	32.99127	-22.4059	5274	LOCO 11/3
2	1	Mooring recovery	Begin	Nov 22 2007 09:05:00	32.99703	-22.40158	5274	
2	1	Mooring recovery	End	Nov 22 2007 11:08:39	33.00501	-22.38587	5400	
3	1	Mooring deployment	Begin	Nov 23 2007 08:22:45	29.99992	-23.00772	5132	LOCO 11/4
3	1	Mooring deployment	End	Nov 23 2007 10:46:11	29.9996	-22.99217	5115	
3	1	Mooring deployment	ground	Nov 23 2007 11:32:24	30.53733	-22.97247	5115	
4	1	Mooring recovery	released	Nov 23 2007 12:53:06	29.9971	-23.07392	5134	LOCO 12/3
4	1	Mooring recovery	Begin	Nov 23 2007 13:44:24	29.99708	-23.07392	5134	
4	1	Mooring recovery	End	Nov 23 2007 15:01:04	29.9899	-23.07028	5134	
5	1	CTD	Begin	Nov 23 2007 15:17:23	29.98823	-23.0691	5134	
5	1	CTD	Bottom	Nov 23 2007 16:34:26	29.98822	-23.06915	5134	
5	1	CTD	End	Nov 23 2007 17:59:39	29.9882	-23.06923	5134	
6	1	Mooring deployment	Begin	Nov 24 2007 08:31:22	28.7994	-24.0014	5109	LOCO 12/4
6	1	Mooring deployment	End	Nov 24 2007 10:41:25	28.7997	-24.0984	5140	
6	1	Mooring deployment	ground	Nov 24 2007 11:29:32	28.82147	-24.11342	5146	
7	1	Mooring recovery	released	Nov 24 2007 13:19:30	28.80097	-24.00417	5109	LOCO 14/3
7	1	Mooring recovery	Begin	Nov 24 2007 14:07:34	28.79907	-23.99545	5109	
7	1	Mooring recovery	End	Nov 24 2007 15:42:32	28.80128	-24.0264	5121	
8	1	CTD_Thermistor	Begin	Nov 24 2007 16:40:20	28.79997	-24.02477	5121	
8	1	CTD_Thermistor	Bottom	Nov 24 2007 17:17:11	28.79983	-24.02505	5121	
8	1	CTD_Thermistor	End	Nov 24 2007 18:46:54	28.79995	-24.02483	5121	
8	2	CTD	Begin	Nov 24 2007 18:57:42	28.80003	-24.02505	5121	
8	2	CTD	Bottom	Nov 24 2007 20:26:37	28.80017	-24.0256	5121	
8	2	CTD	End	Nov 24 2007 22:02:06	28.79978	-24.02555	5121	
9	1	Mooring recovery	released	Nov 25 2007 07:44:33	27.60583	-24.51068	5152	LOCO 13/3
9	1	Mooring recovery	Begin	Nov 25 2007 08:15:32	27.61247	-24.50175	5152	
9	1	Mooring recovery	End	Nov 25 2007 09:50:32	27.6032	-24.53022	5152	
10	1	CTD	Begin	Nov 25 2007 10:02:14	27.60372	-24.53025	5152	
10	1	CTD	Bottom	Nov 25 2007 11:34:22	27.60423	-24.52917	5152	
10	1	CTD	End	Nov 25 2007 13:22:33	27.60312	-24.5295	5152	
11	1	Mooring deployment	Begin	Nov 25 2007 15:31:00	27.6122	-24.57483	5152	LOCO 13/4
11	1	Mooring deployment	End	Nov 25 2007 17:14:31	27.61253	-24.5193	5152	
11	1	Mooring deployment	ground	Nov 25 2007 17:57:02	27.61272	-24.49135	5146	
12	1	Mooring recovery	released	Nov 26 2007 08:06:38	25.49708	-24.8886	5158	LOCO 15/3
12	1	Mooring recovery	Begin	Nov 26 2007 08:40:31	25.49557	-24.8809	5158	
12	1	Mooring recovery	End	Nov 26 2007 10:13:03	25.48062	-24.90545	5164	
13	1	Mooring recovery	released	Nov 27 2007 09:11:24	22.48847	-27.32387	5402	LOCO 16/3
13	1	Mooring recovery	Begin	Nov 27 2007 09:51:09	22.49363	-27.31788	5402	
13	1	Mooring recovery	End	Nov 27 2007 11:29:19	22.49455	-27.34118	5402	
14	1	CTD	Begin	Nov 27 2007 11:45:37	22.4953	-27.3418	5402	
14	1	CTD	Bottom	Nov 27 2007 13:22:26	22.49485	-27.34167	5402	
14	1	CTD	End	Nov 27 2007 14:54:45	22.49518	-27.34198	5402	
15	1	Seismic begin	Begin	Nov 27 2007 15:43:32	22.50105	-27.32302	5402	
16	1	Seismic end	End	Nov 27 2007 17:21:43	22.521	-27.28017	5408	
17	1	ARGO float	released	Nov 28 2007 10:58:26	20.20425	-28.68532	5993	
18	1	Mooring recovery	released	Nov 28 2007 12:37:09	20.00217	-28.80853	4847	LOCO 17/3
18	1	Mooring recovery	Begin	Nov 28 2007 13:11:19	19.99665	-28.8084	4981	Clean Aquaflow
18	1	Mooring recovery	End	Nov 28 2007 15:01:40	19.9925	-28.79618	4786	
19	1	Seismic begin	Begin	Nov 29 2007 09:24:23	17.26325	-29.44832	3914	
19	2	Seismic end	End	Nov 29 2007 16:48:37	16.79975	-29.56253	4536	
20	1	Mooring recovery	released	Nov 30 2007 07:53:20	14.99472	-30.01855	5402	LOCO 18/3
20	1	Mooring recovery	Begin	Nov 30 2007 08:39:36	14.99452	-30.00492	5396	
20	1	Mooring recovery	End	Nov 30 2007 10:15:52	14.98683	-30.02187	5402	

21	1	ARGO float	released	Nov 30	2007 10:18:16	14.98598	-30.02248	5402	
22	1	CTD	Begin	Dec 01	2007 12:04:19	11.46013	-32.41542	4890	
22	1	CTD	Bottom	Dec 01	2007 13:30:45	11.45983	-32.4163	4884	
22	1	CTD	End	Dec 01	2007 15:13:01	11.46	-32.41512	4890	
23	1	ARGO float	released	Dec 02	2007 02:19:24	10.00243	-33.41423	5493	
24	1	CTD_Thermistor	Begin	Dec 02	2007 17:35:39	7.94562	-34.78152	3664	
24	1	CTD_Thermistor	Bottom	Dec 02	2007 18:40:56	7.94552	-34.7816	3652	
24	1	CTD_Thermistor	End	Dec 02	2007 20:08:04	7.94558	-34.78172	3652	
25	1	XBT	Begin	Dec 02	2007 21:24:19	7.8633	-34.83523	4048	X352
26	1	Seismic begin	Begin	Dec 03	2007 11:32:03	6.2738	-35.89315	4091	
27	1	XBT	Begin	Dec 03	2007 12:25:50	6.2322	-35.92042	4298	No data
28	1	XBT	Begin	Dec 03	2007 12:32:21	6.22713	-35.92385	4298	X353
29	1	XBT	Begin	Dec 03	2007 12:39:07	6.22182	-35.92737	4310	X354
30	1	XBT	Begin	Dec 03	2007 12:45:17	6.2171	-35.93048	4317	X356
31	1	XBT	Begin	Dec 03	2007 12:47:48	6.21512	-35.93178	4323	X357
32	1	XBT	Begin	Dec 03	2007 12:53:47	6.21043	-35.93492	4317	X358
33	1	XBT	Begin	Dec 03	2007 12:59:58	6.20562	-35.93798	4317	X359
34	1	XBT	Begin	Dec 03	2007 13:05:53	6.20125	-35.94072	4317	X360
35	1	XBT	Begin	Dec 03	2007 13:11:59	6.19657	-35.94365	4317	X361
36	1	XBT	Begin	Dec 03	2007 13:17:48	6.19242	-35.94632	4317	X362
37	1	XBT	Begin	Dec 03	2007 13:24:00	6.1875	-35.9493	3701	No data
38	1	XBT	Begin	Dec 03	2007 13:29:51	6.18328	-35.9522	4219	X363
39	1	XBT	Begin	Dec 03	2007 13:36:11	6.17875	-35.95537	4225	X364
40	1	XBT	Begin	Dec 03	2007 13:41:44	6.17477	-35.9581	4298	X365
41	1	Seismic end	End	Dec 03	2007 13:53:17	6.16632	-35.964	4371	
42	1	CTD	Begin	Dec 03	2007 21:07:31	5.45928	-36.43347	3945	
42	1	CTD	Bottom	Dec 03	2007 22:19:58	5.4583	-36.43317	3939	
42	1	CTD	End	Dec 03	2007 23:31:56	5.4583	-36.43422	3939	
42	2	ARGO float	released	Dec 03	2007 23:36:50	5.45768	-36.43463	3939	
43	1	MultiBeam begin	Begin	Dec 05	2007 10:02:09	1.32913	-39.1813	2164	Line cnt 0000
43	2	Mooring deployment	Begin	Dec 05	2007 10:52:03	1.29962	-39.20775	1701	DOC 073
43	2	Mooring deployment	End	Dec 05	2007 11:11:38	1.30025	-39.20167	1658	
43	2	Mooring deployment	ground	Dec 05	2007 11:40:17	1.31232	-39.20187	2079	
44	1	MultiBeam begin	Begin	Dec 05	2007 16:41:54	0.81167	-39.78662	2786	line cnt 0006
45	1	MultiBeam end	End	Dec 05	2007 16:50:04	0.80363	-39.79565	3439	line cnt 0006
46	1	MultiBeam begin	Begin	Dec 05	2007 16:52:43	0.80073	-39.79868	3243	line cnt 0006
47	1	Mooring deployment	Begin	Dec 05	2007 18:25:33	0.75757	-39.86397	1658	DOC 07-2
47	1	Mooring deployment	End	Dec 05	2007 18:56:55	0.75563	-39.8492	1371	
47	1	Mooring deployment	ground	Dec 05	2007 19:16:00	0.76392	-39.85082	1567	
48	1	Lander deployment	Begin	Dec 05	2007 20:56:31	0.72613	-39.85272	1091	DOC 07-1
48	1	Lander deployment	End	Dec 05	2007 21:52:24	0.73742	-39.85083	1115	
48	1	Lander deployment	ground	Dec 05	2007 22:21:27	0.74372	-39.85435	1170	
49	1	MultiBeam end	End	Dec 05	2007 22:52:36	0.7298	-39.8592	1243	line cnt. 0018
50	1	CTD	Begin	Dec 06	2007 12:41:43	0.0002	-38.00013	4432	CTD nr.1 Section
50	1	CTD	Bottom	Dec 06	2007 14:01:44	0.00027	-38.00023	4432	
50	1	CTD	End	Dec 06	2007 15:26:04	0.00008	-37.99995	4432	
51	1	CTD	Begin	Dec 06	2007 16:30:11	0.13365	-38.00043	4432	CTD nr.2 Section
51	1	CTD	Bottom	Dec 06	2007 17:51:59	0.13317	-38.0001	4432	
51	1	CTD	End	Dec 06	2007 19:13:49	0.13365	-38.00005	4432	
52	1	CTD	Begin	Dec 06	2007 20:16:30	0.26655	-38.0002	4432	CTD nr.3 Section
52	1	CTD	Bottom	Dec 06	2007 21:33:39	0.26695	-38.00015	4426	
52	1	CTD	End	Dec 06	2007 22:56:36	0.26692	-38.00012	4426	
53	1	CTD	Begin	Dec 06	2007 23:56:33	0.39992	-38.00038	3810	CTD nr.4 Section
53	1	CTD	Bottom	Dec 07	2007 01:05:25	0.40005	-37.99993	3804	
53	1	CTD	End	Dec 07	2007 02:19:28	0.39985	-37.99945	3804	
54	1	CTD	Begin	Dec 07	2007 03:26:40	0.53278	-38.00032	4487	CTD nr.5 Section
54	1	CTD	Bottom	Dec 07	2007 04:44:51	0.53315	-38.00022	4487	
54	1	CTD	End	Dec 07	2007 06:04:35	0.53308	-37.99983	4487	
55	1	CTD	Begin	Dec 07	2007 07:12:55	0.66662	-37.99998	4493	CTD nr.6 Section
55	1	CTD	Bottom	Dec 07	2007 08:29:07	0.66645	-38.00015	4487	
55	1	CTD	End	Dec 07	2007 09:49:44	0.66677	-38.0002	4493	
56	1	CTD	Begin	Dec 07	2007 10:56:32	0.79972	-38.00032	4481	CTD nr. 7 Section

56	1	CTD	Bottom	Dec 07 2007 12:15:27	0.7994	-38.00025	4481	
56	1	CTD	End	Dec 07 2007 13:31:20	0.79977	-38.0005	4481	
57	1	CTD	Begin	Dec 07 2007 14:41:22	0.93275	-38.00023	4469	CTD 8 Section
57	1	CTD	Bottom	Dec 07 2007 16:03:38	0.9334	-38.00012	4469	
57	1	CTD	End	Dec 07 2007 17:28:54	0.93318	-38	4469	
58	1	CTD	Begin	Dec 07 2007 18:48:02	1.06668	-38.00023	3957	CTD 9 Section
58	1	CTD	Bottom	Dec 07 2007 19:55:51	1.06672	-38.00007	3957	
58	1	CTD	End	Dec 07 2007 21:01:19	1.06657	-38.00008	3957	
59	1	CTD	Begin	Dec 08 2007 01:29:32	1.19992	-38.00002	4140	CTD 10 Section
59	1	CTD	Bottom	Dec 08 2007 02:39:58	1.20012	-38.00005	4140	
59	1	CTD	End	Dec 08 2007 03:51:24	1.19978	-38.00015	4140	
60	1	CTD	Begin	Dec 08 2007 05:03:54	1.3329	-38.00003	4152	CTD 11 Section
60	1	CTD	Bottom	Dec 08 2007 06:16:50	1.33318	-38	4146	
60	1	CTD	End	Dec 08 2007 07:35:07	1.33347	-37.99997	4152	
61	1	CTD	Begin	Dec 08 2007 08:43:18	1.46683	-38.0001	4115	CTD 12 Section
61	1	CTD	Bottom	Dec 08 2007 09:51:47	1.46663	-37.99993	4115	
61	1	CTD	End	Dec 08 2007 11:10:41	1.4667	-37.9999	4115	
62	1	CTD	Begin	Dec 08 2007 12:14:20	1.6003	-38.00032	4030	CTD 13 Section
62	1	CTD	Bottom	Dec 08 2007 13:21:14	1.60047	-37.99993	4030	
62	1	CTD	End	Dec 08 2007 14:36:55	1.60032	-38.00047	4030	
63	1	CTD	Begin	Dec 08 2007 15:45:14	1.73348	-38.00038	4231	CTD 14 Section
63	1	CTD	Bottom	Dec 08 2007 16:58:21	1.73297	-38.00017	4231	
63	1	CTD	End	Dec 08 2007 18:18:58	1.73332	-38	4231	
64	1	CTD	Begin	Dec 08 2007 19:25:23	1.86685	-38.00013	4426	CTD 15 Section
64	1	CTD	Bottom	Dec 08 2007 20:41:58	1.86672	-38.00002	4426	
64	1	CTD	End	Dec 08 2007 21:55:47	1.86665	-37.9999	4426	
65	1	CTD	Begin	Dec 08 2007 22:58:55	2.0003	-38.00057	4439	CTD 16 Section
65	1	CTD	Bottom	Dec 09 2007 00:11:09	1.99973	-38.00005	4432	
65	1	CTD	End	Dec 09 2007 01:29:16	2.00012	-38.00013	4432	
66	1	Seismic begin	Begin	Dec 09 2007 17:45:19	02:00.0	-40:43.53	4396	Line A
67	1	MultiBeam begin	Begin	Dec 09 2007 17:45:20	02:00.0	-40:43.53	4396	
68	1	Seismic end	End	Dec 09 2007 19:45:12	02:06.8	-40:43.50	4396	
69	1	Seismic begin	Begin	Dec 09 2007 19:45:55	02:06.9	-40:43.50	4396	Line B
70	1	Seismic end	End	Dec 09 2007 21:44:46	02:13.7	-40:43.50	3634	
71	1	Seismic begin	Begin	Dec 09 2007 21:46:47	02:13.8	-40:43.49	3634	Line C
72	1	Seismic end	End	Dec 09 2007 23:18:16	02:19.6	-40:43.50	2003	
73	1	Seismic begin	Begin	Dec 09 2007 23:50:39	02:19.6	-40:45.50	1990	Line D
74	1	Seismic end	End	Dec 10 2007 01:26:02	02:15.6	-40:45.48	2231	
75	1	Seismic begin	Begin	Dec 10 2007 02:39:01	02:18.0	-40:46.00	2145	
76	1	XBT	Begin	Dec/10/2007 02:48:11	2.30125	-40.75962	1952	X367
77	2	XBT	Begin	Dec/10/2007 02:54:34	2.30133	-40.75498	1961	X369
78	3	XBT	Begin	Dec/10/2007 03:03:15	2.30133	-40.74900	1596	X371
79	4	XBT	Begin	Dec/10/2007 03:06:14	2.30130	-40.74700	1586	X372
80	5	XBT	Begin	Dec/10/2007 03:09:09	2.30120	-40.74487	1590	X373
81	6	XBT	Begin	Dec/10/2007 03:12:46	2.30133	-40.74223	1315	X374
82	7	XBT	Begin	Dec/10/2007 03:15:29	2.30122	-40.74028	1299	X375
83	8	XBT	Begin	Dec/10/2007 03:18:17	2.30135	-40.73833	1311	X376
84	9	XBT	Begin	Dec/10/2007 03:21:05	2.30142	-40.73643	1323	X377
85	10	XBT	Begin	Dec/10/2007 03:23:50	2.30140	-40.73453	1347	X378
86	11	XBT	Begin	Dec/10/2007 03:26:49	2.30135	-40.73267	1353	X379
87	12	XBT	Begin	Dec/10/2007 03:29:34	2.30132	-40.73267	1371	X380
88	13	XBT	Begin	Dec/10/2007 03:32:13	2.30130	-40.72900	1426	X381
89	14	XBT	Begin	Dec/10/2007 03:34:52	2.30135	-40.72725	1518	X382
90	15	XBT	Begin	Dec/10/2007 03:37:43	2.30130	-40.72532	1829	X383
91	16	XBT	Begin	Dec/10/2007 03:40:26	2.30127	-40.72343	1847	X384
92	17	XBT	Begin	Dec/10/2007 03:46:07	2.30123	-40.71960	1884	X385
93	18	XBT	Begin	Dec/10/2007 03:51:58	2.30135	-40.71583	1902	X386
94	19	XBT	Begin	Dec/10/2007 04:03:37	2.30118	-40.70800	1926	X388
95	20	XBT	Begin	Dec/10/2007 04:09:27	2.30113	-40.70357		X389
96		Seismic end	End	Dec 10 2007 05:02:05	02:17.1	-40:40.94	2414	
97		Seismic begin	Begin	Dec 10 2007 05:53:00	02:18.0	-40:42.15	2341	
98		Seismic begin	Begin	Dec 10 2007 05:53:05	02:18.0	-40:42.15	2341	

99		Seismic end	End	Dec 10 2007 07:51:46	02:18.0	-40:34.87	4321	Line F
100		Seismic begin	Begin	Dec 10 2007 07:52:25	02:18.0	-40:34.83	4328	Line G
101		Seismic end	End	Dec 10 2007 09:46:55	02:18.0	-40:27.88	4413	
102		Seismic begin	Begin	Dec 10 2007 09:50:36	02:18.0	-40:27.66	4413	Line H
103	1	XBT	Begin	Dec 10 2007 10:17:11	02:18.0	-40:26.13	4413	X390
104	1	XBT	Begin	Dec 10 2007 10:23:38	02:18.0	-40:25.74	4413	X391
105	1	XBT	Begin	Dec 10 2007 10:29:16	02:18.0	-40.42247	4413	X392
106	1	XBT	Begin	Dec 10 2007 10:35:20	02:18.0	-40.41657	4413	X393
107	1	XBT	Begin	Dec 10 2007 10:42:06	02:18.0	-40.41007	4413	X395
108	1	XBT	Begin	Dec 10 2007 10:46:19	02:18.0	-40.40608	4413	X397
109	1	XBT	Begin	Dec 10 2007 10:49:32	02:18.0	-40.40277	4413	X398
110	1	XBT	Begin	Dec 10 2007 10:52:41	02:18.0	-40.40028	4413	X399
111	1	XBT	Begin	Dec 10 2007 10:56:11	02:18.0	-40.39702	4413	X400
112	1	XBT	Begin	Dec 10 2007 10:59:15	02:18.0	-40.39772	4413	X401
113	1	Seismic end	End	Dec 10 2007 12:04:03	02:18.0	-40:19.89	4413	
114	1	MultiBeam end	End	Dec 10 2007 12:05:06	02:18.0	-40:19.83	4413	Line cnt. 0054
115	1	Mooring deployment	Begin	Dec 11 2007 10:13:07	2.51802	-38.05855	4449	LOCO 18/4
115	1	Mooring deployment	End	Dec 11 2007 11:52:39	2.50147	-38.02657	4449	
115	1	Mooring deployment	ground	Dec 11 2007 12:35:26	2.53463	-38.02725	4425	
116	1	Mooring deployment	Begin	Dec 11 2007 18:40:55	2.01462	-37.69823	4425	LOCO 17/4
116	1	Mooring deployment	End	Dec 11 2007 20:05:55	1.9997	-37.6782	4437	
116	1	Mooring deployment	ground	Dec 11 2007 20:44:52	2.02865	-37.6611	4412	
117	1	Mooring deployment	Begin	Dec 12 2007 11:11:51	0.60203	-36.78078	4504	LOCO 15/4
117	1	Mooring deployment	End	Dec 12 2007 12:30:41	0.59953	-36.75772	4504	
117	1	Mooring deployment	ground	Dec 12 2007 13:04:51	0.62498	-36.75373	4504	
118	1	Mooring deployment	Begin	Dec 12 2007 19:43:42	0.00653	-37.02303	4492	LOCO 14/4
118	1	Mooring deployment	End	Dec 12 2007 21:24:23	0.0003	-36.98962	4492	
118	1	Mooring deployment	ground	Dec 12 2007 22:01:41	0.0256	-36.96617	4498	
119	1	Mooring recovery	released	Dec 13 2007 16:23:18	0.73388	-39.86128	1304	
119	1	Mooring recovery	Begin	Dec 13 2007 17:32:37	0.73302	-39.85695	1225	DOC 07-1
119	1	Mooring recovery	End	Dec 13 2007 18:36:17	0.73392	-39.88423	2073	
120	1	Mooring recovery	released	Dec 13 2007 19:01:24	0.75182	-39.86225	1439	DOC 07-2
120	1	Mooring recovery	Begin	Dec 13 2007 19:22:30	0.75612	-39.85378	1420	
120	1	Mooring recovery	End	Dec 13 2007 19:42:39	0.76717	-39.85897	1725	
121	1	CTD_Thermistor	Begin	Dec 13 2007 21:20:28	0.77828	-39.85327	1853	CTD file nr 200
121	1	CTD_Thermistor	Bottom	Dec 13 2007 21:58:27	0.77878	-39.8534	1865	
121	1	CTD_Thermistor	End	Dec 13 2007 23:06:13	0.77888	-39.85367	1871	
122	1	Mooring recovery	released	Dec 14 2007 08:32:59	1.29523	-39.2021	1573	DOC 07-3
122	1	Mooring recovery	Begin	Dec 14 2007 08:50:19	1.29992	-39.20542	1695	
122	1	Mooring recovery	End	Dec 14 2007 09:04:28	1.30165	-39.20628	1731	
123	001	CTD_Thermistor	Begin	Dec 14 2007 13:38:42	1.18147	-38.6827	4341	CTD file nr 201
123	001	CTD_Thermistor	Bottom	Dec 14 2007 14:14:08	1.18127	-38.68255	4341	
123	001	CTD_Thermistor	End	Dec 14 2007 15:20:52	1.18158	-38.68238	4341	
124	001	Mooring deployment	Begin	Dec 15 2007 00:09:25	0.953	-37.95323	4475	LOCO 16-4
124	001	Mooring deployment	End	Dec 15 2007 01:49:04	0.949	-37.90178	4481	
124	001	Mooring deployment	ground	Dec 15 2007 02:28:49	0.9811	-37.91908	4469	