National Oceanography Centre, Southampton

Cruise Report No. 6

RRS *Charles Darwin* Cruise 169

17 FEB - 19 MAR 2005

Hydrothermal exploration of the southern Mid-Atlantic Ridge

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2006

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ABSTRACT

The principal objective of this cruise was to identify the first site or sites of high temperature hydrothermal venting anywhere on the southern Mid-Atlantic Ridge, to characterize their geological setting, preliminary chemical nature and to identify, where possible, the nature of any vent-endemic species that might inhabit such vents to investigate whether this ridge system might represent a new biogeographic province. Initially we used the TOBI deep-tow sidescan system equipped with a CTD system and optical backscatter sensors, together with Miniature Autonomous Plume Recorders (MAPRs) to identify two new sites in which diagnostic chemically- and particle-laden plumes indicated the presence of high-temperature hydrothermal venting. Subsequently, we used the ABE autonomous underwater vehicle to (1) locate the core of one of these hydrothermal plumes, (2) obtain a detailed map of the underlying seafloor and (3) photograph three discrete hydrothermal sites (2 black-smoker systems, 1 diffuse-flow) and their associated ecosystems. A series of CTD stations were occupied for water column investigations and a number of rock-coring and dredging stations were also undertaken to provide groundtruthing of sidescan sonar images of the Mid-Atlantic Ridge seafloor.

KEYWORDS
ABE, ATLSE, BRIDGET, *Charles Darwin*, Cruise 169 2005, CTD, EM-12, hydrothermal activity, MAPRs, Mid-Atlantic Ridge, Red Lion, South Atlantic Ocean, TOBI, Turtle Pits, vent sites, Wideawake

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Mr. L.Fowler	(SOC, UK)		√		
Mr. M.Bridger	(SOC, UK)			√	
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ITINERARY

Departed:	Mindelo, Cape Verdes	17 Feb 2005
Port-call:	Georgetown, Ascension	04 Mar 2005
Arrived:	Georgetown, Ascension	18 Mar 2005

OBJECTIVES

The objectives of the cruise were three-fold:

(1) To locate and investigate the geologic setting of hydrothermal vent-plumes along the southern Mid-Atlantic Ridge, 2-7°S using TOBI equipped with in situ sensors.

(2) To precisely locate the first sites of venting to be found anywhere on the Southern MAR, using the ABE autonomous underwater vehicle equipped with in situ sensors.

(3) To obtain first geochemical, petrological and biological sampling and characterization of any new hydrothermal field and its surrounding environment.

NARRATIVE

Leg 1

The SOC scientific party for RRS *Charles Darwin* Cruise 169 arrived in Mindelo, Cape Verdes on 15th February 2005. Upon arrival in port, the ship was boarded (Feb 16th) ready to sail next day. With all gear and scientific party on board, the ship departed Mindelo, Cape Verdes at 09:30 (GMT) on 17 Feb (Julian Day 048) bound for the South Atlantic. After 24 hours of transit a preliminary test deployment of the CTD was conducted , to 500m, to aid with cleaning of the rosette's 10-L Niskin bottles (JD 49). As soon as this was completed, the TOBI deep-tow cable was streamed with a 450kg weight attached – an operation planned for the transit from Lisbon to the start of CD168 but which had not yet been completed. Once back inboard, full transit speed was resumed and at 11:32z on JD 050, multibeam mapping was commenced in international waters close to the Sierra Leone Rise. A total of ca.6.25 days transit was required to reach our planned study area, with the Equator being crossed at 16:23z on Julian Day 053. Due to high surface water temperatures close to the equator (often >30°C), ineffective operation of the ship's engines' cooling system required that transit speeds were often reduced significantly below 10kts during the course of the transit south, significantly delaying our initially-predicted arrival in the work area.

Scientific operations commenced on JD 054 (14:14z) with a multi-beam swath bathymetric survey along the length of the Mid-Atlantic Ridge axis from 02°34.20'S, 12°30.00'W as far as 05° 07.85'S, 12°18.54'W. Rather than complete our original multibeam survey plans, this swath mapping was interrupted at 10:00z on JD 55 when it was decided, for efficiency, to commence TOBI operations. Our goal was to survey this section of the ridge crest as efficiently available in the reduced time available using a single pass of the TOBI deep-tow sidescan vehicle rather than a double-swath as has more traditionally been used when investigating the Mid-Atlantic Ridge rift-valley.

Deployment of the TOBI deep-tow vehicle was commenced at 11:00z on JD 055 at 05°11.40'S, 12°17.80'W. Full deployment of TOBI + 6 MAPRs was complete by 12:26z and by 12:56z the TOBI vehicle was on course (ship's position 05°12.00'S, 12° 17.52'W) and being lowered to the seafloor to commence it's northward survey. Acquisition of survey data commenced at 15:20z when TOBI arrived at 800m above the seafloor. Ship's position at this time was 05°06.23'S, 12° 18.19'W. TOBI continued north with two minor computer failures at 18:45 on JD 055 and at 01:14 on JD 056. In the second case, no CTD etc data were acquired for ca.2 hours until 03:00z on JD 056. The TOBI survey continued north as far as ship's position 03° 58.61'S, 12° 11.68'W when, at 00:30z on JD 057 the TOBI system suffered a significant failure. The vehicle was recovered to 1000m wire-out by 04:56z and recovered in-board under daylight between 06:30 and 08:11z.

Next, a first scientific CTD station (CTD-01) was occupied at 04° 04.60'S 12° 16.19'W to a water depth of 4858m. The CTD station commenced at 09:54 on JD 057 and was recovered in-board at 13:15z. Following a brief test of the TOBI umbilical cord (13:53-14:08z) a first rock-core station was occupied at 04° 11.31'S 12°18.05'W in 3131m water depth. The rock corer was deployed at 15:10z on JD 057 and recovered at 18:30z. This station was not without mishap – it included a brief delay (17:52-18:05z) due to winch failure. Once the problem with the winch was confirmed resolved together with news that the TOBI system was not yet ready for further testing, a 2nd CTD station was occupied at 04° 00.34'S, 12° 13.05'W in 4222m. CTD-02 was deployed at 21:45z on JD 057 and recovered in-board at 01:27 on JD 058. Following this, a series of three further rock-core stations were occupied (RC-02, -03 and -04) at 04°6.10'S, 12°18.10'W; at 04°08.70'S, 12° 18.11'W and at 04°13.88'S, 12° 17.18'W respectively. Deployment times for these stations, in water depths of 3535m, 3350m and 2962m were 02:25-04:55z, 06:05-08:04z and 08:52-10:33z. By the end of this sequence the TOBI engineering team had completed their repairs and were ready to redeploy. To ensure overlap in our acquired sonar surveys – including re-interception of a hydrothermal plume revealed by MAPR data during the previous TOBI recovery, the ship was transitted SW from 04°13.77'S, 12°17.06'W at 10:40z on JD 058 to 04°05.49'S, 12°19.56'W (10:40-11:45z) prior to TOBI redeployment.

TOBI Leg 2 deployment was commenced at 13:02z on JD 058 and the complete system, including 6 MAPRs strung below and above the depressor weight that connects via the umbilical to TOBI itself were successfully deployed by 14:22z and data acquisition was commenced by 17:00z. The rest of this TOBI survey was conducted successfully, continuing until 15:00z on JD 059 when recovery of the vehicle at the northern limit of our detailed studies ended. The full TOBI + MAPR system was recovered in-board at 18:25z on JD 059 at ship's position 03°14.60' 12° 10.05'S. From 18:35z on JD059 the ship transmitted almost due south until 08:00z on JD060 ready for our third and final TOBI deployment.

TOBI leg 3 was commenced at 08:30z on JD 060 at 04°55.85'S 11°38.36'W. Full deployment of the TOBI + MAPR system was completed at 09:28z and TOBI was on course by 11:33z and acquiring sidescan sonar data before 12:00z. With the exception of some intermittent problems with the TOBI phase bathymetry system (06:18-07:12z on JD 061 and 05:16-05:21z on JD 062) the majority of TOBI leg 3 was conducted very successfully. At 06:52z on JD 062, however, Ship's power was lost completely while TOBI was still deployed to a wire out of >6,500m, surveying ca.350m above the seafloor approximately 6km astern of the ship. At 07:08z (16 minutes later) power was restored and the ship's speed increased to 2.9kts to prevent TOBI colliding with the seafloor. A further 25 minutes later (07:33z) winch power was obtained once more and TOBI operations recommenced. Approximately 80 minutes later, regrettably, all ship's power was lost once more (08:50z, JD 062). On this occasion TOBI was deployed with almost 7,000m of wire out, surveying 350- 400m above the seabed ca.6km behind the vessel. Although ship's power was restored very promptly on this occasion (08:53z) it still took a further 5 minutes to restore power to the scientific winches and hauling of the vehicle was commenced at 09:00z. At 09:02z communication was regained with the vehicle. During 12 minutes the vehicle had descended from

380m above the seafloor to 274m up at a rate of >8m/minute. Rather than fail to complete all aspects of our survey, the TOBI vehicle was now raised to >500m above the seafloor to complete our final period of survey (from 09:10z onward) – sufficiently deep to continue geophysical mapping but too shallow to have any merit for hydrothermal operations. Recovery of the TOBI vehicle was commenced at 10:32z on JD 062, enabling a complete single-swath sidescan survey to be completed all the way to the Ascension Fracture Zone. The full system of TOBI+MAPRs was recovered inboard between 13:01 and 14:05z on JD 062 at 06°48.63'S, 11°13.84'W. At that time course was made directly for Georgetown, Ascension Island (07° 54.00'S, 14° 25.02'W) where Leg 1 of cruise CD 169 ended (09:15z, JD 063).

Leg 2

Having embarked the 5-person ABE team from WHOI, USA, Leg 2 of Cruise CD 169 commenced with departure from our position anchored off Ascension Island at 17:00z on JD 063. Our target for Leg 2 of the cruise was the southern of two new hydrothermal plume sites located in the 2nd-order volcanically active ridge-segment at 5°S. During transit we attempted an off-axis background CTD station, CTD-03. The CTD rosette was deployed at 07:15z an lowered to 3390m at 6° 06.27'Sm 13°14.78'W. However, a fault was identified with the rosette CTD system that prevented any Niskin bottles from being fired and, hence, from any water samples being collected. The system was recovered inboard at 10:04z and transit continued toward the work area. At 13:18z a test station was occupied (5°41.90'S, 13°00'W) and the CTD-rosette lowered to 500m. Upon recovery in-board (14:05z) all 24 Niskin bottles were tripped successfully and it was decided to conduct a full background station immediately before proceeding. Station CTD 04 (5° 42.52'S, 12° 59.56'W) was commenced at 14:30z. The CTD-rosette was lowered to 3481m depth and recovered in-board at 17:26z after all 24 bottles had been fired.

At 23:45z on JD 064, the ship arrived back at the MAR ridge-crest and two rock-core stations were occupied. RC-05 (5° 06.91'S, 12° 19.17'W) was commenced at 23:55z, deployed to 3380m and recovered in-board at 01:39z on JD 065. RC-06 (5° 04.02'S, 12° 17.29'W) was commenced at 03:40z, deployed to 3599m and recovered in-board at 05:51z. From 05:57z until 08:15z an additional line of swath bathymetric mapping was conducted to provide a more comprehensive coverage of the segment prior to ABE deployment, between 4°54.05'S, 12° 25.90'W and 4° 43.93'S 12° 28.26'W and demarcating the western boundary of the segment-centre's rift-valley. Upon completion of this swath survey, the first ABE transponder (TX-01) was deployed at 10:04z at 4° 47.91'S 12° 24.72'W. Transponder 'D' reached the seabed at 10:51z and the required navigation survey was completed approximately 1 hour later at 11:55z.

At 13:09z on JD 065, station CTD-05 was occupied at 04° 45.98'S, 12° 23.01'W. The deployment was commenced at 13:09z but a fault was detected at 13:19z after lowering to just 50m depth. The vehicle was hauled out of the water but not recovered in-board at 13:27z and redeployed at 13:33z after being re-set. At 13:44z the CTD computer system failed again (CTD @ 100m water depth) and was re-set. With no visual display but digital data available it was decided to continue with the cast and the CTD was deployed to 3146m at 14:51z. Immediately upon attempting to fire Niskin bottles through the rosette command system, however, the CTD suffered a major system failure and was recovered in-board at 15:54z with no water samples taken. At 16:45z, the first BRIDGET tow-yo of the cruise was attempted. Deployment of BGT-01 commenced at 17:10z at 4° 43.26'S, 12° 25.07'W. The vehicle was lowered to the proposed survey depth of 2720m at 19:01z having reported numerous operating errors throughout the deployment, Test firings of the BRIDGET rosette were continued until 19:28z and the vehicle was recovered inboard at 20:55z at 4° 44.95'S, 12°23.05'S still north of the segment centre and without any useable data recorded. At this stage

neither the CTD-rosette nor the BRIDGET deep-tow vehicle were operational to guide our hydrothermal exploration programme as intended.

At 22:20z on JD 065, our second transponder (transponder 'B') was deployed at 4° 47.28'S, 12° 21.33'W (TX-02) followed by the third and final transponder (transponder 'A') which was deployed at 4° 49.53'S, 12° 22.47'W (TX-03) at 02:40z on JD 066.

In the continuing absence of either operational system from RSU intended for conducting hydrothermal plume detection and location it was decided to improvise by deploying a series of self-recording MAPR plume-instruments at fixed intervals along the TOBI deep-tow cable attached to the depressor weight. Deep Underwater MAPR deployments (DUM-01) was commenced at 05:30z on JD 066 at 4° 48.80'S, 12° 26.14'W, south of the segment centre. A series of way-points were selected for the ship to sail a grid although the only navigational aid on the DUM instrument-package as deployed was a pinger to detect height off-bottom. After multiple attempted passes across the breadth of the seafloor, from south to north, the DUM-01 system was recovered in-board at 05:46z on JD 067 at 04° 45.72'S 12° 28.71'W, north of the segment centre.

Following the DUM-01 recovery, two rock-core stations were occupied. RC-07 (4° 48.64'S, 12°23.24'W) was commenced at 07:34z but recovered at 07:52z and only re- deployed in the correct location at 08:37z on JD 067. The package was deployed to 3129m at 09:24z and recovered inboard at 11:19z after further delay due to a winch failure encountered during recovery of the rock-corer. RC-08 (4° 46.24'S, 12° 22.62'W) was less troublesome. After arriving on station at 11:33z, the rock-corer was deployed at 12:02z, deployed to 3143m by 12:57z and recovered in-board at 14:00z.

Following a brief transit, a CTD test-deployment was conducted to 500m at 4° 48.50'S 12° 21.17'W (15:00-15:42z) and then preparations were made for first deployment of the ABE autonomous underwater vehicle. Dive ABE-150 commenced with deployment at 4° 48.50'S, 12° 21.10'W – launch operations commenced at 16:20z and the vehicle was released at 16:35z. Tracking of the vehicle was continued until 18:00z and transit was then made to the next CTD station.

Station CTD 06 was occupied at 4° 49.74'S, 12° 21.82'W. The system was deployed at 18:30z on JD 067, lowered to 2890m at 19:45z and recovered in-board at 21:25z. A further station, CTD 07, was then occupied at 4° 46.95'S, 12° 23.55'W. This station was commenced at 23:15z on JD 067. The CTD-rosette reached a maximum depth of 2995m at 00:17z on JD 068 and was recovered in-board at 01:42z. Following these two CTD stations, three rock-cores were collected. RC-09 (4° 48.89'S, 12° 22.91'W) was commenced at 03:00z. The rock-corer was deployed to 3034m at 03:44z and recovered in-board at 04:40z. RC-10 (4° 47.67'S, 12° 22.00'W) was commenced at 05:45z, deployed to 3086m at 06:33z and recovered in-board at 07:32z. Rock core RC-11 (4° 50.93'S, 12° 22.25'W) was commenced at 08:43z, deployed to 3155m at 09:40z and recovered in-board at 10:45z.

Following stem-down (for ABE tracking) transit, station CTD 08 (4° 48.65'S, 12° 21.81'W) was commenced at 11:50z deployed to 2852m at 12:57z and recovered in-board at 14:45z. At this time a problem was found with the hydrowire and all science operations had to be suspended for a further ca.4.5 hours from 15:00 until 19:25z until the problem was resolved.

CTD 09 (4° 47.68'S, 12° 22.03'W) was commenced at 19:31z on JD 068, deployed to 2985m at 20:40z and recovered in-board at 21:55z. At this stage it was considered incautious to commence any further over-the-side operations prior to ABE recovery. Instead, the ship was transitted to the AEB recovery position, arriving on-location at 22:45z at 4° 47.44'S, 12°24.58'W. ABE surfaced at 23:40z on JD 068 and dive ABE 150 was completed with recovery in-board at 00:32z on JD 069.

A series of four rock-cores were occupied next. RC-12 (4° 45.97'S, 12° 23.84'W) was commenced at 01:42z on JD 069 but only reached the seafloor at 3062m at 04:35z due to a hydraulic pipe rupture that interrupted operations from 01:52z to 03:40z – a further 2 hours of lost science time. The station was finally completed at 05:40z. RC-13 (4° 47.44'S, 12° 24.66'W) was commenced at 06:18z, deployed to 2831m at 07:15z and recovered in-board at 08:11z. RC-14 (4° 49.59'S 12° 24.05'W) was commenced at 0907z, deployed to 2884m at 10:02z and recovered in-board at 11:05z. Finally, RC-15 (4° 50.18'S, 12°23.23'W) was commenced at 11:31z, deployed to 3051m at 12:30z and then recovered in-board at 13:40z. Over-the-side science operations were then interrupted to proceed to the ABE 151 launch site.

Having arrived on station at 4° 48.53'S, 12° 48.53'W, ABE was not yet ready for deployment. Instead a further CTD test-deployment was conducted to 500m (1705-1736z, 4° 48.68'S, 12° 23.01'W). ABE deck-testing was completed at 18:04z and at 18:53z on JD 069, dive ABE 151 was commenced at 4° 48.57'S, 12° 22.95'W. Following monitoring of ABE;s descent to the seafloor, station CTD 10 was occupied close by at 4° 47.95'S, 12° 22.51'W. The system was launched at 19:50z, deployed to a maximum depth of 2985m at 20:54z and recovered in-board at 22:28z. At that time the USBL navigation pod was raised and transit commenced to the north leaving ABE Dive 151 in progress at the segment centre.

At 01:30z on JD 070, the ship arrived on station to commence dredge DR-01. This station commenced at 4° 38.27'S, 12°25.46'S, deployed to the seafloor at 3596m between 03:00 and 05:35z and was recovered in-board at 07:35z at 4° 39.11'S, 12° 24.80'W. The ship then returned south conducting two further swath survey lines in the northern portion of the ridge segment (08:17z-09:35z) before re-deploying the USBL stem ready for station CTD-11 (4° 48.57'S, 12° 22.33'W) followed by ABE recovery. Deployment for CTD-11 was commenced at 10:48z, reached a maximum depth of ca.2980m at 11:46z and was recovered inboard at 13:21z. A 3.5 hour delay then resulted while awaiting ABE's return from the seafloor.

At 17:00z, dive ABE 151 was completed with recovery of the AUV inboard at 4° 47.50'S, 12° 23.20'W. A further period of swath mapping was conducted next, north of the segment centre once more (17:25-19:50z) en route to a further dredge station. Station DR-02 was commenced at 4°44.33'S, 12° 23.41'W at 20:10z on JD 070. The dredge was deployed to the seafloor at 3247m between 21:50 and 22:50z and recovered in-board at 00:43z on JD 071 at 4°45.33'S, 12° 21.90'W.

Returning to the segment centre, the ship arrived on station for CTD 12 at 01:25z on JD 071. Upon arriving on station, however, a further problem with the CTD-rosette was encountered. Station CTD 12 was attempted again at 04:14-04:37z (4° 47.86'S, 12° 22.56'W) but immediately upon entering the water significant errors were encountered. At 07:01z the CTD system was ready for re-deployment once more but, again, significant problems were encountered with the system and the station was abandoned at 07:13z. Once again, we were without any mechanism for meaningful water column hydrothermal plume investigations and over-the-side water column operations were brought to a complete stop. Fortunately AUV operations continued.

At 1030z on JD 071 ABE passed its deck-test for dive 152 and was ready for launch at 1100z when the ship's crane suffered an untimely failure. Dive ABE 152 was subsequently initiated at 12:52 with the vehicle launched at 4° 48.69'S, 12° 22.51'W. The vehicle was tracked to the seafloor and confirmed to have started its mission successfully at 15:30z. In the continuing absence of an operational CTD system it was decided, next, to attempt a further operational test of the BRIDGET system previously deployed on JD 065.

BRIDGET tow-yo BGT-02 commenced at 17:24 on JD 071 at 4°45.80'S, 12° 23.70'W. The vehicle was deployed to ca.2800m by 19:44z although by that time it had suffered multiple system

crashes starting at 18:11z with the instrument at less than 1500m depth (i.e. ca. half desired operational depth for this cruise). At depth operations were continued, with multiple system resets required until 20:39z at which point recovery was commenced. The BGT-02 deployment was concluded at 22:49z on JD 071 at 4° 50.13'S, 12° 21.89'W. Although the tow-yo conducted had approached and ended directly above hydrothermally active centre of this second-roder ridge segment, no useable data had been acquired. This vehicle was supposed to operate as the instrument of choice for Leg 2 of cruise CD169 to guide subsequent ABE operations. Instead, half of the shiptime available for this leg had now expired, ABE was already conducting its first near-bottom vent-location dive, but the BRIDGET vehicle was still inoperational, as was the conventional CTD-rosette.

For the next operation, rock core station RC-16 was occupied at 4° 48.28'S, 12° 21.51'W. The corer was deployed at 01:30z on JD 072, deployed to 2898m at 02:29z and recovered inboard at 03:40z. The ship then transitted to the recovery position for ABE arriving on station at 04:05z. ABE surfaced at 05:45z and was recovered in-board at 05:15z at 4° 48.64'S, 12° 23.03'W. A series of swath survey lines were then occupied extending through the southern portion of the segment between 4° 49.8'S and 5° 08.2'S and then extending along the eastern and western boundaries of the previously mapped segment centre, 4° 32-49'S. This swath survey was conducted between 06:45z and 18:06z including brief interruption for a CTD test-deployment to 1000m (CTD-14) at 5° 8.17'S, 12° 11.71'W, 10:30-11:20z.

At 20:00z, rock-core station RC-17 (4° 48.65'S, 12° 22.65'W) was commenced. The corer reached 3054m at 20:59z and was recovered inboard at 22:05z. The ship was then repositioned for a further rock-core station but the sudden availability of the CTD-rosette again at 22:25z meant that the next rock-core station was postponed and the ship re-positioned for station CTD-15 at 4° 48.58'S, 12° 22.41'W. This station was commenced at 23:21z on JD 072 and reached a maximum water depth of 2975m at 00:25z on JD 073. The CTD-rosette was recovered in-board at 03:19z.

The next operations were a series of three closely spaced rock-core deployments. RC-18 (4° 47.78'S, 12° 22.53'W) was deployed at 05:28z, reached 3020m at 06:24z and was recovered at 07:25z. RC-19 (4° 48.04'S, 12° 22.60'W) was deployed at 07:44z, reached 3010m at 08:48z and was recovered in-board at 09:50z. RC-20 (4° 47.25'S, 12° 22.85'W) was deployed at 10:10z, reached 3094m at 11:11z and was recovered in-board at 12:11z.

Following these operations the ship was re-positioned ready for launch of dive ABE 153 and the USBL stem was lowered accordingly (13:23z). Prior to commencement of this ABE dive, however, station CTD-16 was occupied (4° 47.80'S, 12° 22.61'W). Deployment commenced at 14:25z, a maximum depth of 2991m was reached at 15:47z and the instrument was recovered in-board at 17:19z. After passing deck-tests, dive ABE 153 was successfully launched at 4° 48.08'S, 12° 22.76'W some 2.5 hours later, at 19:59z.

After confirming that ABE had descended safely to the seafloor and begun its survey as planned, the ship transited south for rock core station RC-21 at 4° 50.16'S, 12° 21.97'W. The corer was deployed at 21:30z, reached 3012m depth at 22:32z and was recovered in-board at 23:30z. The ship then returned north for dredge station DR-03. This dredge was initiated at 00:57z on JD 074 at 4° 46.35'S 12° 23.19'W. After deployment along the seabed from 02:02-03:16z the dredge was recovered in-board at 04:50z at 4° 47.45'S 12° 21.87'W. When all was secure transit was made to the ABE recovery site. Despite initial problems with communication with the vehicle confirmation was received that the vehicle was ascending through the water column at 10.50z. Dive ABE 153 was eventually completed at 13:55z when the vehicle was recovered in-board at 4° 49.80'S 12° 22.04'W.

Although it was intended that ABE should be re-deployed as soon as possible following dive ABE 153, the opportunity was taken to occupy a further CTD station (CTD 17, 4° 48.34'S, 12° 22.30'W) while ABE was being prepared for redeployment. CTD 17 was deployed at 14:45z, reached a maximum depth of 2952m at 16:04z and was recovered inboard at 17:46z. The ship then proceeded to the Dive ABE 154 deployment site, arriving on-station at 19:00z. Dive ABE 154 was initiated at 20:39z when the vehicle was released at 4° 48.63'S 12° 22.71'W.

After deployment the vehicle was monitored during descent to the seafloor and commencement of its pre-programmed survey and then, at 21:31, transit was made to our final dredge station. DR-04 was deployed at 21:56z at 4° 47.63'S 12° 22.69'W. The dredge was lowered to the seafloor and remained on-bottom from 23:29z on JD 074 to 01:10 on JD 075. It was recovered in-board at 4° 44.96'S, 12° 20.85'W at 02:45z on JD 075.

The final rock-sampling station of the cruise followed – rock-core RC 22 located at 4° 49.28'S 12° 21.89'W. The rock core was deployed at 03:35z, lowered to the seafloor at 2927m at 04:31z and recovered inboard at 05:28z. During lowering of the rock-core, confirmation was received from ABE that it had finished the mission for Dive ABE 153 and was returning to the surface. The ship arrived at the ABE recovery position at 06:00z, ABE surfaced at 06:33z and was recovered in-board at 4° 48.39'S, 12° 22.45'W at 06:51z on JD 075 approximately 10 hours after launching.

As soon as ABE was recovered, a final CTD station was occupied. CTD-18 (4° 48.61'S, 12° 22.39'W) was deployed at 07:12z, lowered to a maximum depth of 2959m at 08:20z and recovered in-board at 09:53z. Following rapid downloading of data and recharging of batteries, the ship then repositioned for final dive ABE 155. The ship arrived on-station, above the Red Lion vent-site, at 11:40z. There was a 60 minute delay in deployment to guard against ABE's camera over-heating and the vehicle was launched at 4° 48.02'S 12° 22.68'W at 12:51z.

Our penultimate over-the-side operation was a vertical cast of 4 stand-alone pumps (SAP02) at 4° 48.5'S, 12°22.3'W. Deployment started at 13:35z and concluded at 20:13z. Pump operations were conducted from 16:16-18:16z. Following recovery of the SAPs in-board the ship transited north for a third and final attempt at use of the BRIDGET vehicle. Tow-yo BGT-03 commenced at 21:40z on JD 075 at 4° 44.97'S 12° 24.44'W but had to be recovered inboard at 21:53 and the ship repositioned for re-deployment at 23:58z, JD 075, at 4° 45.77'S 12° 23.83'W. From 01:30-03:34z on JD 076, BRIDGET reportedly operated very successfully at the required depths, between 2700m and the seafloor detecting nephelometer and Eh anomalies and closing Niskin bottles upon demand. This performance sadly came too late to be of any benefit to the cruise and, further, none of the data displayed in real time was logged in a manner that could be accessed during the remainder of the cruise – although the data were subsequently recovered from the logging computer and restored to the PSO, post-cruise. At 04:53z, JD 076, BRIDGET was recovered in-board at 4° 48.55'S 12° 21.78'W having been tow-yo'ed directly across the 5°S MAR vent-sites.

At 05:55z ABE returned to the surface for the last time and transponder "B" was released at 05:56z. Dive ABE 155 was concluded at 06:22z when the vehicle was recovered in-board at 4° 48.30'S 12° 27.25'W. The remaining navigation transponders were released and recovered between 07:06z and 09:30z. At this time, science operations were broken off from 4° 49.71'S 12° 22.53'W and passage made direct to Ascension Island.

Leg 2 and, hence, the entire scientific operations of RRS *Charles Darwin* Cruise CD 169 were completed with the disembarkation of the scientific party by pilot boat at Ascension Island at 08:50z on JD 077.

The ship's track followed by RRS *Charles Darwin* during CD 169 is shown in Figure 1. A diary of events is given as Appendix A and Science Logs for Legs 1 & 2 are given as Appendices B & C.

(C.German)

SCIENTIFIC REPORTS

1. EM-12 Multi-beam Bathymetry.

1.a) Introduction

The Simrad EM-12 is a 13kHz multibeam echo sounding system, designed to operate in water depths from 50m to 11,000m (full ocean depth), using 81, 1.5^{o} equidistant beams providing 120^{o} coverage. The theoretical swath width in deep water recording mode is up to 7.4 times water depth, although this coverage is restricted by speed of advance of the ship, character of the seafloor and weather conditions. Typical value for the coverage during CD169 was approximately three times water depth.

The EM12 is composed of transducer arrays, a transmitter subsystem, a receiver subsystem, including beam-forming and special digital signal processors, a Bottom Detection Unit (BDU), and an Operator Unit (OPU) with external interfaces for data input and output on serial line and Ethernet. Also included are the Quality Assurance Unit (QAU) and Sonar Imaging Unit (SIU).

The transmit fan is split into several individual sectors with independent active steering according to vessel roll, pitch and yaw. This places all soundings on a "best fit" to a line perpendicular to the survey line. The sectors are frequency coded (12.7, 13.0 and 13.3kHz) to avoid interference (the outer beams have the lower frequency to optimise coverage). The steering is fully taken into account when the position and depth of each sounding is calculated, as is the refraction due to the sound speed profile, vessel attitude and installation angles. The ping rate is only limited by the round trip travel time in the water.

The transceiver unit uses a combination of phase and amplitude detection, resulting in measurement accuracy on the order of 50cm or 0.2% of depth RMS (whichever is greater), practically independent of beam pointing angle.

At the beginning of survey the BDU is configured with the relevant settings required, i.e. mode (deep or shallow), beam coverage and weather conditions, for example. The BDU determines the range to the bottom in every beam using data from the transceiver unit, and transfers the ranges to the OPU. The OPU, is the operator interface of the EM12, does the final conversion from beam ranges to position and depth on the seafloor, and interfaces with other systems in the ship, e.g. gyro, DGPS. The OPU also uses the sound velocity information to calculate the beam ranges into depths.

Both BDU and OPU are located in the ship's plot. From here it is possible to quality assure the data as it is acquired.

The Mermaid software, housed on the Mermaid UNIX workstation, also in the plot, is where the swath data is stored. Here the cruise identification, CD169, is logged and all acquired data transferred to that ID directory. The Mermaid UNIX workstation also houses the Merlin software. This allows visualisation of data acquisition, where if any loss of data should occur, adjustments could be made to the BDU/OPU settings. A Merlin slave display unit was also available in the main scientific laboratory for watch keepers to keep an eye on data quality.

The swath data is initially processed on the OPU and logged as a line number. These line numbers have to be manually incremented on the OPU, in order to assure no loss of data should the system fail. Upon line number change the raw data is automatically copied to the Mermaid system where it is stored.

1.b) Data acquisition and system performance

In order to acquire accurate swath data two operations may need to be performed. Firstly a sound velocity profile (SVP) is required in order that the OPU can accurately calculate true depths. Second it may be necessary to run a calibration survey, in order to check the roll and pitch bias.

The EM12 was activated soon after departure from Cape Verde, but due to the fact that for cruise CD169 swath data was not required until we reached our survey area, which was 6 days transit, we did not acquire a SVP, as this was intended to be done shortly before the swath survey commenced, or perform a calibration survey. However, once the system was logging and using the SVP installed, following cruise CD168, it was found that the quality of the data was good and did not merit a calibration check. Although with increasing distance from Cape Verde, some deterioration of the data could be seen as a result of not applying a SVP relevant to the region of transit.

Upon arrival at the start of the survey area, time constraints, due to a slower than expected transit, meant that no SVP was acquired. However SVP information taken from an Expendable Bathy Thermograph (XBT), acquired during a previous cruise to the region (JR65, 1991), was input to the OPU.

The Swath survey began at 17:37 on the 23rd February 2005 at 2° 55.98'S 12° 14.12'W.The intended use of the survey was to fill-in gaps in existing swath data and to locate a ridge axis where no swath data existed. This was necessary in order to produce a "road map" by which the TOBI (Towed Ocean Bottom Instrument) sidescan sonar instrument could be flown. Due to the time constraints generated by the slow transit, the swath survey was cut short. The survey ended at 10:04 on the 24th February 2005 at 5° 08.43'S 12° 18.39'W.

Data quality throughout was good with very little deterioration, other than some noise in the outer 5 to 10 beams on either side. The new data was processed and merged with the existing data (see later). This new data set was then used to generate bathymetry plots by which TOBI could be navigated during TOBI's first two deployments.

Due to the reduced swath survey area, the EM12 was also used during TOBI survey 03. This survey was to "fly" over a section of the ridge where our existing data had some data gaps. As the TOBI vehicle is towed up to 4km behind the ship, it was possible to print off a screen dump of the swath, which was several kms ahead of the TOBI vehicle and fill in the gaps on our printed swath plots. This data was again of good quality and processed to be merged with the existing data.

At the end of TOBI survey 03, just prior to our transit into Ascension, for a crew change, the ship lost all electrical power resulting in the EM12 shutting down. Once the ships power problems were rectified, the EM12 was re-started. However during the 19hr transit to Ascension, there were problems with the EM12 data, where a time error between the OPU time and DGPS input time occurred. All the raw data for this period is currently inaccessible for processing.

During the crew change at Ascension the EM12 was re-booted. This involved the powering down of the system. Upon re-start the time problem had seemingly been rectified and logging was again resumed.

EM12 data was acquired during the transit out to the designated working area, approximately 200M north of Ascension, for CD169, leg2. Although no specific swath surveying was required during leg 2, wherever possible the EM12 was left on to acquire data in an ad-hoc fashion. This proved to be valuable in that during transit from one station to another additional data could be added to that which previously existed.

Also during leg 2, where time allowed between other instrumentation down times, swath data was acquired along the flanks of part of the ridge section that had never been swathed, prior to leg 1. This allowed an increased understanding of the regional setting of the survey area where all work during leg 2 occurred. (It was necessary to set the transmit mode of the EM12 to "off" when close to the ABE survey areas, as the 13kHz frequency of the EM12 affected their transponder signals. This resulted in the EM12 being switched on and off frequently and for varying periods of time.)

During one of the ad-hoc ridge flank surveys, the problem, which occurred after the power loss, recurred. This resulted in abandoning the survey. It was established that the clock on the OPU was 7min different to that on the DGPS. Once the problem was identified it was simply a case of manually setting the time on the OPU to tie-in with the DGPS input signal. (The error manifested itself by displaying the message "Time dif –378570 millisec between pos and ping to big" on the Merlin consol as well as there being no data visual on the Merlin window.)

A total of 85 swath lines were logged and processed (line numbers not incremented by any fixed time period). Of these 85 lines 17 were not available due to the OPU time problems (a total of 21hrs worth of swath data).

A full list of swath survey data is logged at Appendix D.

(A.Evans)

2. TOBI Operations.

The Towed Ocean Bottom Instrument (TOBI) deep tow vehicle was deployed and recovered three times during CD169, between1030z (JD 055) – 0811z (JD 057), 1314z (JD 058) – 1825 (JD 059), and 0814 (JD060) – 1405 (JD062).

The proposed survey plan was to use the EM12 multibeam bathymetry data acquired during the earliest part of the cruise to design the acquisition of two parallel, marginally overlapping sonar swaths, occupying reciprocal tracks through the axial valley of a least four of the second order ridge segments closest to the Ascension Fracture Zone. Due to time constraints, however, only a single pass was made, covering a six-kilometre swath central to the axis. Approximately 2700 square kilometres of ridge axis were insonified producing high quality images of extensive fresh-looking sheet flow packages and more MAR-typical, constructional volcanic ridges. Heavily sedimented, broad non-transform discontinuities linking the segments appear to host localised volcanic activity in intermediate 'relay' pull-apart basins.

Additional instrumentation carried by TOBI also produced key results for the cruise. A nephelometer on the vehicle forming part of the hydrothermal particulate monitoring suite (see Science Report 5 on MAPRs, below), confirmed in real time the presence of hydrothermal plumes at a number of sites within the segments studied. Phase difference sonar data were continuously collected for post-cuise processing into interferometric bathymetry. Finally, chirp seismic profiler and three component magnetometer data acquired will constrain high resolution topographic and magnetic field variations, respectively, for comparison with ABE AUV data in the focus study area (see Science Report 6, below).

It is worth noting that the complementarity of the imagery acquired using the 30kHz TOBI sidescan and both the SMS2000 multibeam and 675 kHz scanning altimeter on ABE produced a very powerful integrated dataset for analysis of neovolcanism and neotectonic processes at mid-ocean ridge systems.

(I.Rouse, L.Parson)

3. BRIDGET Operations.

The BRIDGET deep-tow system is a deep-tow CTD+sensor unit for the identification, investigation and sampling of hydrothermal plumes. The instrument was a joint development, under the NERC's BRIDGE programme, between the University of Cambridge and the former Institute of Oceanographic Sciences Deacon Laboratory (1993-1995). In 2001, BRIDGET was formally transferred into UKORS ownership to become part of the National Marine Equipment Pool.

The BRIDGET deep-tow carries the following sensors and samplers:

- FSI Micro CTD Ser. No. 1327 (BRIDGET CTD)
- FSI Micro CTD Ser. No. 1359 (TOBI CTD borrowed as a spare)
- Chelsea Instruments Alphatracka Transmissometer 25 cm. pathlength.
- Chelsea Instruments Aquatracka nephelometer.
- SeaTech Light Scattering Sensor (LSS)
- General Oceanics 12 position rosette pylon (modified) equipped with 12 x 2.5 litre Niskin bottles.
- Simrad Mesotech Acoustic Altimeter (500 metre range).
- Dual clinometer attitude sensor and flux gate magnetometer compass unit

For the second cruise running (following CD128 to the Central Indian Ridge in 2001) this was not a happy cruise for BRIDGET. A major limitation for most of the cruise was that there were significant teething problems with the new version of software that had been developed to interface the vehicle subsequent to transfer into UKORS. As the very final operation of the cruise, however, a successful CTD tow-yo was completed and, although the stored data could not be accessed at sea, real-time success was apparent during the cast, as projected onto the controlling computer's display scheme and the recorded data was successfully recovered from the relevant hard-drive post cruise. After some years in the wilderness, it is to be hoped that BRIDGET will once again be ready to serve again as an international state-of-the-art survey vehicle in years to come.

(C.German, D.White)

4. CTD operations

4.a) CTD sensor configuration

CTD configurations and calibration factors are listed in Appendix E reflecting changes as they occurred during the course of the cruise. Main system sensors are given in Table 4.1. In addition to those listed below an experimental E_h sensor was deployed for all casts, physically attached to the stabilising fin and giving direct, voltage, readout to Voltage channel 5 (V5), while external Mn and Fe sensors were attached to the frame on an occasional basis. These latter sensors did not contribute to the Sea Bird data stream.

SENSOR / SYSTEM TYPE	SERIAL No	REMARKS
Sbe 9+ CTD	09p-1987-0528	Main ctd, 24 way st st frame
Digiquartz pressure sensor	73299	
Sbe 03p temperature sensor	03p-4489	primary
Sbe 03p temperature sensor	03p-4490	secondary
Sbe 04c conductivity sensor	04c-3052	primary
Sbe 04c conductivity sensor	04c-3054	secondary
Breakout box	B019109T	
Sbe 5T pump	2793	primary
Sbe 5T pump	3607	secondary
Sbe dissolved oxygen	43-0709	
Sbe 32 carousel	32-19817-0243	
Deck unit	11p34173-0676	spare
Deck unit	11p23680-0587	Main unit
BBRTD scattering meter	169	
Transmissometer	161/2642/002	
Fluorometer	88/2360/108	
seapoint OBS	10491	

Table 4.1 : CTD main system sensors

4.b) CTD Deployments

22 individual CTD casts were conducted during the course of the cruise. Of these, 5 were test casts to 500 or 1000 meters to test system performance after faults developed (see later in text) or to fill the Niskin bottles with water from depth to leach contaminants. Two casts, casts 012 and 013, were aborted at 70 metres and 30 metres respectively and are not included in cast records but do influence the total cast number.

The arrangement of sensors differed during the CTD programme in an attempt to rectify performance issues. These changes are given in Table 4.2; configuration files with relevant changes are included in Appendix D.

CTD cast logging was always begun on deck. The instrument package was lowered into the water with minimal pause at the surface, taken to 3 meters and held there for 5 minutes. This was to allow the Mn, and Fe (if present), sensors to prime their pumps, and to allow the Sea Bird T/C pumps to start and stabilise readings. Following this wait the package was lowered directly to a predetermined depth calculated to be approximately 50 meters above the seafloor. At this point a decision was made to continue the downcast depending on the output of the Beam Transmission, Optical Backscatter Sensors and Eh sensor (V5) as indicators of hydrothermal plumes in that vicinity. Bottle firing sequences were decided at the lowest point of the cast on the basis of this

same information but including any temperature anomaly information if observed. If conditions were appropriate and indicated the close proximity of fresh vent fluids, for instance the presence of a buoyant plume or temperature anomaly, the instrument package was "Tow-yo'd" up and down through the plume for more comprehensive sampling.

Station Number	Cast Number	System Changes
Test 2	005	Seapoint OBS removed for this cast
006	008	Deck Unit and Logging computers swapped. New *.con file in accordance.
010	014	Seapoint OBS to V3, Fluorometer to V4, BBRTD to 2. New *.con file in accordance.

Table 4.2: CTD configuration changes

4.c) CTD Performance

The CTD system suffered a number of problems during the course of the cruise. In retrospect these may be related to the same cause though, at the time, they manifested themselves in such a way that other causes were indicated.

Issues first arose on cast 004 (Station 003) when, at the end of the downcast, the Deck Unit registered an error, the modem link to the SBE 32 carousel was lost and bottles could not be fired either via software or manually. The unit was examined on deck and no problems could be found after cycling the power. A test dip was conducted, cast 005 (station "Test 2") to 500 metres and all bottles were fired successfully though modulo error counts, indicating communication errors, were higher than expected. It was decided to continue the CTD programme and cast 006 (Stn. 004) was successful in all respects. The problems recurred on cast 007 (Stn. 005) when on start up the Deck Unit failed to initiate until the third attempt. Logging computers were extremely unstable with a propensity to hang at the NMEA (GPS) acquisition stage and the main overlay display was not responding. Attempts to refresh the display caused the software to crash. This first occurred at 50 metres and the instruments were brought to the surface and restarted. The second occurrence was at 100m and the system was reset and the downcast was continued from there. Upon firing the first bottle the software running on the data collection computers once more crashed. Subsequent attempts to fire a bottle via software also cause the same effect and the Deck Unit modem status light was out. Attempts to fire the bottles manually from the Deck Unit were unsuccessful. The Deck Unit was left running and the package brought to the surface with no water samples being taken. Upcast instrument data was still logged under the new name of cast 005A on the backup computer only. Further investigation on deck indicated modem communication problems and the Deck Unit was replaced with the spare unit (s/n 11p34173-0676). Data logging computers were also swapped at this point as the Sea Bird software, during modem communication periods, seemed more stable on the Windows 2000 operating system than under Windows XP. Continued tests of the rosette firing mechanism indicated difficulty firing some positions on a regular basis. The trigger mechanism was removed and thoroughly cleaned. This appeared to fix the problem.

Problems next arose in the set up for casts 012 and 013 when the Deck Unit failed to start up completely when powered on. Over the course of these two casts various remedies were applied to what was a very intermittent problem but which appeared, at least in part, temperature related. Sometimes the system would appear to be stable only to crash an hour later. A new pigtail was attached to the CTD wire termination, the sea cable extension to the SBE9+ was replaced, cables to the temperature and conductivity probes were replaced and the breakout box was opened and inspected for leaks. A test cast to 1000 metres was conducted successfully and once more the CTD programme was resumed. The system failed again on the set up for the next cast. The SBE9+ unit

was removed at this point since metering of the auxiliary channel power supply pins indicated that the unit was not supplying power to the outboard sensors. On inspection of the power board two screws that hold a large heat sink onto the bottom of the power switching unit were found to be loose and in intermittent contact with the modem board directly below them. Additionally a power output regulation transistor was found to be faulty. These issues were rectified and stable power was stored to the unit. Some contacts on the power supply board were re-soldered at the same time. The unit was reassembled and secured back into the frame. All subsequent casts were conducted without incident.

4.d) Data Processing

Data for each cast (upcast and downcast) was first converted from the raw data file to ASCII using the SBE Data Processing software under the following configuration;

Depth (sea water, m)
Pressure (digiquartz)
Voltage 4
Beam Transmission
User Polynomial (BBRTD)
Temperature 1 (ITS-90, Deg C)
Temperature 2 (ITS-90, Deg C)
Potential Temperature (ITS-90, Deg C)
Conductivity 1 (mS/cm)
Conductivity 2 (mS/cm)
Density (kg/m3)
Salinity (PSU)
Voltage 5
Voltage 3

Subsequently this converted data was corrected for conductivity cell thermal mass effects within the same suite of software running the sub routine Cell Thermal Mass configured as follows:
Thermal anomaly amplitude (alpha) = 0.03
Thermal anomaly time constant (1/beta) = 7
(for both primary and secondary temperature sensors).

On completion the data was corrected for heave and roll fluctuations using the Loop Edit subroutine. Casts 001 to 011 were compensated for loops below 0.25 metres per second (15 m/min) and Casts 014 to 018 were compensated for loops less than 0.10 metres per second (6 m/min) since these casts involved slow up and down casts above the plume site.

All converted files after and including the cell thermal mass correction procedures were then averaged over 10 second time intervals.

(P.Keen)

5. Miniature Autonomous Plume Recorders (MAPRs)

Six MAPR units were provided for cruise CD169 from Dr Ed Baker, NOAA-PMEL in the USA. These MAPRs were deployed extensively throughout both legs of the cruise - 40 stations in total. On the first leg all 6 MAPRs were deployed for each of TOBI runs 1 to 3. Two sensors were deployed at heights of 1 m and 50 m above the depressor weight and the remaining 4 were

suspended from a wire that hung directly below the depressor weight with instruments deployed at 50, 100, 150 and 200 m below the depressor.

All Rockchip stations (1-22) were run with a MAPR 20 m above the rock chipper.

A MAPR was attached to the CTD frame on CTD stations 6, 8, 9, 11, 15, 16, 17 and 18 as a fallback for the unreliable optical backscatter sensor on the CTD (see earlier).

On all dredge stations (1-4) a MAPR was attached to the wire 10 m above the pinger.

On the deep undulating MAPR station (DUM1), 6 MAPRs were attached at an equal spacing of 50 m to the wire, weighted down by a bottom weight. The string was then towed behind the ship at different depths to search for plume signals.

On the Stand Alone Pump stations SAPS 1 and 2 four MAPRs were attached on the wire at the same depth as each of the pumps.

The data for all MAPR deployments were recovered successfully. Only a part of the downcast for station CTD 11 was missed, due to a programming error.

(R. Prien)

6. ABE (Autonomous Benthic Explorer)

6.a) Overview

The ABE vehicle from WHOI (USA) was used extensively during Leg 2 of cruise CD169 in three modes – *i)* to map non-buoyant hydrothermal plumes; *ii)* to conduct detailed swath mapping of the seafloor and intercept buoyant hydrothermal plumes; *iii)* to investigate and photograph new hydrothermal fields on the deep seafloor. During the course of the cruise, 5 ABE dives were conducted ABE 150 to ABE 155 – one Phase I, two Phase II, one partially failed Phase III (sensors operational but no photographs recorded), and two further Phase III dives.

6.b) ABE Dive 150.

ABE150 was a phase 1 dive. The dive tracks were based on clues obtained from an earlier TOBI tow on leg 1 of this cruise. The depths were refined before the ABE dive from CTDs and the tow of an array of MAPRs (DUM-1). The dive was very successful, we found E_h and OBS (optical back-scatter) anomalies at two different depths nearly at the center of the survey grid.

These data did not constrain the search nearly as well as the MAPR data from our past experience with AEB in the Lau Basin so we had to cover a larger area and use significantly larger track spacings (1km for ABE150 versus 200m on the phase 1 Lau dives).

The dive tracks made up a grid with lines 4.5km long spaced at 1 km. The dive started at a spot about 2 km away, the start point was chosen based on considerations of total water depth, LBL (long base-line) net coverage, and terrain. The inefficiency of the long connector leg was accepted since the chosen starting spot reduced some uncertainty for the first dive. Tracklines alternated depths between 2750 m and 2875 m depth.
The 3 element LBL worked very well and coverage was solid - only one flyer was crunched for the entire dive. The vehicle DR'd (dead reckoned) when expected based on maximum transponder range (set to 7 seconds, changed to 8 after testing it during the abort phase of this dive).

The DVL (Doppler velocity log) performed well also. It maintained bottom-lock out to ranges of up to 250 meters (the maximum setting). Mike Jakuba noticed some strange segments when it lost bottom lock and water track simultaneously.

Summary: ABE150
Start time: 2005/03/08 16:27:19
Survey start: 2005/03/08 19:16:15
Survey end: 2005/03/09 20:04:53
Surface time: 2005/03/09 23:38:33
Recovery time: 2005/03/10 00:33:39
descent: 0.23 kwhr over 2.81 hrs, ave pwr: 80.1 w
survey: 4.65 kwhr over 24.80 hrs, ave pwr: 187.4 w over 43.3km 2810 m depth
ascent: 0.13 kwhr over 4.72 hrs, ave pwr: 28.1 w
surface: 0.05 kwhr over 0.92 hrs, ave pwr: 49.8 w
Total energy use: 5.01 kwhr
Min cell voltages
1: 3.65 3.63 3.66 3.66 3.63 3.65 3.65 3.65 3.65 3.66 3.64 3.66 3.65 3.66
2: 3.65 3.67 3.66 3.67 3.65 3.67 3.65 3.66 3.65 3.66 3.64 3.67 3.65 3.66
3: 3.65 3.65 3.64 3.66 3.65 3.67 3.66 3.67 3.65 3.67 3.64 3.66 3.63 3.66
energy from pack 1: 1.660 2: 1.675 3: 1.673 kwhrs

ABE150 DVL stats
119125 pings over 24.7 hour survey
beam 1, 82.4 pct max range: 240.4
beam 2, 82.9 pct max range: 240.4
beam 3, 79.9 pct max range: 240.4
beam 4, 83.1 pct max range: 240.4
0 beams 15.4 pct
1 beams 1.0 pct
2 beams 0.8 pct
3 beams 5.9 pct
4 beams 77.0 pct
average ping rate: 1.34 pings/sec
Mean speeds u: -0.405 v: 0.004 w: -0.022

6.c) ABE Dive 151

ABE151 was a phase 2 dive based on the data from ABE150, CTD, and MAPR data. Tracklines, each 600m long, ran ENE-WSW with 30 meter spacing at 50 meters height. We ran the SM2000 for bathymetry along with the Imagenex (the latter data were not very useful, ABE altitude too high). The dive identified two vent sites. On the first few lines at the southern end of the survey, the data showed a vent site with temperature rises of about 150 mdeg and OBS hits of just over 100 mV. At the northern end we saw solid temperature hits (200 mdeg increase) and an OBS signal over 100 mV lasting for over a minute on the last trackline.

Our choice of the survey area was critical for the success of this dive, as the vent signals were seen on the first and last lines only.
The vehicle performed well, LBL and DVL nav were excellent. The dive ended when the end-of-mission time was reached, although low battery warnings were being generated on every climb and descent and it probably would not have made it more than a few minutes more.

Summary: ABE151
Start time: 2005/03/10 18:45:06
Survey start: 2005/03/10 21:24:39
Survey end: 2005/03/11 12:49:18
Surface time: 2005/03/11 16:35:21
Recovery time: 2005/03/11 16:55:22
descent: 0.42 kwhr over 2.65 hrs, ave pwr: 157.4 w
survey: 4.71 kwhr over 15.40 hrs, ave pwr: 305.8 w over 35.2km 2930 m depth
ascent: 0.21 kwhr over 4.28 hrs, ave pwr: 48.0 w
surface: 0.02 kwhr over 0.33 hrs, ave pwr: 57.5 w
Total energy use: 5.33 kwhr
Min cell voltages
1: 3.58 3.52 3.58 3.60 3.58 3.59 3.59 3.59 3.58 3.60 3.57 3.61 3.58 3.62
2: 3.59 3.61 3.60 3.60 3.61 3.61 3.58 3.62 3.57 3.60 3.58 3.60 3.60 3.61
3: 3.59 3.59 3.57 3.60 3.60 3.61 3.61 3.61 3.58 3.61 3.59 3.60 3.56 3.60
energy from pack 1: 1.778 2: 1.781 3: 1.776 kwhrs

ABE151 DVL stats
89804 pings over 15.3 hour survey
beam 1, 100.0 pct max range: 237.7
beam 2, 100.0 pct max range: 240.4
beam 3, 100.0 pct max range: 219.0
beam 4, 100.0 pct max range: 240.4
0 beams 0.0 pct
1 beams 0.0 pct
2 beams 0.0 pct
3 beams 0.0 pct
4 beams 100.0 pct
average ping rate: 1.63 pings/sec
Mean speeds u: -0.626 v: -0.001 w: -0.016

6.d) ABE Dive 152

Close, but no cigar. ABE flew great tracklines at 5 meters height through the vent field. The survey track started with a large box (250 x 200) then two 100 meter boxes over the spot determined by the adaptive algorithm. Track spacing was 5 meters. All went very well except that the camera failed after about 100 bottom images. All other data were good, including the SOC manganese sensor (see Science Report 7).

LBL tracking and bottom following worked very well. The vehicle hit bottom a few times, including once when it hung up for 9 minutes, but it timed out and freed itself. Vehicle came up with one very strong burn mark on the stbd pod fwd and some muck on the nose. In the case of the big hangup, none of the ranging devices (fwd looking Robertson at 60 deg up, DVL, Imagenex) saw the obstacle coming.

OBS, temperature and E_h data look great. The E_h data clearly outline the smoker field in the NW corner (identified by the IPT algorithm) and a lower temperature area (diffuse flow?) in the southeast quadrant.

Summary: ABE 152
Start time: 2005/03/12 12:42:47
Survey start: 2005/03/12 15:16:16

Survey end: 2005/03/13 03:04:51
Surface time: 2005/03/13 05:49:32
Recovery time: 2005/03/13 06:12:05
descent: 0.35 kwhr over 2.55 hrs, ave pwr: 137.3 w
survey: 2.22 kwhr over 11.80 hrs, ave pwr: 188.0 w over 17.0km 2967 m depth
ascent: 0.20 kwhr over 3.36 hrs, ave pwr: 58.9 w
surface: 0.03 kwhr over 0.38 hrs, ave pwr: 75.0 w
Total energy use: 2.77 kwhr
Min cell voltages
1: 3.74 3.64 3.74 3.75 3.74 3.75 3.74 3.75 3.74 3.75 3.75 3.75 3.75 3.76
2: 3.75 3.76 3.75 3.76 3.75 3.77 3.74 3.76 3.74 3.76 3.74 3.75 3.74 3.76
3: 3.74 3.75 3.73 3.75 3.75 3.75 3.74 3.75 3.74 3.76 3.73 3.75 3.73 3.74
energy from pack 1: 0.959 2: 0.957 3: 0.953 kwhrs

ABE152 DVL stats
147431 pings over 11.8 hour survey
beam 1, 99.9 pct max range: 240.4
beam 2, 99.8 pct max range: 240.4
beam 3, 99.7 pct max range: 240.4
beam 4, 99.5 pct max range: 240.4
0 beams 0.0 pct
1 beams 0.0 pct
2 beams 0.0 pct
3 beams 1.1 pct
4 beams 98.9 pct
average ping rate: 3.48 pings/sec
Mean speeds u: -0.379 v: 0.002 w: -0.004

6.e) ABE Dive 153

ABE153 was a phase 2 dive. We had planned a phase 3 dive, but the failure of the camera on deck made us change plans. In hindsight, the failure on deck was a blessing since the camera had a major problem, a short in the oil-filled cable. This had caused the problem on dive 152, but we danced (frantically) around the problem (more in another document). We had the camera working fine on the bench, but not with the full vehicle cabling. So the camera setup we were about to launch for the phase 3 version of 153 was doomed to failure. We removed the camera and computer and ran a phase 2 (no sm2000, since the same computer runs both the sm2000 and the camera). Camera repairs continued while the vehicle ran the phase 2 ABE153 survey.

The tracklines for ABE153 consisted of a 600x600 m block north of the area surveyed in ABE151 with EW lines, then long lines running NS to the east expanding the 151 survey. Since we were relying on the imagenex for bathy, we ran at 40m height with 25m spaced lines.

The tracklines north of the ABE151 lines closed the vent field that we spotted on the northernmost line of ABE151. On ABE153, this field showed OBS hits on the order of 200 mV and temperature increases of about 200 mdeg (similar to the hits seen on ABE151). The 4 lines run expanding the 151 survey area to the east did not show any large excursions of temperature or OBS.

The dive ended with an abort command issued from the surface, since the camera was now working and we decided to start the next camera dive as soon as possible. We tried at about 0600 with no success. Al's theory, verified by the data, was that the replacement thruster was noisy and prevented the 10.5 interrogations from being received at the vehicle. I (DY) kept trying throughout

the morning. On a northbound line whenever I noticed a few 13.0 responses I switched the ducer to the command box and sent some codes. I did this a few times, finally getting through. The data showed that when the code was received, the vehicle was hill climbing and had slowed its aft thrusters (including the noisy one). After the thrusters shut down, reception of the 10.5 interrogations was very consistent, as opposed to nearly zero when they were running.

Summary: ABE 153
Start time: 2005/03/14 18:52:21
Survey start: 2005/03/14 22:31:37
Survey end: 2005/03/15 10:39:00
Surface time: 2005/03/15 13:24:14
Recovery time: 2005/03/15 13:47:17
descent: 0.26 kwhr over 3.65 hrs, ave pwr: 72.6 w
survey: 3.09 kwhr over 12.12 hrs, ave pwr: 255.1 w over 26.1km 2990 m depth
ascent: 0.07 kwhr over 3.31 hrs, ave pwr: 21.3 w
surface: 0.01 kwhr over 0.38 hrs, ave pwr: 34.8 w
Total energy use: 3.43 kwhr
Min cell voltages
1: 3.67 3.61 3.67 3.70 3.67 3.68 3.68 3.69 3.66 3.70 3.68 3.70 3.68 3.70
2: 3.69 3.70 3.69 3.69 3.69 3.71 3.68 3.70 3.68 3.69 3.67 3.70 3.67 3.70
3: 3.68 3.69 3.68 3.70 3.69 3.69 3.69 3.70 3.68 3.70 3.67 3.69 3.67 3.69
energy from pack 1: 1.141 2: 1.146 3: 1.144 kwhrs

ABE 153 DVL stats
80268 pings over 12.0 hour survey
beam 1, 100.0 pct max range: 226.1
beam 2, 100.0 pct max range: 240.5
beam 3, 100.0 pct max range: 288.6
beam 4, 99.9 pct max range: 253.3
0 beams 0.0 pct
1 beams 0.0 pct
2 beams 0.0 pct
3 beams 0.2 pct
4 beams 99.8 pct
average ping rate: 1.86 pings/sec
Mean speeds u: -0.586 v: 0.002 w: -0.009

6.f) ABE Dive 154

ABE 154 was a phase 3 dive (close up survey including camera) at the southern of the two vent sites. It was a short run to get essential data and to make sure all was well with the camera. The vehicle ran a 5m-spaced block over the site identified by the adaptive algorithm on ABE152 with lines 80m long. Then it ran a 100m x 100m block over a presumed diffuse vent field to the southeast.

The vehicle and camera system performed well. LBL navigation worked fine and most fixes used all 3 transponders. The DVL performed well also, although the output was not used in realtime. Bottom-following worked very well. We had made a few changes after the crashes on ABE152. We lowered the forward looking sonar from 30 degrees down to 45 degrees down and changed how that data was weighted in the bottom following algorithm. This time the vehicle did not hit the structures, although in looking at the pictures there were a few close calls. The vehicle made

several passes over structures on the order of 5 m tall without incident and it flew through clouds of black smoke on several occasions.

The bottom-following was set to 5m, and the vehicle held this pretty well even when flying up over the structures. Another change made after the crashes on 152 was to make the vehicle less aggressive when flying down.

Summary: ABE 154
Start time: 2005/03/15 20:30:19
Survey start: 2005/03/15 23:06:01
Survey end: 2005/03/16 03:40:12
Surface time: 2005/03/16 06:30:21
Recovery time: 2005/03/16 06:47:22
descent: 0.33 kwhr over 2.59 hrs, ave pwr: 129.4 w
survey: 0.85 kwhr over 4.57 hrs, ave pwr: 186.0 w over 5.7km 2968 m depth
ascent: 0.16 kwhr over 3.26 hrs, ave pwr: 49.8 w
surface: 0.02 kwhr over 0.28 hrs, ave pwr: 60.4 w
Total energy use: 1.35 kwhr
Min cell voltages
1: 3.81 3.70 3.81 3.81 3.80 3.81 3.79 3.81 3.81 3.82 3.80 3.81 3.80 3.83
2: 3.81 3.83 3.81 3.82 3.82 3.83 3.80 3.81 3.79 3.82 3.80 3.82 3.81 3.82
3: 3.80 3.81 3.79 3.80 3.81 3.82 3.80 3.80 3.80 3.82 3.78 3.81 3.78 3.80
energy from pack 1: 0.457 2: 0.448 3: 0.445 kwhrs

ABE 154 DVL stats
31327 pings over 4.6 hour survey
beam 1, 99.9 pct max range: 288.6
beam 2, 99.8 pct max range: 288.6
beam 3, 99.6 pct max range: 288.6
beam 4, 99.6 pct max range: 288.6
0 beams 0.0 pct
1 beams 0.0 pct
2 beams 0.1 pct
3 beams 0.8 pct
4 beams 99.1 pct
average ping rate: 1.90 pings/sec
Mean speeds u: -0.353 v: 0.009 w: -0.00

6.f) ABE Dive 155

ABE155 was a longer photo run over the northern vent site 4° 47.84'S 12° 22.65'W). We planned a long, complex mission involving visits to several other sites after completing an adaptive survey on the main site. But the vehicle ran slower than expected and the abort time occurred at the end of the first adaptive survey.

The vehicle made a reasonable survey of the site, but the LBL navigation was poor. A number of factors contributed to the low quality: a) the vehicle was moving very slowly with strong current; b) the survey area was directly on the BD transponder baseline, so if A was not received a fix could not be computed; c) transponder B showed clear clipping by terrain - only at the closest (eastern) end of the survey could the vehicle hear B; d) transponder A showed some unexplained directional effect, the vehicle did not hear it well when driving away; e) the returns from D were a bit ratty. These results are in contrast to the other vent site to the south, where the acoustic tracking was nearly perfect.

We have been having trouble with our doppler velocity log (DVL), so we did not have it connected into the vehicle's navigation processing in real time. The problems now seem fixed, but we were shy to use it in real time given the quality of our previous LBL results. With the benefit of hindsight, that decision was clearly wrong: the DVL works fine and would have helped enormously in this case.

The dive achieved some very good results despite the LBL problems and slow/incomplete progress of the programmed survey. The adaptive algorithm properly identified the best site, and the vehicle returned there for more survey lines at a different orientation. The strongest plume hits and best photos were obtained during the adaptive survey. We made a quick mosaic of one of the approaches to the large structures, and it looks good.

Summary: ABE 155
Start time: 2005/03/16 12:42:12
Survey start: 2005/03/16 15:30:36
Survey end: 2005/03/17 03:01:43
Surface time: 2005/03/17 05:53:30
Recovery time: 2005/03/17 06:22:03
descent: 0.41 kwhr over 2.80 hrs, ave pwr: 147.1 w
survey: 1.93 kwhr over 11.51 hrs, ave pwr: 167.2 w over 12.0km 3029 m depth
ascent: 0.19 kwhr over 3.52 hrs, ave pwr: 54.1 w
surface: 0.05 kwhr over 0.48 hrs, ave pwr: 96.0 w
Total energy use: 2.53 kwhr
Min cell voltages
1: 3.76 3.65 3.76 3.77 3.75 3.77 3.75 3.77 3.76 3.77 3.75 3.77 3.76 3.78
2: 3.77 3.78 3.76 3.78 3.77 3.78 3.75 3.77 3.75 3.77 3.75 3.77 3.76 3.77
3: 3.76 3.76 3.75 3.77 3.77 3.77 3.76 3.77 3.75 3.77 3.75 3.76 3.74 3.76
energy from pack 1: 0.846 2: 0.844 3: 0.842 kwhrs

ABE 155 DVL stats
141840 pings over 11.5 hour survey
beam 1, 99.9 pct max range: 288.6
beam 2, 99.8 pct max range: 287.0
beam 3, 99.9 pct max range: 288.6
beam 4, 98.8 pct max range: 288.6
0 beams 0.0 pct
1 beams 0.0 pct
2 beams 0.0 pct
3 beams 1.6 pct
4 beams 98.4 pct
average ping rate: 3.42 pings/sec
Mean speeds u: -0.314 v: 0.000 w: -0.003

(D.Yoerger, A.Bradley, M.Jakuba, A.Billings)

7. *In situ* Chemical Sensors

7.a) E_h sensors.

In addition to the E_h sensor mounted on the ABE vehicle, two further E_h sensors were provided by Dr Koichi Nakamura (Japan). These sensors were deployed, one on the CTD, and one on the BRIDGET deep-tow vehicle. Both sensors worked reliably on all deployments (all CTD stations and BRIDGET tow-yo 3) without any failures. Drops in the output signal of the E_h sensor routinely coincided with signals in other parameters (optical backscatter, temperature anomalies, in situ Mn/FeII)

7.b) *In situ* Fe and Mn analysers.

Two *in situ* analysers were deployed on this cruise. Both analysers can be set up as manganese or iron II analysers by changing the reagents and standards accordingly.
Both analysers were installed on the CTD frame for 2 CTD casts. On the first cast both analysers showed inconclusive results with a high noise on the baseline and no discernible effect of standard and blank when these were switched on instead of the sample input. After an adjustment of pump parameters both analysers showed a more stable baseline and easily identifiable steps when switching to blank or standard. For the following CTD deployments (CTD 15-18) the analyser worked without failure, apart from a problem with the internal flash memory card on CTD 18, leading to the loss of in situ Mn data for the first hour of measurements on CTD 18.

On ABE dives 150 to 152 the analyser installed on the vehicle was set up to measure Mn, all deployments were successful. On ABE dives 153 & 154 the analyser was set up to measure Fe II. These deployments also were successful.

On dive 150 the internal data logging of ABE did not record the Mn analyser data and they had to be recovered from the internal flash memory of the analyser's electronics. All dives yielded data sets that showed Mn and Fe II signals coinciding with other sensors on board ABE (optical backscatter, E_h, temperature anomalies).
The second analyser was deployed on CTD stations 3, 5 and 15 to 18 and on BRIDGET run 3, set up for the measurement of manganese in all cases. For CTD stations 3 and 5 on the first leg, the first analyser (later installed on ABE) was also run on the CTD, set up for Fe II.

(R.Prien, D.Connelly)

8. Hydrothermal Plume Water-Column Sampling

8.a) Sampling for total dissolvable metals, methane and nutrients

A total of 13 CTD casts were made. Samples from all casts were taken for total dissolvable metals (Mn, Fe) and methane. Half of the methane samples were collected for shipboard analysis and half for storage for analysis back at SOC. Nutrient samples were collected from those CTD casts that showed strongest evidence of hydrothermal impact. In addition to the CTD casts, 2 sets of samples were collected using the sampling rosette on BRIDGET, for a total of 15 samples.

CTD 16 was collected in the buoyant portion of a hydrothermal plume and so extra samples were collected for all analytes.

Methane samples were collected immediately the CTD arrived back on deck. In general, duplicate samples were collected into 100 ml borosilicate glass bottles, preserved with 100ml of mercuric chloride and crimp sealed with Teflon lined caps.

TDMn/Fe samples were collected into acid cleaned 1 litre LDPE bottles and acidified in the clean laboratory with 1ml of quartz distilled concentrated nitric acid. The samples are double bagged and packed.

Nutrient samples were collected into 30ml polycarbonate bottles and frozen.

Due to unforeseen problems with the standards for the GC, samples were not analysed on board for methane. Initial runs on the GC showed that there was methane in the samples that had a high nephel reading but the decision was made to save all of the samples and collect a better data set back at SOC.

Table 8.1: numbers of water column samples taken for shore analyses.

CTD #	Metals	Nutrient	Methane	Other
1	15		48	
2	12		24	
3	Failed			
4	12		24	Labelled CTD3!!!
6	12		24	
7	8		16	
8	6		15	
9	6		12	
10	12	12	24	
11	11	11	24	
12	Failed			
13	Failed			
14	Failed			
15	15	14	30	
16	48 (24*2)	24	96	Buoyant Plume!
17	7	7	14	
18	14	14	28	
BGT01	5		10	
BGT02	10			
Totals	204	82	389	

(D.Connelly)

8.b) Filtration of Niskin Samples

Selected samples from CTD-rosette Niskin bottles were filtered through 0.4µm cyclopore membrane filters as soon as the bottles were brought on deck. The volume of seawater filtered was recorded and the membrane filters retained.

From CTD 3, a background station, 6 samples were filtered. From CTDs 6 – 11 and from CTD 15, a total of 50 samples (500 – 1500mL) were filtered. These samples all came from the non buoyant plume, as revealed by optical sensors on the CTD: an increase in nephelometry and/or a decrease in transmissometer reading.

CTD 16 collected 18 samples in the buoyant plume and all the remaining water in the Niskin bottle (approx 6000mL) after methane, TDMn/TDFe and nutrient samples had been taken was filtered. These filter membranes were observed to have black/brown precipitate present. Above the buoyant plume 2 background samples and 4 non-buoyant plume samples were filtered (1000mL each).

CTDs 17 and 18 collected 5 samples from the edge of a buoyant plume and in each case all the remaining water in the Niskin bottle was filtered, as before (approx 7000mL). There were no non-buoyant plume samples from these CTD casts.

(S.Bennett)

8.c) Stand Alone Pump Sampling

Two SAPS stations were carried out. The location was chosen using the CTD optical back scatter data that showed a strong (max 34mV) broad signal from 2725 – 2925m on the down cast and from 2800 – 2925m on the up cast. Out of all the CTD data this station had the broadest plume with the strongest signal.

A 450 kg weight, pinger and 4 SAPS along with a MAPR each, were attached to a plastic coated wire at 25m intervals and lowered (30m/min) into the ocean. The wire was stopped with the pinger 60m off the sea floor (weight 35m off bottom) putting the first SAPS at 2900m. Three more SAPS continued up the wire at 25m increments with the top station at 2825m. The filters used were 293mm 1 μm nuclepore membrane filters.

SAPS01 had to be aborted after 2 .5 hours, but as the pumps had already started, the filters were kept as background samples. COSAP04, 03, 02 and SN005 pumped 373.5, 28, 146 and 170L respectively.

SAPS02 was completed and the pumps switched on at the correct depth for 2 hours and then returned to the surface (hauling @ 40m/min). COSAP04, 03, 02 and SN005 pumped 1299, 1534, 532 and 1246L respectively. Precipitate was observed on the filter membrane and the MAPR data showed positive optical back scatter signals compared to the background signals during the time the pumps were switched on. This precipitate can be inferred to be hydrothermal plume precipitate.

(S.Bennett)

9. Electrochemical Measurements

9.a) Background

Although abundant in the Earth's crust iron (Fe) is relatively insoluble in oxygenated sea water resulting in concentrations that are known to limit phytoplankton growth and nitrogen fixation rates over large areas of the ocean. For marine geochemists, one of the most important aspects of iron is that it precipitates rapidly in hydrothermal plumes, modifying the gross flux from vents to the oceans. But if only a small proportion of dissolved Fe escapes from hydrothermal plumes it could dominate the budget for deep-ocean dissolved Fe. It is therefore essential to understand the biogeochemical cycling of Fe in hydrothermal systems and their influence throughout the deep ocean. Our knowledge of Fe speciation in seawater, however, is severely limited due to a lack of measurements of Fe concentrations and its degree of organic complexation in seawater. The few existing electrochemical measurements of Fe speciation demonstrate that greater than 99% of the operationally defined "dissolved" Fe that passes through a 0.4 micron filter is strongly bound to organic ligands of presumed biological origin. Our knowledge of Fe speciation in deep waters is also severely lacking due to lack of data, while our knowledge of Fe speciation in hydrothermal plumes is virtually zero except for limited studies on size fractionation. Organic complexation has been measured on deep samples collected in the Sub-Arctic North Pacific and shown to be also highly complexed. However the origin of these ligands is completely unknown. Colloidal (0.4 micron - 0.02 microns molecular diameter) Fe and binding ligands may be the driving force in Fe hydrothermal inputs into the deep ocean keeping the Fe in solution long enough for hydrothermal inputs to play an important role in the Fe deep-ocean budget.

This study aims to investigate Fe organic complexation in deep water samples in distil and plume samples from a newly discovered vent site close to Ascension Island in the South Atlantic. Major goals of the study are to elucidate the dominant size fraction, concentration and binding strength of

these ligands along with determining the concentration of free iron available and ultimately the organically bound fraction.

9.b) Electrochemistry equipment.

This system is used for on-board measurements of Fe-organic complexation. This data can be used with total Fe data to model the ligand concentrations, the different class of ligand (L1, L2), the conditional stability constants of these different ligand classes, and Fe(III)′ (soluble inorganic Fe(III) hydrolysis species). The instrumentation used consists of a PAR303A hanging mercury drop electrode connected to an Ecochemie 303 Interface and an Ecochemie μAutolab 3 voltammeter; the system was run using GPES software. During D286 major problems were encountered with the system. However after servicing and air-freighting out to Ascension in time for CD169 the 303A electrode was found to be in full working order and preliminary studies were undertaken on collected samples.

9.c) Methodology.

Seawater was collected using the CTD at stations and depths in the plume and in the background (Table 9.1). Samples were pressure filtered using research grade nitrogen through an acid washed 0.4 micron polycarbonate filter and collected in Teflon bottles. Samples for immediate analysis were placed in the fridge while the majority of the samples were frozen for subsequent analysis at SOC. Previous studies have shown that immediate freezing of the samples retains the integrity of the sample for future speciation studies. Analysis will be undertaken at SOC using the technique of CLE-ACSV (Competitive ligand exchange – adsorptive cathodic stripping voltammetry) with the added ligand TAC. Complexing capacity titrations will be undertaken on the samples to determine the Fe-TAC response over a series of increasing Fe concentrations (0.1 to 20 nM). Total dissolved Fe will be measured in the laboratory at Southampton Oceanography Centre. The seawater will be subjected to UV irradiation and analysed using CSV with DHN as the added ligand. Total Fe values will also be determined using high-resolution isotope dilution inductively coupled plasma mass spectrometry after $Mg(OH)_2$ coprecipitation or solvent extraction and determination by GFAAS (graphite furnace atomic absorption spectroscopy). After the total values have been measured, the numbers combined with the complexing capacity titrations can then be used to yield the ligand concentrations, the different class of ligand, the conditional stability constants of these different ligand classes, and Fe(III)′ (soluble inorganic Fe(III) hydrolysis species).

Table 9.1 CTD stations sampled for Fe speciation studies during CD169.
(Fridge samples in italics)

CTD #	Sample #	OTE Bottle #
3	*1*	*24*
	9	*8*
5	3	10
7	3	8
8	5	14
9	2	6
10	6	12
	6	*12*
	7	14
	7	*14*
	8	16
	9	18
	10	20

11	4 5 6	8 10 12
15	3 4 5 6	11 12 13 14
16	15 16 17 18 22	15 16 17 18 22

9.d) Preliminary Results.

Only a limited number of samples were run on-board ship due to the time constraints and length required for each titration (~ 4 hours). Initial data from samples analysed on ship showed evidence for organic complexation. Figure 2 shows a complexing capacity titration for Niskin Bottle #14 from CTD cast 10. Linear analysis of this data yields a ligand concentration of 2.10 nM with a logKL of 11.9. This is consistent with deep ocean ligand concentrations and depths, comparing favourably with data from the tropical deep Pacific (2.5 nM and 11.2 log KL) and the sub-Arctic North Pacific (1.76 nM and 12.1 Log KL).

9.e) Future Work.
All frozen samples collected will be air freighted to SOC and analysed using the same equipment in the SOC clean electrochemistry laboratory. Totals will be determined and speciation calculations undertaken using the linear approach and compared with a non-linear modelling programme.

(G.Fones)

10. Petrological Sampling

10.a) Deployments

Rock chipper stations were made by the ship maintaining a constant position and deploying the chipper over the starboard side on a 6mm hydro-wire at a rate of ≤ 60 m/minute. The chipper hit the seafloor at this speed, after which it was withdrawn at 5m/min until 5 m above the bottom and then recovered at 60m/min.

Rock dredge stations were made by the ship maintaining a constant position and deploying the dredge over the aft at a rate of ≤ 60 m/minute on the 16mm coring warp. Once on the seafloor, the ship made for an end way-point at a rate of 1kt. (30m/min) over the ground, and the dredge wire was veered at a rate of 10-15m/min. The pinger was kept to 50-100m off bottom. At the end of the haul, the package was recovered, stowed and the dredge samples sorted and bagged.

10.b) Problems encountered during deployments

Difficulties arose with the rock-chipper when, on station RC07, the package encountered resistance on pulling off the bottom. There was no sediment at the location, and the chipper probably snagged on a loose rock. The crew operating the winch used the recommended technique for dealing with this situation, and at no time exceeded the safe working load as displayed on the CLAM system. However, on being informed of the incident later, by the scientist on watch at the time, it was explained that the maximum load had been 1800 kg. Recognising this to be close to the maximum load-bearing of the 6mm hydro-wire, I enquired why this was inconsistent with the CLAM system display. On investigation, it was found that the CLAM had displayed parameters inappropriate to the hydro-wire. This caused a potentially dangerous situation. As a result of the incident, officially reported as a "near miss" by the TLO, elsewhere, >3000m of damaged wire was removed and stowed on deck.

The winch drivers' consoles, both inside the Main lab. and at the winch driving stations, display incorrect operational data. For example, the brake light is on, even when the brake is off. The speed control knob does not correlate with the positions marked on the consol, e.g. when the control is set to the neutral position the winch still either hauls or veers. This is unsafe and must be rectified.

A hydraulic pipe on the starboard gantry burst through corrosion. The duty engineer immediately repaired it, but the repair took about two hours. Luckily the chipper was stopped at 28m and the weather fair at the time.

10.c) Scientific Samples Obtained

On the basis of available bathymetry (SIMRAD EM12 and ABE-derived SM2000) and TOBI-derived sidescan sonar imagery, the active Southern Mid-Atlantic Ridge axis was located for sampling by rock chipping and dredging. Twenty two chipper sites and 4 dredge sites were chosen (see Appendix F). In addition, MAPRs (Mini Autonomous Plume Recorders) were attached to the chipper (20m above) and dredge wire (beside the pinger at 150m above the dredge) and recorded depth, pressure, temperature and particulate backscatter – see Section 7, above.

Much of the central part of segment 2 (5°S) was sampled, including multiple stations across the area of sheet flows, the hydrothermal sources and the surrounding older hummocky lava terrain. The ends of the segment were also sampled, but with rather poor recovery.

10.d) Preliminary Scientific Highlights:

Station RC07, central north segment 2, recovered abundant iron oxide sediment, fresh glass and small fragments of sulphide. The station was chosen on the basis of two criteria: it is directly below the strongest, and depth extensive plume signal obtained by the MAPRs during the Leg 1 TOBI survey. There also appears at this position an unusual-shaped feature (resembling a 'Mexican's Hat') on the TOBI imagery that overlays and buries fissures in the unsedimented and young sheet flow. The MAPR profile from RC07 showed a tall and dense particulate plume that extended to the seafloor. Combined with the sulphide fragments, this site appears to support an active, high-temperature hydrothermal vent.

Dredge 02, on the central sheet flows and Mexican's Hat area, recovered a variety of extremely fresh lavas, including frozen wave-like structures of glass, several centimetres thick. These structures indicate extremely rapid flow rates for this sheet flow, an inference supported by frozen eddies on the surface on the sheet flow, seen on ABE photographs of the area.

Dredge 04, on the central axial sheet flow and areas with Eh and positive temperature anomalies, recovered extremely fresh glassy sheet flows, several to tens of centimetres thick. Also recovered was a small white crab (10cm x 5cm), a gastropod shell (6mm long) and fragments of mussel shell. These are vent fauna and were observed *in situ* on ABE photographs.

(B.Murton)

11. Biological Investigations

11.a) Overview

Hypothesis-driven investigations of ecosystems in different oceanic regions can provide immediate insights into the processes controlling regional biogeographic patterns and the evolution of chemosynthetic fauna. Understanding how biogeographic processes shape faunal evolution can be achieved through the identification of key ridge localities like the South Atlantic that will yield large first order "jumps" in our knowledge of faunal evolution and biogeography. Hypotheses for the South Atlantic are founded on this premise, as well as on the finding that the recently-discovered Central Indian Ridge faunal province hosts fauna that are distinct (with only one species exception) from the biologically characterized vent ecosystems of the northern Mid-Atlantic Ridge. The overarching hypothesis is that the Equatorial Atlantic Fracture Zones act as a large-scale barrier or species-specific filter to along-axis dispersal and dispersion of species in two ways:

H1) the physical displacement of adjacent segments of the volcanically-active MAR axis, across the Romanche and Chain Fracture Zones, leads to a prohibitively large geographic separation (order 1,000km) between adjacent active high-temperature hydrothermal fields.

H2) strong regional-scale currents flow across the MAR axis, from West to East, through both the Romanche and Chain Fracture Zones. The oceanographic currents of the Fracture Zones as well as their geological structure inhibit along-axis transport of larvae (and species).

To address these hypotheses, my goal during this cruise was to: 1) determine the structure and distribution of vent faunal communities and their associated geological setting on the Southern Mid-Atlantic Ridge via detailed digital imaging surveys, mosaic-mapping, and faunal sampling (via complementary De-Ridge remotely operated vehicle programs) in areas that span the diversity of observed habitats, and 2) to elucidate the distribution of venting activity and habitat diversity through detailed photo-characterization of constituent communities for future detailed biological studies, and demonstrate the utility of AUV technology, (specifically ABE) for hydrothermal

biological research through nested Phase II to Phase III approaches.

11.b) Autonomous characterization of venting activity, biological communities and habitat distribution using ABE.

Phase III overlapping image surveys acquired 12bit images every 5 seconds during 2 ABE dives employing 5m trackline spacing and speeds of 0.4 to 0.6 m/sec. A trigger feature was enabled that upon completion of an initial broad survey, ABE would center the next grid based on binning, within a spatially discrete area, the highest average temperature and Eh anomalies. The tracklines for the trigger surveys were 100 x 100 meters in the opposite direction and diagonal from the initial survey box. The imaging surveys were conducted from 4 to 5 meters altitude to permit the mosaic mapping of spatial relationships and associations among biological, hydrothermal, and geological phenomena.

Table 11.1. ABE biological image statistics

ABE Dive #	Area	Total # of images / dive
154	Southern	6421
155	Northern	11374

Southern Phase II area: Based on E_h and Temperature anomalies during ABE dive 153 (a Phase III survey in which the digital black and white camera system did not work), an 80 x 80 meter box located at the northern end of a north-south collapsed pit, and an 80 x 100m box, 25 meters to the southeast. ABE images revealed a broad spectrum of lava morphologies surrounding a series of linear collapsed lava pits with several sulfide chimneys constructed from the base of the pits. Images of the southeastern area revealed extensive and discrete mussel communities hosting gastropods, shrimp, clams, and barnacles in cracks and crevices associated with sheet and hackly lava flows.

Northern Phase II area: ABE images revealed at least one black smoker and the presence of abundant shrimp, resembling *Rimicaris*. No live mussels were observed.

11.c) Biological Collections

One brachyuran crab was collected during Dredge 04. This specimen was preserved and transported to the Woods Hole Oceanographic Institution.

Table 11.2. Biological sample and dredge location.

Dredge # DR04	Julian Day	Time	Lat' Start End	Lon° Start End	Depth (m)
On bottom	074	21:56	4 47.63	12 22.69	3043
Off bottom	075	01:10	4 48.98	12 12.83	3276

SUMMARY

RRS *Charles Darwin* Cruise CD169 enjoyed remarkable success. We were able to systematically survey approximately 200km of the Mid-Atlantic Ridge crest south of the Equator (ca.3-7°S) and

investigate the interplay of volcanic, tectonic and hydrothermal activity. Evidence for high-temperature hydrothermal venting was discovered in two locations, one of which had not even been mapped by multi-beam swath bathymetry before the cruise began. Using SOC's TOBI deep-tow sidescan vehicle, equipped with NOAA-PMEL MAPRs we were able to identify particle laden plumes and using a CTD-rosette water samples were taken from these plumes to confirm, geochemically, that they were hydrothermal in nature. One of these sites was in a non-transform discontinuity between two adjacent 2nd order ridge segments. The other was at the very centre of a spreading ridge segment which, TOBI revealed, hosted an area of ca.15km2 of geologically fresh, unfaulted lava flows. By the end of the 2nd Leg of our cruise, tha ABE autonomous underwater vehicle had managed to precisely locate and photograph the first vent-sites ever to be found in the South Atlantic Ocean and reveal the dominant fauna inhabiting the area. The data gathered was sufficient to guide a complementary ROV cruise by the German Ridge Program, aboard RV *Meteor*, directly to these sites less than one month after they were found. As well as proving an extremely efficient mode of hydrothermal exploration, the TOBI/ABE combination also allowed a full program of CTD and rock-sampling operations to be undertaken while ABE was operating autonomously at the seabed.

Although RRS *Charles Darwin* Cruise CD169 enjoyed considerable success, it was not without disappointments, too. To be fair, the ship itself was in much better condition when the PSO last sailed on her in 2001 (CD127, CD128) when a number of failures led to near collapse of the science programme. Nonetheless, it should be recognized that a "near-miss" in complete power failure of the vessel came close to causing the loss of TOBI which was being towed some kilometers behind the ship and only 350m above the seafloor at the time. The ship's engineers deserve particular credit for averting that problem as promptly as they did – with only minutes to spare! Another continuing setback was with the BRIDGET deep-tow. Ian Rouse and Dave White struggled committedly throughout the cruise to render the vehicle useful for science which they achieved during the last 12 hours of station work. It was fortunate that the rest of the science programme managed without the BRIDGET data but it would have been much higher quality had that been available from the outset. Perhaps the most disappointing outcome for the cruise, however, was from the CTD. During 20 years of seagoing this has routinely been considered the most reliable piece of equipment that one can turn to when all else fails. Instead, during much of the cruise it was questionable how reliable the system was and, throughout, it proved impossible to obtain reliable optical back-scatter data from the UKORS instrument – something that has been a mainstay of such research in the UK since at least 1988 (*Discovery* 176). For this cruise, however, the only safe approach was to attach a NOAA-PMEL MAPR to all CTD deployments to ensure that reliable results were obtained.

(C.German)

ACKNOWLEDGEMENTS

I am pleased to the have the opportunity to thank Capt.P.Sarjeant and the Officers and Crew of the RRS *Charles Darwin* for the efficacy with which the cruise was conducted. Everyone made their contributions, from the officers of the watch with their ship handling and station keeping skills to the deck hands helping with novel ABE deployments; from the galley crew who did so much to keep spirits high to the engineers who so narrowly averted the demise of TOBI at the end of Leg 1 – all overseen by the watchful eye of a Master who takes pride in a safely run vessel.

Our science party also enjoyed great support from our Technical support team from UKORS. Particular thanks go to Dave Turner, TLO, for helping organize our way through some rather trying times – at one point we had NO operating instrumentation that was fit to be deployed over the side of the ship – and to Ian Rouse who worked tenaciously during Leg 1 to trouble-shoot and repair TOBI on the sole occasion when that instrument encountered problems. With support like that, UK Marine Science should only continue to prosper.

RRS *Charles Darwin* Cruise CD169 would have been impossible without the financial support of NERC through core strategic funding to the Fluid Fluxes Group and the Ocean Crust Group of the Challenger Division for Seafloor Processes, Southampton Oceanography Centre, UK. In addition, essential funding to enable participation of the Woods Hole Oceanographic Institution's science team and their ABE autonomous underwater vehicle was provided through the NOAA Ocean Exploration program in the USA. Additional funding was also provided by NERC via a PhD studentship to Ms.Sarah Bennett and by the Census of Marine Life "ChEss" program (Chemosynthetic Ecosystems) for which location of the first vents and vent-ecosystems on the Southern Mid-Atlantic Ridge had been a very high priority.

(C.German)

Figure 1: RRS *Charles Darwin* CD169 Cruise Track

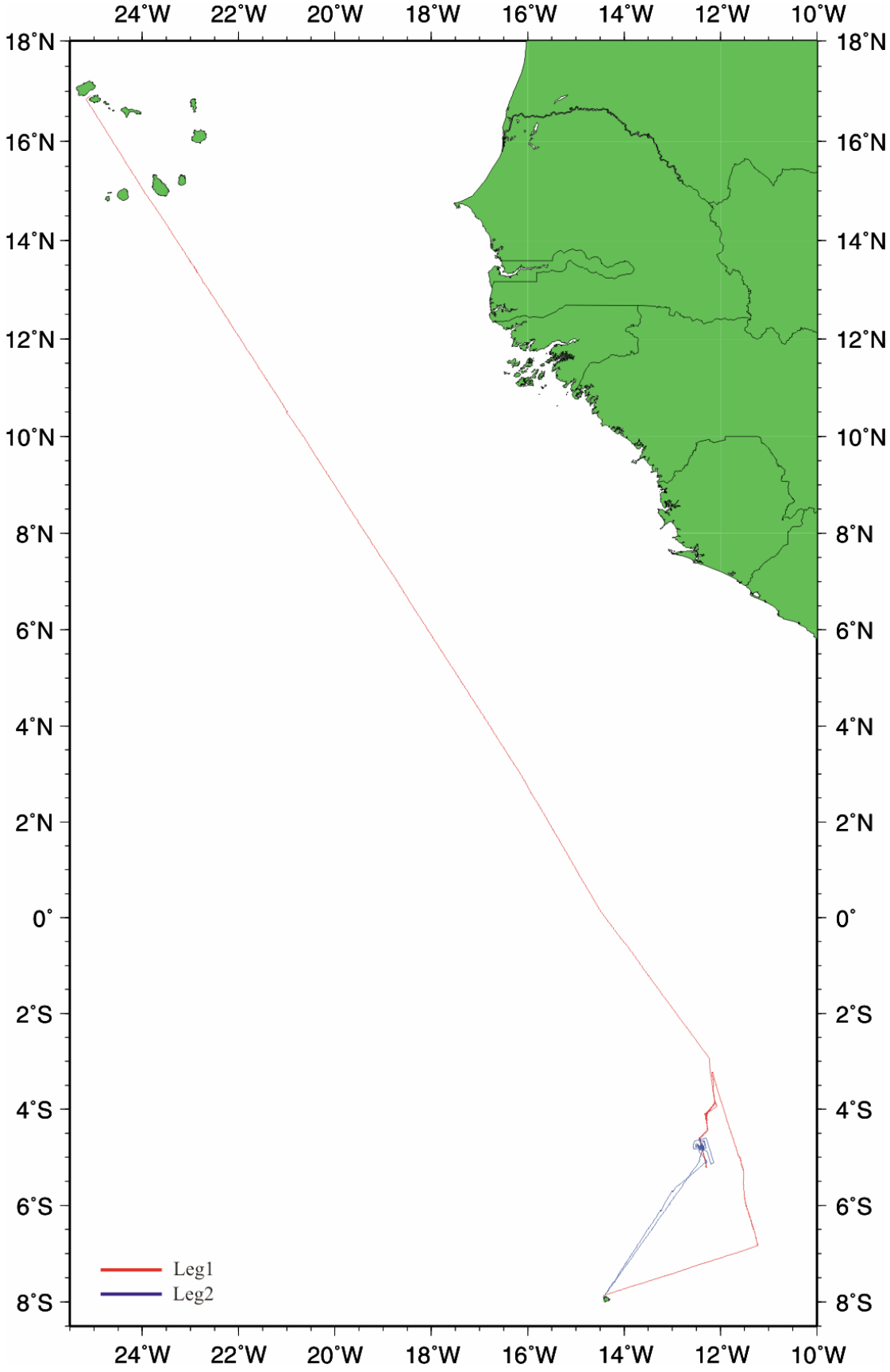
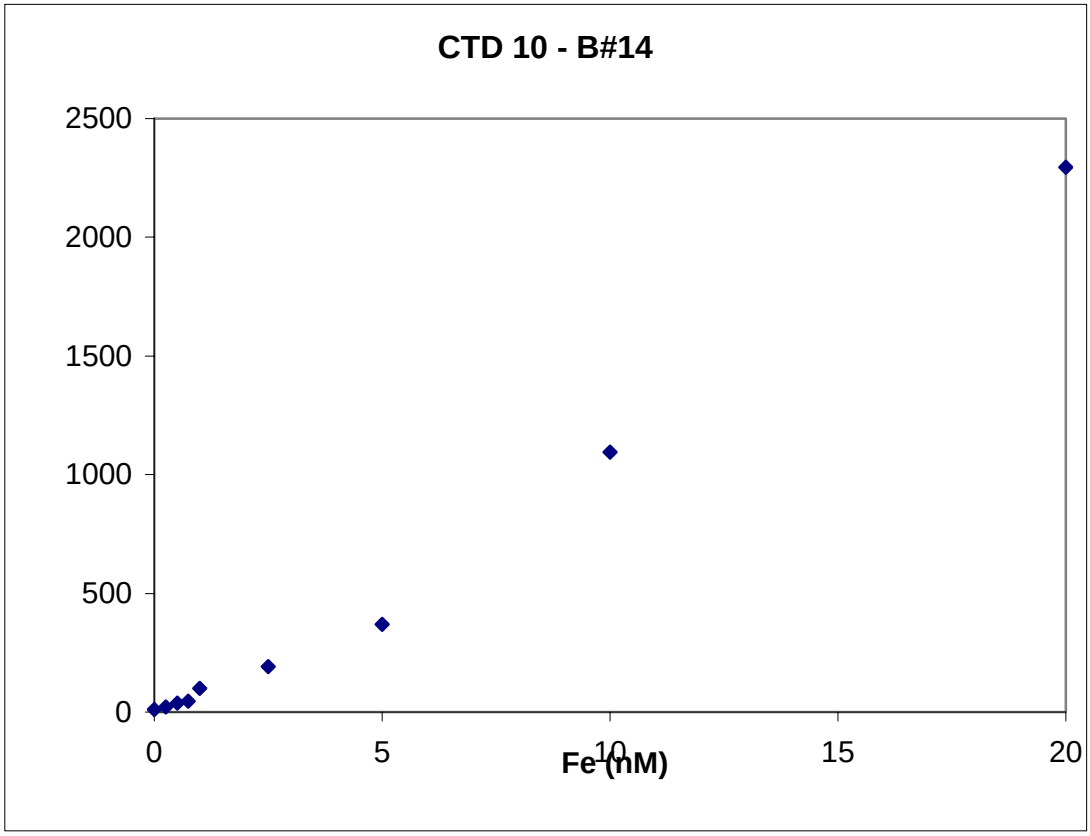


Figure 2: Fe complexing capacity titration

(see Science Report 9: Electrochemical Measurements)



APPENDIX A – DIARY OF EVENTS

Times in text are UTC-1 'til 0100, 22nd February, thence UTC

2005-02-16
0900 Scientific & Technical staff for CD 169 join vessel. Minor mobilisation work underway. Vessel bunkering and taking FW & fresh provisions this day. RSU Crew reliefs.
1500 Sign on of Scientific & Technical party + Safety Briefing & Familiarisation Tour.

2005-02-17
0800 Completing alongside tasks.
0855 Complete tests of ME, Bow Thrust & Steering Gear – all satisfactory.
0912 ERSB
0923 Last line
0930 Clear of breakwater
0936 RFA on passage; B'water 120 degs @ 0.6nm
1200 16 37.8N 25 01.5W Wind NE 20 knots
1615 Emergency & Boat Stations muster

2005-02-18
0001 14 55.8N 23 55.3W
0925 V/l heaving-to for CTD test deployment
0934 13 35.9N 23 00.9W CTD01 deployed
1010 CTD recovered
1030 13 35.3N 23 00.8W Resume transit @ 2 knots; streaming deep tow cable
1200 13 29.6N 22 56.8W Continue streaming deep tow; v/l speed 6 knots; Wind NE 22 knots
1318 13 23.8N 22 53.1W Commence hauling deep tow
1606 13 11.7N 22 45.5W Deep tow cable recovered; resume transit @ 125 rpm

2005-02-19
0001 12 05.3N 22 01.7W
1037 10 33.4N 21 01.7W Commence Swath recording on passage
1200 10 25.5N 20 57.5W Wind NExN 10 knots

2005-02-20
0001 08 40.1N 19 48.2W
1200 06 52.8N 18 38.2W Wind NE 10 knots

2005-02-21
0000 05 08.2N 17 31.2W
1200 03 28.2N 16 27.0W Wind Light & Variable
1424 03 07.6N 16 13.9W Reduce to 118rpm @ ER request due to high LT circuit temps
1600 02 55.5N 16 05.6W Adj. co. to 150 degs (T&G)
1610 02 53.3N 16 04.9W Further reduction to 113rpm
1920 02 27.3N 15 50.1W Further reduction to 105rpm

2005-02-22
0100 01 47.7N 15 27.1W Clocks advanced 1hr to GMT
1200 00 32.4N 14 43.6W Wind SSE 15 knots
1447 00 11.6N 14 31.7W Adj. co. to 144 degs (T&G)
1510 00 08.9N 14 30.0W Incr. to 123rpm

2005-02-23
0001 00 55.8S 13 41.6W
1200 02 19.8S 12 40.5W Wind SE 20 knots; v/l pitching heavily @ times
1742 02 56.5S 12 14.0W Commence Swath survey proper; adj co. to 176 degs (T&G)
1936 03 13.3S 12 12.8W Adj. co to 171 degs (T&G)

2005-02-24
0006 03 52.8S 12 07.1W A/c to 219 degs (T&G)
0200 04 06.3S 12 17.9W A/c to 175 degs (T&G)
0415 04 26.0S 12 16.8W A/c to 224 degs (T&G)

0600 04 37.2S 12 27.0W A/c to 166 degs (T&G)
0625 04 41.0S 12 26.0W A/c to 150 degs (T&G)
0728 04 48.4S 12 21.8W A/c to 165 degs (T&G)
0735 04 49.5S 12 21.5W A/c to 195 degs (T&G)
0745 04 51.2S 12 21.9W A/c to 180 degs (T&G)
0810 04 54.3S 12 22.0W A/c to 165 degs (T&G)
1000 05 08.1S 12 18.4W Slowing at termination of s-bound Swath run
1033 05 10.9S 12 17.8W 10kHz sonar fish deployed
1036 3.5kHz PES deployed
1111 05 11.4S 12 18.0W Commence TOBI deployment; streaming MAPR string
1139 MAPR string streamed & stoppered-off
1148 TOBI outboard
1150 TOBI umbilical streamed
Wind SE 10 knots
1218 Depressor wt connections complete & tested
1221 05 12.1S 12 18.0W Depressor wt outboard; MAPRs attached @ 0 & 50 metres; veering deep tow cable
1237 05 12.3S 12 17.9W Cease veer @ 300m; commence turn @ 10 degs/min & 3 knots
1257 05 12.0S 12 17.5W Turn completed & resume veering cable
1400 onwards Adjustments of co & speed as necessary to meet track requirements

2005-02-25
0025 04 49.0S 12 23.0W A/c to 349 degs (T&G)
0618 04 36.6S 12 25.3W Commence turn to stbd @ 1 degree/min
0730 04 34.6S 12 24.3W Settled on new co. 048 degs (T&G)
1151 04 27.6S 12 16.5W Commence turn @ 2 degs/min to 352 degs
1200 04 27.3S 12 16.3W Wind SSE 15 knots
1615 Emergency exercises/familiarisation
1630 04 15.7S 12 17.3W A/c to 000 degs (T&G)
2015 04 06.2S 12 17.2W Commence turn @ 2 degs/min
2104 04 04.7S 12 16.4W Settled on new course, 038 degs (T&G)

2005-02-26
0001 03 59.4S 12 12.3W
0037 03 58.3S 12 11.5W TOBI signal fails; commence hauling
0410 03 52.0S 12 07.2W Slow course change towards recovery heading
0500 03 51.8S 12 06.1W Cease hauling @ 1000m wire out
0630 03 55.0S 12 04.9W Resume hauling
0722 Depressor wt recovered & MAPR string stoppered-off
0737 Prop stop – heading & forward way maintained by bow thrusters
0747 TOBI landed on deck
0811 03 56.4S 12 04.9W MAPR string recovered; securing deck
0900 Repositioning for CTD station
0955 04 04.6S 12 16.1W CTD02 deployed
1105 CTD near bottom
1200 04 04.6S 12 16.2W Wind SE 15 knots
1315 CTD recovered
1352 Streaming TOBI umbilical for test purposes
1431 04 06.2S 12 16.5W Umbilical recovered; repositioning to Rock Chipper (RC) site
1510 04 11.0S 12 17.5W Hove-to on station
1603 RC deployed; RC01
1830 04 11.6S 12 18.6W RC recovered
1940 04 06.1S 12 16.6W A/c to 288 degs (T&G)
2011 04 05.7S 12 19.5W Hove-to awaiting TOBI repairs
2044 Decision to continue other work o'night; v/l heading for CTD statn.
2157 04 00.3S 12 13.0W CTD03 deployed
2317 Hauling from 4120m

2005-02-27
0128 04 00.3S 12 13.1W CTD recovered; repositioning to RC02
0246 04 06.0S 12 18.1W RC deployed; RC02
0500 04 06.5S 12 18.0W RC recovered
0612 04 08.7S 12 18.1W RC deployed; RC03
0803 04 08.5S 12 18.0W RC recovered; repositioning to RC04

0858 04 13.8S 12 17.1W RC deployed; RC04
1032 04 13.7S 12 17.0W RC recovered
1041 Set co. for TOBI deployment position
1143 04 05.5S 12 19.2W Hove-to @ position; Wind SE 15 knots
1316 04 05.8S 12 19.3W Commence deploying MAPR string
1352 TOBI streamed
1414 Depressor wt streamed
1424 04 06.2S 12 19.4W Commence veering Deep Tow cable; slow turn onto track (038 degs)
2124 03 56.4S 12 10.0W A/c to 031 degs (T&G)
2359 03 51.9S 12 07.2W A/c to 351 degs (T&G)

2005-02-28
0630 03 35.6S 12 09.2W A/c to 002 degs (T&G)
0900 03 29.8S 12 09.0W Hauling Deep Tow & running ahead on Bow Thrust due to fan failure in SCR cabinet of propulsion system
1000 TOBI 800m off bottom; prop system off for repairs
1130 03 25.1S 12 08.9W Main propulsion back on line; veering TOBI to preferred depth
1200 03 24.3S 12 08.8W Wind SE 12 knots
1431 03 19.0S 12 10.0W Commence hauling for TOBI recovery prior relocation
1620 03 14.8S 12 10.9W Altering course, head-to-wind
1720 03 14.7S 12 09.7W Recovering Depressor wt & hanging-off MAPR string
1800 TOBI landed on deck
1825 03 15.0S 12 09.3W MAPR string recovered; set co 163 degs for new deployment site

2005-03-01
0001 03 54.2S 11 57.9W
0832 04 55.8S 11 38.3W V/l @ 0.5 knot; Commence deploying MAPR string
0855 04 55.8S 11 38.4W Streaming TOBI
0927 04 55.8S 11 38.5W Depressor wt outboard & commence veering Deep Tow cable
1124 04 58.6S 11 37.4W A/c to 135 degs (T&G)
1200 04 59.4S 11 37.2W Wind SSE 15 knots
1242 05 00.3S 11 35.7W A/c 170 degs (T&G)
1645 05 09.3S 11 33.9W A/c 162 degs (T&G)
2054 05 18.0S 11 31.1W A/c 182 degs (T&G)

2005-03-02
0001 05 25.3S 11 31.2W
0304 05 32.7S 11 31.6W A/c 176 degs (T&G)
0948 05 49.0S 11 30.3W A/c 169 degs (T&G)
1200 05 54.0S 11 29.5W Wind SExE 20 knots
1407 05 59.0S 11 28.6W A/c 163 degs (T&G)

2005-03-03
0001 06 20.8S 11 21.6W
0234 06 26.5S 11 19.8W A/c 161 degs (T&G)
0655 06 36.2S 11 16.4W V/l suffers total loss of power
0700 Propulsion restored; v/l heading 190 degs; rpm increased to 100+ initially to re-tension TOBI tow.
0740 06 38.1S 11 16.6W Co restored to 164 degs; speed 2 – 2.5 knots
0855 06 41.4S 11 15.9W Second loss of power
0858 Propulsion restored
1033 06 44.4S 11 14.9W Commence hauling TOBI
1200 06 47.5S 11 14.0W Wind ExS 17 knots
1258 06 49.6S 11 13.5W Reduce rpm to < 1 kn thro' water
1320 06 49.8S 11.13.7W Depressor wt recovered & MAPR string hung-off
1341 06 49.9S 11 15.9W TOBI recovered to deck
1400 3.5 & 10 kHz fish inboard
1405 MAPR string recovered
1406 06 50.1S 11 14.0W Set co for Ascension Is.

2005-03-04
0001 07 23.1S 12 54.2W
0600 07 41.9S 13 54.6W
0855 A/c 180 degs, NW of Ascension Is

0900 07 52.8S 14 24.7W EoP; ERSB
0906 Comp satisfactory ME, BT & steering gear tests
0933 Commence walking back anchor
0943 Cease veer @ 6 sh in water; Bates Pt brng 115 degs x 0.72nm
0948 RFWE
1015 1st boat transfer completed; Joiners onboard; Medical cases ashore
1138 Baggage exchange completed via pontoon. Wind SExS 12 knots
1218 Launch a'side with Agent & medical cases.
1248 Ship's business completed; Agent & leavers away
Vessel completing equipment shifts & essential generator maintenance

1630 ME, steering gear & BT tested & satisfactory
1636 ERSB
1639 Comm heaving anchor
1655 4 sh on deck
1710 Anchor's aweigh; v/l manoeuvring clear of anchorage
1724 RFAoP; Bates Rock brng 139 degs x 1.8nm; set co 033 for work area 1940 07
35.2S 14 13.0W Heave to for ABE maintenance
2008 Resume passage

2005-03-05
0003 07 04.1S 13 52.9W
0655 06 06.4S 13 15.0W Heave to on station
0720 06 06.3S 13 14.9W CTD04 deployed
0830 USBL spar lowered
1005 USBL spar recovered
1010 06 06.7S 13 14.2W CTD recovered; resume passage
1317 05 42.0S 13 00.0W Heave to for CTD test dip. Wind SExS 15 knots
1339 05 42.1S 13 00.0W CTD05 deployed
1405 CTD recovered; repositioning to avoid longlines
1431 05 42.5S 12 59.6W CTD06 redeployed
1508 USBL spar lowered
1615 05 42.4S 12 59.4W Emergency muster & exercises
1728 05 42.6S 12 59.3W CTD recovered
1750 05 42.7S 12 59.3W USBL spar recovered; set co 050 degs for next work area
2355 05 06.8S 12 19.1W RC deployed; RC05

2005-03-06
0140 05 06.8S 12 19.4W RC recovered; commence Swath survey
0340 05 04.0S 12 17.3W RC deployed; RC06
0550 05 04.0S 12 17.2W RC recovered; resume Swath survey
0810 04 44.3S 12 28.4W Cease swath survey; v/l bound for first transponder deployment
0907 04 47.1S 12 25.5W USBL spar lowered
1005 04 47.9S 12 24.6W Transponder #1 released
1053 04 47.3S 12 24.1W 'Boxing-in' transponder
1158 Transponder position fixed; repositioning to CTD station
1200 Wind SExS 18 knots
1312 04 46.0S 12 23.1W CTD07 deployed
1534 04 45.6S 12 23.7W CTD recovered – unsuccessful; v/l repositioning for BRIDGET deployment
1710 04 43.3S 12 25.0W Bridget streamed
1800 04 43.6S 12 24.6W Co 120 degs @ 0.8 knots; veering deep tow
1820 Co 100 degs @ 0.4 knots
1930 04 44.1S 12 23.6W Hauling Bridget due technical problems
2046 Commence recovery
2055 04 44.9S 12 23.9W BRIDGET on deck
2117 Aft deck secure; proceeding for second transponder deployment
2210 04 47.2S 12 21.4W Commence deployment
2220 04 47.2S 12 21.3W Transponder #2 released; repositioning for #3
2315 04 49.5S 12 22.4W Transponder #3 released; 'listening' during descent

2005-03-07
0110 04 46.8S 12 20.9W 'Boxing-in' #2 transponder
0241 04 49.53S 12 22.46W #3 transponder not detected. #4 transponder released in adjacent

			position
0329	04 48.9S	12 22.0W	‘Boxing-in’ #4 transponder
0455	04 50.7S	12 33.9W	USBL spar recovered; set co for MAPR string deployment area
0525	04 48.9S	12 26.2W	Heave-to & commence deployment
0608	04 49.7S	12 26.4W	MAPRs all attached – continue veering deep tow cable
0703	04 50.5S	12 26.4W	2300m wire out; commence MAPR survey conducting cross tracks Mid-Atlantic ridge.
1200	04 48.3S	12 21.3W	Wind SExE 5 knots
1409	04 47.1S	12 26.8W	Aborted turn to stbd due wire angle; shortening cable
1523	04 44.6S	12 28.2W	Slow turn to port to resume survey
1541	04 43.6S	12 28.6W	USBL spar lowered
1700	04 45.0S	12 30.5W	Co 098 degs @ 3 knots thro’ water
2330	04 46.2S	12 21.2W	Slow turn onto W’ly heading

2005-03-08

0324	04 46.3S	12 26.1W	Commence hauling MAPR string
0507			First of MAPRs at surface
0615	04 47.0S	12 30.8W	MAPR string recovered & USBL spar retracted
0735	04 46.8S	12 23.4W	Hove-to & RC (07) deployed
0816	04 47.0S	12 23.4W	RC recovered; v/l repositioning
0832	04 46.6S	12 23.1W	V/l repositioned; deployment resumed
0925	04 46.8S	12 23.2W	RC on bottom
1120	04 47.0S	12 23.4W	RC recovered; proceeding to RC08
1206	04 46.1S	12 22.5W	RC08 deployed; Wind SSE 18 knots
1258	04 46.25S	12 22.61W	RC on bottom
1404	04 46.3S	12 22.6W	RC recovered; v/l repositioning
1444	04 48.5S	12 21.1W	USBL spar lowered
1514-1541			CTD08 test dip; thence preparing for ABE deployment
1635	04 48.4S	12 21.2W	ABE released (ABE150); v/l hove-to for monitoring
1810	04 48.9S	12 21.2W	Re-locating for CTD deployment
1844	04 49.5S	12 21.9W	CTD09 deployed
2125	04 49.9S	12 21.5W	CTD recovered; v/l re-locating
2315	04 46.9S	12 23.6W	CTD10 deployed

2005-03-09

0144	04 47.0S	12 23.4W	CTD recovered; v/l re-locating
0236	04 48.8S	12 22.9W	RC09 deployed
0445	04 48.8S	12 22.9W	RC recovered; v/l re-locating
0540	04 47.7S	12 22.0W	RC10 deployed
0733	04 47.6S	12 22.1W	RC recovered; v/l repositioning
0848	04 50.9S	12 22.2W	RC11 deployed
1045	04 51.2S	12 22.1W	RC recovered; v/l repositioning for CTD station
1152	04 48.6S	12 21.7W	CTD11 deployed; Wind SExE 14 knots
1414	04 48.5S	12 21.9W	CTD recovered; v/l repositioning
1620	04 46.8S	12 22.1W	Hove-to; reeling off & cropping Hydro Wire
1920	04 47.7S	12 22.0W	CTD12 deployed
2156	04 47.7S	12 21.8W	CTD recovered
2300	04 47.3S	12 24.9W	Hove-to awaiting surfacing of ABE
2341	04 47.3S	12 24.8W	ABE sighted on surface; range approx 7 cables

2005-03-10

0030	04 47.4S	12 24.6W	Lifting line hooked-on ABE
0040	04 47.4S	12 24.8W	ABE clear of water & landed on cradle
0056	04 47.3S	12 24.8W	USBL pole retracted & gate valve closed
0134	04 45.6S	12 23.7W	RC12 deployed
0139			Hydraulic failure; 28m wire out
0339			Resume veering
0540	04 45.8S	12 24.0W	RC recovered; v/l repositioning
0620	04 47.4S	12 24.6W	RC13 deployed
0823	04 47.2S	12 24.4W	RC recovered; v/l repositioning
0902	04 49.5S	12 24.0W	RC14 deployed
1104	04 49.5S	12 24.0W	RC recovered; v/l repositioning
1130	04 50.1S	12 23.3W	RC15 deployed; Wind SE 19 knots
1339	04 50.2S	12 23.2W	RC recovered; v/l repositioning

1414 04 48.5S 12 23.0W USBL spar lowered
1700 CTD deployed for cleaning purposes
1736 CTD recovered
1810 04 48.6S 12 23.0W Re-positioning for ABE deployment
1852 04 48.6S 12 22.9W ABE released; v/l hove-to for monitoring
1908 Re-positioning for CTD#10
1925 04 48.0S 12 22.5W CTD13 deployed
2230 04 47.9S 12 22.4W CTD recovered
2245 USBL spar retracted; v/l relocating for rock dredge

2005-03-11
0113 04 38.3S 12 25.4W Commence streaming Dredge #1
0300 04 38.3S 12 25.3W Dredge on bottom
0535 04 39.1S 12 24.8W Off bottom
0735 04 40.1S 12 25.1W Dredge recovered; courses various (Swath?)
0950 04 48.2S 12 22.4W USBL spar lowered
1020 Repositioning for CTD#11
1045 04 48.5S 12 22.3W CTD14 deployed
1322 04 48.6S 12 22.4W CTD recovered; Wind SExE 18 knots
1446 04 47.3S 12 23.3W Hove-to awaiting ABE recovery
1640 04 47.6S 12 23.0W ABE on surface
1658 'Hooked & tagged'
1700 04 47.4S 12 23.2W ABE 'cradled'
1728 04 47.7S 12 23.1W USBL spar retracted; v/l repositioning for Swath survey run
1812 04 48.6S 12 17.9W Commence Swath survey; co 345 degs
1915 04 39.9S 12 21.0W Complete survey & a/c for Dredge start pt.
2008 04 44.3S 12 23.4W Commence streaming Dredge #2
2251 04 44.4S 12 22.2W Dredge off bottom

2005-03-12
0044 04 45.3S 12 21.9W Dredge recovered; repositioning for CTD
0136 04 47.8S 12 22.6W CTD failed @ deployment
0710 04 47.8S 12 22.6W CTD 'downtime' continues
0854 04 47.8S 12 22.5W USBL spar lowered
1105 04 48.6S 12 23.3W Hove-to for ABE deployment
1236 Commence ABE deployment; Wind SExS 10 knots
1252 04 48.7S 12 22.5W ABE released; monitoring to bottom
1600 04 48.8S 12 22.5W Hove-to awaiting instructions
1620 Repositioning for BRIDGET deployment
1722 04 45.9S 12 23.7W Commence streaming BRIDGET
1900 04 46.5S 12 23.2W Cease veer at 2900m wire out
1920 04 46.8S 12 23.0W Towing BRIDGET – CMG 162 degs; speed 1.0 knots
2116 04 48.7S 12 22.3W Commence hauling BRIDGET
2248 04 50.3S 12 21.8W BRIDGET on deck
2307 Relocating to RC site

2005-03-13
0125 04 48.5S 12 21.3W RC16 deployed
0223 04 48.48S 12 21.25W RC at bottom
0326 04 48.6S 12 21.1W RC recovered; v/l relocating for ABE recovery
0550 04 48.4S 12 22.7W ABE on surface
0618 04 48.5S 12 23.0W 'Hooked & tagged'
0620 'Cradled'
0642 USBL spar retracted; v/l relocating for Swath survey
0748 04 53.3S 12 16.6W Commence Swath survey; CMG 163 degs; speed 9.5 knots
0832 04 59.0S 12 14.8W Hove-to @ Watch leader's request
0903 Resume Swath survey
1020 05 08.2S 12 11.6W Hove-to for CTD test dip
1125 CTD recovered; resume Swath survey
1200 05 06.9S 12 08.2W Hdg 343 degs; Wind SExS 20 knots
1522 04 35.9S 12 17.8W A/c 254 degs
1700 04 40.4S 12 32.6W A/c 198 degs
1735 04 45.5S 12 34.1W A/c 168 degs
1807 04 49.8S 12 33.0W A/c 082 degs – bound for RC station

1937 04 48.6S 12 22.4W RC17 deployed
2100 04 48.5S 12 22.4W RC at bottom
2205 04 48.5S 12 22.3W RC recovered; v/l repositioning
2326 04 48.5S 12 22.3W CTD15 deployed

2005-03-14
0320 04 48.6S 12 22.5W CTD recovered; v/l repositioning
0525 04 47.7S 12 22.5W RC18 deployed
0722 04 47.6S 12 22.4W RC recovered
0750 04 48.1S 12 22.7W RC19 deployed
0850 04 48.04S 12 22.59W RC at bottom
0949 04 48.2S 12 22.6W RC recovered
1009 04 47.2S 12 22.8W RC20 deployed
1115 04 47.27S 12 22.83W RC at bottom
1212 04 47.4S 12 22.9W RC recovered; Wind ESE 15 knots
1324 USBL spar lowered
1426 04 47.8S 12 22.6W CTD16 deployed
1718 04 47.8S 12 22.7W CTD recovered
1831 04 48.2S 12 22.7W Re-positioned for ABE deployment
1959 04 48.13S 12 22.71W ABE released
2052 04 48.1S 12 22.7W Re-positioning for RC station
2129 04 50.2S 12 22.0W RC21 deployed
2234 04 50.16S 12 21.95W RC on bottom
2334 04 50.2S 12 21.8W RC recovered; re-locating for dredge station

2005-03-15
0046 04 46.4S 12 23.1W Dredge03 outboard
0202 04 46.36S 12 23.10W Dredge on bottom (3235m); incr to 1 knot OTG
0450 04 48.1S 12 21.6W Dredge recovered
0540 – 0600 Checking acoustic response from ABE
0745 04 48.5S 12 22.5W Heave-to @ SAPs deployment position
0836 04 48.6S 12 22.3W Commence streaming SAPs & MAPRs string
0917 String completed; continue veering
1030 ABE inadvertently released; commence heaving SAPs string
1216 04 48.6S 12 22.3W Complete SAPs string recovery; re-positioning for ABE recovery
1336 04 47.6S 12 22.0W ABE sighted on surface; Wind SE 15 knots
1348 'Hooked & tagged' and clear of water
1353 04 47.7S 12 22.1W ABE cradled; v/l repositioning for CTD
1452 04 48.3S 12 22.3W CTD17 deployed
1745 04 48.1S 12 21.9W CTD recovered; v/l lying a-hull to provide lee for work on ABE
1830 Re-positioning to launch site
1900 04 48.6S 12 22.7W Hove-to awaiting launch
2040 04 48.63S 12 22.69W ABE released; v/l monitoring & then re-locating for dredge
2200 04 47.6S 12 22.7W Dredge04 outboard
2330 04 47.67S 12 22.68W Dredge on bottom

2005-03-16
0247 04 49.9S 12 20.9W Dredge recovered; re-positioning for RC
0333 04 49.3S 12 21.9W RC22 deployed
0530 04 49.3S 12 21.7W RC recovered
0600 04 48.3S 12 22.8W Hove-to for ABE recovery
0635 04 48.4S 12 22.6W ABE on surface
0647 'Hooked & tagged'
0650 04 48.4S 12 22.4W ABE cradled
0715 04 48.6S 12 22.4W CTD18 deployed
0951 04 48.6S 12 22.4W CTD recovered; v/l re-positioning for ABE release
1145 04 48.1S 12 22.7W Hove-to awaiting deployment; Wind SE 18 knots
1250 04 48.0S 12 22.6W ABE released; v/l re-positioning for SAPs deployment
1334 04 48.5S 12 22.3W Commence streaming SAPs 02 string
1403 All SAPs clamped to wire; continue veering to reqd depth
1830 04 48.5S 12 22.2W Commence hauling SAPs
2013 04 49.3S 12 22.4W All SAPs gear recovered; v/l re-positioning for BRIDGET deployment
2141 04 44.8S 12 24.6W Commence BRIDGET deployment
2156 Recovering due to technical problems

2358 04 45.7S 12 23.8W Re-deploying

2005-03-17
0320 04 47.9S 12 22.3W Commence hauling BRIDGET
0455 04 48.7S 12 21.8W BRIDGET recovered to deck
0545 04 47.6S 12 23.5W In position for ABE recovery
0600 ABE on surface
0620 04 47.7S 12 23.4W 'Hooked & tagged'
0625 'Cradled'; v/l re-locating for transponder recoveries
0715 04 47.0S 12 22.0W NE transponder recovered
0812 04 47.6S 12 25.2W NW transponder recovered
0835 USBL spar retracted & gate valve closed
0908 04 48.6S 12 23.8W S'ly transponder recovered
0933 04 49.9S 12 22.6W 'Dead' transponder not located; commence Swath run towards Ascension Island
1118 05 06.0S 12 22.1W A/c to 214 degs (T&G); complete Swath run & science for cruise
1200 05 12.0S 12 31.3W Wind SE 18 knots
1800 06 02.3S 13 06.4W

2005-03-18
0001 06 52.3S 13 41.7W
0600 07 51.0S 14 23.7W
0715 Critical bridge gear tests completed & satisfactory
0718 RSBE; EoP Pyramid Pt brng 147 degs x 1.23 nm
0742 Comm walking back port anchor
0748 Holding on at 5 sh on deck. 'CB' anchorage, Clarence Bay; RFWE.

P. Sarjeant
Master

	CD169 leg1: science log																									
	SHIP		Latitude (S)		Longitude (W)							Swath/ TOBI		TOBI							Plotted Position (m)	Lat		Lon		Comments
Operation	JD	Time	deg	min	deg	min	Dec.Lat	Dec.Lon	CMG	SMG	Depth	Line	#	W/o	Alt	z(m)	HDG	Dec.Lat	Dec.Lon	L-bck	Deg.	Min	Deg	Min	
	048	09:30	16	55.00	25	00.00																			Depart Mindelo
CTD Test	049	10:36	13	35.91	23	00.94	13.599	23.016																	CTD in water
CTD Test	049	10:53	13	35.87	23	01.07	13.598	23.018																	Firing bottles @ 500m
CTD Test	049	11:10	13	35.82	23	01.10	13.597	23.018																	CTD on deck, all bottles fired - probs with Salinity?
Stream Cable	049	10:55	13	35.17	23	00.80	13.586	23.013	147	6.0															Cable in water + 450kg weight
Stream Cable	049		13	11.65	22	45.35	13.194	22.756																	Cable & weight inboard
Start EM12	050	11:32	10	34.21	21	02.20				10.9		01													Begin EM12 mapping nr Sierra Leone Rise
Swath	054	14:14	02	34.20	12	30.00			149	8.2	2884	Transit	14												
Swath	054	14:32	02	36.20	12	28.60			143	8.9	3062	Transit	14												
Swath	054	14:59	02	39.05	12	26.70			149	7.9	3058	Transit	14												
Swath	054	15:29	02	42.40	12	24.20			150	8.0	3046	Transit	14												
Swath	054	16:00	02	45.75	12	21.80			141	7.7	2872	Transit	14												
Swath	054	16;30	02	48.80	12	19.20			142	8.0	2387	Transit	14												
Swath	054	17:00	02	51.90	12	17.00			142	7.9	2608	Transit	14												
Swath	054	17:30	02	55.10	12	14.70			141	8.0	2299	Transit	14												
Swath	054	17:37	02	55.90	12	14.10			142	8.0	2060	Transit	14												End transit, Alter course
Swath	054	17:41	02	56.50	12	14.00			176	8.2	1787	01	15												On course- Line 1
Swath	054	18:00	02	59.10	12	13.80			174	8.4	2776	01	15												
Swath	054	18:30	03	03.40	12	13.50			177	8.5	3500	01	15												
Swath	054	19:00	03	08.00	12	13.10			176	8.7	4020	01	15												
Swath	054	19:30	03	12.32	12	12.90			176	9.1	4058	01	15												
Swath	054	19:36	03	13.40	12	12.80			171	7.7	3932	01, 02	5, 16												WP3: EOL1 & on course SOL2
Swath	054	20:00	03	16.66	12	12.26			172	9.3	3865	02	16												
Swath	054	20:30	03	20.98	12	11.57			171	9.2	3166	02	16												
Swath	054	21:00	03	25.20	12	10.94			173	8.6	3012	02	16												
Swath	054	21:30	03	29.56	12	10.26			178	7.7	3588	02	17												
Swath	054	22:00	03	33.91	12	09.62			175	8.6	3619	02	17												
Swath	054	22:30	03	38.25	12	08.90			169	8.5	3608	02	17												
Swath	054	23:00	03	42.72	12	08.34			171	8.9	3642	02	17												
Swath	054	23:30	03	47.09	12	07.63			171	7.3	3571	02	17												
Swath	054	00:00	03	51.76	12	06.90			174	8.4	3662	02	17												
Swath	055	00:02	03	52.25	12	06.84			183	9.4	3800	03	18												
Swath	055	00:30	03	55.60	12	09.40			225	8.4	4209	03	18												
Swath	055	01:00	03	59.15	12	12.20			223	9.0	4075	03	18												
Swath	055	01:30	04	02.50	12	14.90			217	9.3	4272	03	18												
Swath	055	01:59	04	06.19	12	17.88			189	8.5	3587	03	19												
Swath	055	02:29	04	10.55	12	17.59			175	8.5	3164	04	19												
Swath	055	03:00	04	14.89	12	17.26			175	8.5	3016	04	19												
Swath	055	03:30	04	19.35	12	16.87			175	8.1	3343	04	19												
Swath	055	04:00	04	23.71	12	16.45			175	8.5	3569	04	19												
Swath	055	04:12	04	25.80	12	16.79				8.7	3529		20												WP6 eol 4 A/C
Swath	055	04:16	04	26.07	12	16.79			216	9.0	3418	05	20												O/C sol 5
Swath	055	04:30	04	27.49	12	18.16			226	9.5	3387	05	20												
Swath	055	05:00	04	30.79	12	21.26			220	9.0	3392	05	20												
Swath	055	05:30	04	34.04	12	24.39			228	9.0	3572	05	20												
Swath	055	05:50	04	36.55	12	26.80			228	9.0	3430		20												Course change to sol 6 early
Swath	055	06:00	04	37.40	12	26.90			166	9.0	3392	06	21												o/c sol 6
Swath	055	06:24	04	40.70	12	26.10			150	9.0	3288	07	22												o/c sol 6
Swath	055	06:32	04	41.78	12	25.62			152	9.1	3363	07	22												Course alteration eol 6 sol 7
Swath	055	07:00	04	45.02	12	23.71			151	8.1	3296	07	22												
Swath	055	07:25	04	48.30	12	21.80			165	8.1	2946	08	23												a/c to 165
Swath	055	07:30	04	48.80	12	21.70			165	9.3	2930	08	23												
Swath	055	07:35	04	49.30	12	21.60			195	9.4	2914	09	23												a/c to 195
Swath	055	07:44	04	50.70	12	21.90			180	8.6	3040	10	23												a/c to 180
	CD169 leg1: science log																									
	SHIP		Latitude (S)		Longitude (W)							Swath/ TOBI		TOBI							Plotted Position (m)	Lat		Lon		Comments

Operation	JD	Time	deg	min	deg	min	Dec.Lat	Dec.Lon	CMG	SMG	Depth	Line	#	W/o	Alt	z(m)	HDG	Dec.Lat	Dec.Lon	L-bck	Deg.	Min	Deg	Min	
Swath	055	08:00	04	52.90	12	21.90			184	7.8	3252	10	23												
Swath	055	08:10	04	54.16	12	22.01			181	7.6	3328	11	23												a/c to 165
Swath	055	08:30	04	56.70	12	21.45			164	7.6	3444	11	23												
Swath	055	09:00	05	00.41	12	20.40			165	6.8	3345	11	23												
Swath	055	09:30	05	04.12	12	19.46			162	8.1	3311	11	23												END OF SWATH EOL 11
Swath	055	10:00	05	07.85	12	18.54			168	7.8	3454	11	23												Continue line for TOBI deployment
Transit	055	10:07																							Underway to TOBI start
Transit	055	10:20	05	10.50	12	17.80			170	3.5	3658	-													Reducing speed to deploy 10 KHz, 3.5 KHz fish
TOB-01	055	10:30	05	10.80	12	17.80			170	3.5	3632	-													
TOB-01	055	10:40	05	11.10	12	17.80			174	1.5	3467	-													2 Fish in
TOB-01	055	11:00	05	11.40	12	17.87			286	1.2	3280	-													
TOB-01	055	11:07																							Bat fish + 1st mapper in (M12)
TOB-01	055	11:13																							2nd mapper in (M13)
TOB-01	055	11:20																							3rd mapper in (M6)
TOB-01	055	11:28																							4th mapper in (M29)
TOB-01	055	11:50																		.					TOBI in th water
TOB-01	055	12:10																							TOBI electronics ok - ready to deploy
TOB-01	055	12:20																							Bomb in water
TOB-01	055	12:23																							5th mapper in (at 0m W/O)
TOB-01	055	12:26																							6th mapper in (at 50m W/O)
TOB-01	055	12:34	05	12.27	12	17.98			151	1.0															
TOB-01	055	12:36	05	12.33	12	17.93																			Commensing turn at 10 degrees per minute
TOB-01	055	12:56	05	12.00	12	17.52	5.200	12.292	351	3.7	3281			300		217	357	5.203	12.292	**379**					TOBI deployed - on course
TOB-01	055	13:00	05	11.83	12	17.54	5.197	12.292	337	2.2	3300			462		231	349	5.202	12.291	**590**					
TOB-01	055	13:27	05	10.50	12	17.63	5.175	12.294	359	2.8	3675			1661		801	355	5.190	12.293	**1645**					
TOB-01	055	14:00	05	09.12	12	17.76	5.152	12.296	356	2.7	3662			2795		1282	348	5.176	12.291	**2674**					
TOB-01	055	14:29	05	08.10	12	17.90	5.135	12.298	347	3.0	3293			3953		2144	359	5.167	12.298	**3511**	**5**	**10.00**	**12**	**17.05**	
TOB-01	055	14:48	05	07.43	12	18.05	5.124	12.301	331	1.9	3517														Reduced W/O to 20m/min
TOB-01	055	14:55												4837											Stop winch
TOB-01	055	15:01	05	07.05	12	18.15	5.118	12.303	337	2.0	3554			4837		2789	352	5.155	12.297	**4142**	**5**	**9.40**	**12**	**17.45**	
TOB-01	055	15:20	05	06.23	12	18.19	5.104	12.303	347	2.0	3501			4837		2637	351	5.142	12.297	**4245**					TOBI 800m of bottom - sol 12
TOB-01	055	15:30	05	06.01	12	18.24	5.100	12.304	350	2.0	3548			4836	850	2632	351	5.138	12.298	**4247**	**5**	**8.30**	**12**	**17.80**	
TOB-01	055	16:00	05	05.01	12	18.51	5.084	12.309	000	2.8	3607			4835	765	2643	354	5.122	12.304	**4239**	**5**	**7.40**	**12**	**17.90**	At WP 9
TOB-01	055	16:30	05	04.02	12	18.79	5.067	12.313	357	1.9	3452	12		5050	738	2786	354	5.107	12.309	**4402**	**5**	**6.45**	**12**	**18.20**	
TOB-01	055	17:00	05	03.09	12	19.04	5.052	12.317	338	2.0	3425	12		5200	449	2944	350	5.092	12.310	**4476**	**5**	**5.50**	**12**	**18.45**	
TOB-01	055	17:30	05	02.17	12	19.31	5.036	12.322	343	2.3	3479	12		5158	447	3428	353	5.073	12.317	**4044**	**5**	**4.55**	**12**	**18.80**	
TOB-01	055	18:00	05	01.27	12	19.54	5.021	12.326	351	1.7	3534	12		5117	323	3405	353	5.057	12.321	**4010**	**5**	**3.50**	**12**	**19.00**	
TOB-01	055	18:30	05	00.28	12	19.79	5.005	12.330	349	1.9	3615	12		5074	438	3516	354	5.039	12.326	**3848**	**5**	**2.40**	**12**	**19.30**	
TOB-01	055	18:45	04				4.000																		TOBI glitch, rebooted successfully at 18:55
TOB-01	055	19:00	04	59.31	12	20.11	4.989	12.335	334	1.8	3454	12		5146	455	3469	354	5.032	12.331	**3991**	**5**	**1.50**	**12**	**19.60**	
TOB-01	055	19:30	04	58.29	12	20.38	4.972	12.340	345	1.9	3575	12		5353	492	3135	350	5.012	12.333	**4529**	**5**	**0.80**	**12**	**19.75**	
TOB-01	055	20:00	04	57.35	12	20.67	4.956	12.345	347	1.9	3466	12		5474	439	3033	350	4.998	12.337	**4747**	**5**	**0.00**	**12**	**19.90**	
TOB-01	055	20:30	04	56.36	12	20.94	4.939	12.349	357	2.2	3552	12		5522	390	3088	348	4.982	12.340	**4768**	**4**	**58.80**	**12**	**20.20**	
TOB-01	055	21:00	04	55.44	12	21.20	4.924	12.353	339	2.1	3512	12		5523	369	3122	346	4.966	12.343	**4746**	**4**	**57.85**	**12**	**20.35**	
TOB-01	055	21:05												5523											Haul 10m/m
TOB-01	055	21:11												5446	374										Winch stopped
TOB-01	055	21:30	04	54.51	12	21.47	4.909	12.358	338	1.9	3380	12		5446	386	3118	345	4.949	12.347	**4655**	**4**	**57.25**	**12**	**20.60**	
TOB-01	055	21:37												5446											Haul10m/m
TOB-01	055	21:50												5321	400										Winch stopped
TOB-01	055	22:00	04	53.67	12	21.71	4.895	12.362	334	1.6	3290	12		5321	406	3082	344	4.934	12.350	**4528**	**4**	**56.00**	**12**	**21.00**	
TOB-01	055	22:15												5321											Haul10m/m
TOB-01	055	22:22												5240											Increase haul to 15 m/m
TOB-01	055	22:30	04	52.83	12	21.93	4.881	12.366	336	2.2	3284	12		5158	303	3061	345	4.919	12.355	**4342**	**4**	**55.00**	**12**	**21.20**	
TOB-01	055	22:55												4743	481										Winch stopped
TOB-01	055	23:00	04	51.82	12	22.20	4.864	12.370	354	2.2	3131	12		4743	521	2781	351	4.900	12.364	**4032**	**4**	**54.00**	**12**	**21.60**	
TOB-01	055	23:30	04	50.90	12	22.46	4.848	12.374	338	1.9	3106	12		4744	580	2691	349	4.885	12.367	**4097**	**4**	**53.20**	**12**	**21.80**	Veer 5m/m, Increase veer to 10m/m

	CD169 leg1: science log											**Swath/**								**Plotted Position**					
	SHIP		**Latitude (S)**		**Longitude (W)**							**TOBI**		**TOBI**						**(m)**	**Lat**		**Lon**		**Comments**
Operation	**JD**	**Time**	**deg**	**min**	**deg**	**min**	**Dec.Lat**	**Dec.Lon**	**CMG**	**SMG**	**Depth**	**Line**	**#**	**W/o**	**Alt**	**z(m)**	**HDG**	**Dec.Lat**	**Dec.Lon**	**L-bck**	**Deg.**	**Min**	**Deg**	**Min**	
TOB-01	055	23:39												4783											

TOB-01	055	23:59	04	49.89	12	22.73	4.832	12.379	326	1.3	3015	12		4962	467	2706	350	4.870	12.372	**4349**	**4**	**52.00**	**12**	**22.05**	Winch stopped
TOB-01	056	00:30	04	48.89	12	23.04	4.815	12.384	356	1.8	2964	12		4910	352	2677	349	4.853	12.376	**4306**	**4**	**51.20**	**12**	**22.50**	WP10 passed
TOB-01	056	01:00	04	47.87	12	23.23	4.798	12.387	333	1.8	2994	13		4889	350	2659	347	4.836	12.378	**4293**	**4**	**50.05**	**12**	**23.00**	
TOB-01	056	01:03												4889											Haul 5m/min
TOB-01	056	01:14																							TOBI CTD locked out
TOB-01	056	01:22												4707											Winch stopped
TOB-01	056	01:30	04	46.86	12	23.39	4.781	12.390	334	2.0	3129	13		4707			347	4.816	12.382	**3894**	**4**	**48.85**	**12**	**22.85**	**! No TOBI altitude. Layback est'd from past values**
TOB-01	056	02:00	04	45.85	12	23.60	4.764	12.393	344	2.0	3070	13		4706			354	4.799	12.390	**3893**	**4**	**47.75**	**12**	**23.40**	**! No TOBI altitude. Layback est'd from past values**
TOB-01	056	02:30	04	44.84	12	23.77	4.747	12.396	338	2.0	3220	13		4705			353	4.782	12.392	**3892**	**4**	**46.80**	**12**	**23.40**	**! No TOBI altitude. Layback est'd from past values**
TOB-01	056	02:45												4705											start veering at 8m/sec
TOB-01	056	02:57												4802											**Winch stopped**
TOB-01	056	03:00	04	43.86	12	23.97	4.731	12.400	333	2.3	3251	13		4802			355	######	######		**4**	**46.00**	**12**	**23.55**	**! No TOBI altitude. Layback est'd from past values**
TOB-01		03:10																							**nephel 0.038**
TOB-01	056	03:30	04	42.68	12	24.16	4.711	12.403	347	2.5	3300	13		4964	475	2640	356	4.751	12.400	**4394**	**4**	**45.00**	**12**	**24.00**	
TOB-01	056	04:00	04	41.54	12	24.40	4.692	12.407	329	2.5	3427	13		5458	355	2875	425	4.711	12.446	**4829**	**4**	**44.10**	**12**	**23.95**	**Pay out @ 8**
TOB-01	056	04:30	04	40.44	12	24.59	4.674	12.410	357	1.7	3528	13		5597	433	2887	354	4.719	12.405	**4985**	**4**	**43.15**	**12**	**24.20**	**veer @ 7**
TOB-01	056	05:00	04	39.37	12	24.78	4.656	12.413	355	1.9	3583	13		5788	357	3029	356	4.703	12.410	**5122**	**4**	**41.90**	**12**	**24.45**	
TOB-01	056	05:30	04	38.31	12	25.00	4.639	12.417	335	2.1	3627	13		5787	367	3039	357	4.685	12.414	**5115**	**4**	**41.20**	**12**	**24.40**	
TOB-01	056	06:00	04	37.26	12	25.20	4.621	12.420	357	1.8	3648	13		5791	421	3057	355	4.667	12.416	**5108**	**4**	**40.50**	**12**	**24.50**	**Veer @ 8**
TOB-01	056	06:18	04	36.61	12	25.31	4.610	12.422	326	2.4	3620	13													**turn to WP started: 1°/min. Should take 1 hr to WP.**
TOB-01	056	06:30	04	36.24	12	25.33	4.604	12.422	347	2.1	3650	13		5748	347	3095	355	4.650	12.418	**5034**	**4**	**39.20**	**12**	**24.60**	**Haul @ 15. WP11 eol.**
TOB-01	056	07:00	04	35.37	12	24.94	4.590	12.416	031	1.0	3521			5695	397	3172	357	4.634	12.413	**4920**	**4**	**38.10**	**12**	**24.80**	**Turning**
TOB-01	056	07:30	04	34.60	12	24.32	4.577	12.405	031	2.3	3727	14		5648	415	3203	9.4	4.620	12.413	**4842**	**4**	**36.85**	**12**	**24.95**	**o/c on line 1, veer @ 8**
TOB-01	056	07:39												5648											**Winch haul @ 10**
TOB-01	056	07:42												5635											**Winchstop**
TOB-01	056	07:47												5636											**Veer @ 8**
TOB-01	056	08:00	04	33.79	12	23.48	4.563	12.391	054	2.9	3751	14		5761	460	3133	28.1	4.603	12.413	**5025**	**4**	**35.90**	**12**	**25.50**	
TOB-01	056	08:30	04	33.08	12	22.69	4.551	12.378	051	2.6	3671	14		6020	417	3167	39.3	4.589	12.409	**5310**	**4**	**35.10**	**12**	**25.00**	**NB "PlottedPos" = estimated TOBI posn from map**
TOB-01	056	09:00	04	32.32	12	21.85	4.539	12.364	050	2.3	3470	14		6400	421	3232	44	4.576	12.400	**5714**	**4**	**34.40**	**12**	**24.10**	**winch stopped**
TOB-01	056	09:30	04	31.54	12	20.98	4.526	12.350	049	3.0	3393	14		6401	544	3146	47	4.561	12.388	**5765**	**4**	**33.60**	**12**	**24.40**	
TOB-01	056	10:00	04	30.73	12	20.04	4.512	12.334	066	2.0	3395	14		6401	523	3025	51.2	4.545	12.375	**5831**	**4**	**32.90**	**12**	**23.10**	
TOB-01	056	10:30	04	29.89	12	19.12	4.498	12.319	058	3.1	3455	14		6401	377	2984	53.2	4.530	12.361	**5853**	**4**	**32.00**	**12**	**21.80**	
TOB-01	056	11:00	04	29.11	12	18.24	4.485	12.304	058	2.0	3242	14		6401	367	2954	53.3	4.517	12.347	**5869**	**4**	**31.20**	**12**	**20.15**	
TOB-01	056	11:30	04	28.25	12	17.28	4.471	12.288	043	3.0	3335	14		6402	506	2943	52.9	4.503	12.331	**5875**	**4**	**30.20**	**12**	**19.50**	
TOB-01	056	11:51																							**Start turn for WP13 (bridge late informing)**
TOB-01	056	11:57	04	27.41	12	16.40	4.457	12.273	038	2.0	3234	14		6402	326	2917	53	4.489	12.316	**5889**	**4**	**29.60**	**12**	**18.75**	**Haul at 5m/min**
TOB-01	056	12:00												6389											**Increase haul to 10m/m**
TOB-01	056	12:05												6339											**Winch stopped**
TOB-01	056	12:25												6339											**Veering 5m/min**
TOB-01	056	12:30	04	26.04	12	15.97	4.434	12.266	344	2.8	3331	14		6372	567	2871	51.5	4.467	12.308	**5879**	**4**	**28.80**	**12**	**17.50**	
TOB-01	056	12:32												6374											**Stopped winch**
TOB-01	056	12:46												6374											**Haul at 5m/min**
TOB-01	056	12:51												6354											**Stopped winch**
TOB-01	056	13:00	04	24.78	12	16.09	4.413	12.268	355	3.2	3450	14		6354	367	2938	38.7	4.454	12.301	**5824**	**4**	**27.70**	**12**	**16.80**	
TOB-01	056	13:30	04	23.42	12	16.28	4.390	12.271	359	2.5	3450	14		6354	422	2840	17.8	4.441	12.288	**5874**	**4**	**26.55**	**12**	**16.00**	
TOB-01	056	13:38																							**Veering 10m/min**
TOB-01	056	14:00	04	22.08	12	16.45	4.368	12.274	357	2.8	3565	14		6643	600	2888	5.8	4.424	12.280	**6172**	**4**	**25.40**	**12**	**15.80**	
TOB-01	056	14:19																							**Winch stopped**
TOB-01	056	14:30	04	20.83	12	16.64	4.347	12.277	352	2.5	3474	14	###	6956	379	3050	359	4.406	12.276	**6442**	**4**	**24.60**	**12**	**16.20**	
TOB-01	056	15:00	04	19.58	12	16.79	4.326	12.280	354	2.6	3300	14	###	6956	420	3065	359	4.385	12.279	**6434**	**4**	**23.10**	**12**	**16.30**	
TOB-01	056	15:22											*00*	6956											**Haul at 10m/min**
TOB-01	056	15:30	04	18.32	12	16.99	4.305	12.283	350	2.5	3200	14	###	6871	440	3053	358	4.363	12.281	**6345**	**4**	**21.80**	**12**	**16.45**	**still hauling at 10m/min.**
TOB-01	056	16:00	04	16.96	12	17.17	4.283	12.286	356	2.5	3153	14	##	6721	371	2966	358	4.339	12.284	**6221**	**4**	**20.50**	**12**	**16.80**	
TOB-01	056	16:04	04				4.000							6721											**Haul @ 5**
TOB-01	056	16:14																							**Haul @ 10**
TOB-01	056	16:16																							**Haul @ 15.**
TOB-01	056	16:30	04	15.68	12	17.30	4.261	12.288	000	2.8	3096	14		6459	355	2865	355	4.315	12.284	**5979**	**4**	**19.25**	**12**	**16.50**	

	CD169 leg1: science log											**Swath/**									**Plotted Position**					
	SHIP		**Latitude (S)**		**Longitude (W)**							**TOBI**		**TOBI**							**(m)**	**Lat**		**Lon**		
Operation	**JD**	**Time**	**deg**	**min**	**deg**	**min**	**Dec.Lat**	**Dec.Lon**	**CMG**	**SMG**	**Depth**	**Line**	**#**	**W/o**	**Alt**	**z(m)**	**HDG**	**Dec.Lat**	**Dec.Lon**	**L-bck**	**Deg.**	**Min**	**Deg**	**Min**	**Comments**
TOB-01	056	16:32												6459											**haul @ 20**
TOB-01	056	16:56																							**Haul at 10m/min**
TOB-01	056	17:00	04	14.40	12	17.30	4.240	12.288	357	2.7	2954	15		5933	395	2675	356	4.290	12.285	**5486**	**4**	**17.40**	**12**	**16.80**	**Stop winch**

TOB-01	056	17:05																										**Haul at 10m/min**
TOB-01	056	17:06																										**Haul at 20m/min**
TOB-01	056	17:15																										**Haul at 10m/min**
TOB-01	056	17:30	04	13.31	12	17.31	4.222	12.289	040	1.7	2952	15		5627	411	2684	0.6	4.269	12.289	**5136**	**4**	**16.20**	**12**	**16.90**		
TOB-01	056	17:31												5627														**winch stopped**
TOB-01	056	17:34																										**Haul at 10m/min**
TOB-01	056	17:38																										**Haul at 15m/min**
TOB-01	056	17:42									2914			5511														**winch stopped**
TOB-01	056	17:50									2899			5511														**Veer at 10**
TOB-01	056	17:53									2897			5537														**winch stopped**
TOB-01	056	18:00	04	12.00	12	17.30	4.200	12.288	000	2.0	2925			5537	347	2578	2	4.246	12.290	**5090**	**4**	**15.00**	**12**	**17.20**		**Haul at 10m/min**
TOB-01	056	18:21									3060			5321														**Haul at 5m/min**
TOB-01	056	18:24									3094			5308														**winch stopped**
TOB-01	056	18:28									3108			5308														**veer 10m/min**
TOB-01	056	18:30	04	10.77	12	17.31	4.180	12.289	001	2.4	3128	15		5327	461	2467	3.4	4.224	12.291	**4911**	**4**	**13.50**	**12**	**17.00**		**veer 15m/min**
TOB-01	056	18:33									3128			5368														**Stopped winch**
TOB-01	056	18:46									3118			5370														**Veer 10m/min**
TOB-01	056	18:58									3207			5476														**Stopped winch**
TOB-01	056	19:00	04	09.47	12	17.27	4.158	12.288	356	1.7	3214	15		5476	395	2505	3.6	4.204	12.291	**5059**	**4**	**12.20**	**12**	**17.05**		
TOB-01	056	19:11	04				4.000				3324	15		5477														**veer 10m/min**
TOB-01	056	19:15									3399			5527														**veer 15m/min**
TOB-01	056	19:20																										**Chris changed time delay to 4.5sec on 3.5KHz**
TOB-01	056	19:30	04	08.23	12	17.28	4.137	12.288	358	2.3	3470	15		5746	440	2584	2.4	4.186	12.290	**5322**	**4**	**10.50**	**12**	**17.05**		
TOB-01	056	19:45									3574			5979														**Winch stopped**
TOB-01	056	20:00	04	06.95	12	17.22	4.116	12.287	346	2.9	3631	15		5979	363	2657	1.3	4.166	12.288	**5546**						
TOB-01	056	20:09												5979														**veer 15m/min**
TOB-01	056	20:17	04	06.22	12	17.27	4.104	12.288	351	2.2	3697	15		6115	515	2688	3.2	4.155	12.291	**5683**								**start turn at w/p 14**
TOB-01	056	20:30	04	05.81	12	17.18	4.097	12.286	050	1.7	3738	15		6296	449	2848	5.8	4.149	12.292	**5805**	**4**	**9.00**	**12**	**17.00**		**veer reduce to 10m/m**
TOB-01	056	20:32												6306														**Winch stopped**
TOB-01	056	20:47												6306														**veer 10m/min**
TOB-01	056	21:00	04	04.89	12	16.58	4.082	12.276	039	2.5	3801	15		6430	412	3067	2.5	4.135	12.279	**5841**	**4**	**8.00**	**12**	**17.00**		
TOB-01	056	21:07	04	04.67	12	16.41	4.078	12.274	033	2.2	3895	16		6511	343	3146	4.5	4.131	12.278	**5891**						
TOB-01	056	21:20												6631														**Winch stopped**
TOB-01	056	21:30	04	03.99	12	15.91	4.067	12.265	052	2.4	4105	16		6631	302	3264	13.4	4.119	12.278	**5962**	**4**	**7.30**	**12**	**16.80**		
TOB-01	056	21:52												6631														**veer 10m/min**
TOB-01	056	22:00	04	03.05	12	15.18	4.051	12.253	052	2.6	4222	16		6714	406	3249	26.5	4.100	12.278	**6066**	**4**	**6.20**	**12**	**16.80**		
TOB-01	056	22:16												6879														**Winch stopped**
TOB-01	056	22:30	04	02.18	12	14.48	4.036	12.241	055	3.4	4231	16		6879	396	3325	33.1	4.084	12.272	**6212**	**4**	**5.00**	**12**	**16.20**		
TOB-01	056	22:32												6879														**Veer10m/m**
TOB-01	056	22:50												7050														**Increase veer to15m/m**
TOB-01	056	23:00	04	01.22	12	13.72	4.020	12.229	056	3.0	4208	16		7203	637	3446	36.4	4.068	12.264	**6515**	**4**	**4.40**	**12**	**16.00**		
TOB-01	056	23:15												7422														**Decrease veer to 10m/m**
TOB-01	056	23:18												7445														**Winch stopped**
TOB-01	056	23:24										16		7445														**Veer 10m/m**
TOB-01	056	23:30	04	00.33	12	13.01	4.006	12.217	036	2.5	4272	16		7522	495	3653	39.8	4.053	12.256	**6765**	**4**	**3.20**	**12**	**15.50**		
TOB-01	056	23:50												7692														**Winch stopped**
TOB-01	057	00:00	03	59.54	12	12.39	3.992	12.207	036	1.8	4311	16		7692	377	3809	41.3	4.039	12.248	**6873**	**4**	**2.50**	**12**	**14.70**		
TOB-01	057	00:26												7692														**Hauling @ 20 m/min**
TOB-01	057	00:28																										**On board computer crashed**
TOB-01	057	00:30	03	58.61	12	11.68	3.977	12.195	047	2.2	4193	16		7604	292		45.4	4.023	12.241	**7167**						
TOB-01	057	00:38																										**Hauling for recovery @ 25 m/min. ETA 5AM**
TOB-01	057	02:55	03	56.02	12	09.70	3.934	12.162	035	2.3	4310			5428				3.969	12.186	**4709**						
TOB-01	057	03:06	03	53.82	12	08.38	3.897	12.140	012	23.0	4164			3660				3.897	12.140							
TOB-01	057	04:00	03	52.39	12	07.52	3.873	12.125	042	1.9	3982			2358												
TOB-01	057	04:39	03	51.57	12	06.60	3.860	12.110	087	1.1	3582			1340												

	CD169 leg1: science log											**Swath/**							**Plotted Position**						
	SHIP		**Latitude (S)**		**Longitude (W)**							**TOBI**		**TOBI**							**(m)**	**Lat**		**Lon**		**Comments**
Operation	**JD**	**Time**	**deg**	**min**	**deg**	**min**	**Dec.Lat**	**Dec.Lon**	**CMG**	**SMG**	**Depth**	**Line**	**#**	**W/o**	**Alt**	**z(m)**	**HDG**	**Dec.Lat**	**Dec.Lon**	**L-bck**	**Deg.**	**Min**	**Deg**	**Min**	
TOB-01	057	04:56	03	51.76	12	06.12	3.863	12.102	140	2.1	3359			1000											**Winch stopped @ 1000m: await daylight recovery.**
TOB-01	057	05:20	03				3.000																		**5.5 chart recorder stopped**
TOB-01	057	06:00	03	53.98	12	05.32	3.900	12.089	162	1.6	3542														
TOB-01	057	06:30	03	55.03	12	04.96	3.917	12.083	158	2.3	3653			991											**Haul in at10m/min**
TOB-01	057	07:00	03	55.81	12	04.75	3.930	12.079	154	1.7	3713			271											

Operation	SHIP JD	Time	Latitude (S) deg	min	Longitude (W) deg	min	Dec.Lat	Dec.Lon	CMG	SMG	Depth	Swath/ TOBI Line	#	TOBI W/o	Alt	z(m)	HDG	Dec.Lat	Dec.Lon	Plotted Position (m) L-bck	Lat Deg.	Min	Lon Deg	Min	Comments
TOB-01	057	07:13																							6th MAPR inboard (M9)
TOB-01	057	07:19																							5th MAPR inboard (M8)
TOB-01	057	07:22																							Depressor weight on deck
TOB-01	057	07:35	03	56.30	12	04.70	3.938	12.078	180	1.7	3458														
TOB-01	057	07:48	03	56.30	12	08.84	3.938	12.147	264	0.5	3466														TOBI on deck
TOB-01	057	08:00	03	56.35	12	04.89	3.939	12.082	222																4th MAPR inboard (M29)
TOB-01	057	08:03																							3rd MAPR inboard (M6)
TOB-01	057	08:07																							2nd MAPR inboard (M13)
TOB-01	057	08:11																							1st MAPR and BAT fish inboard (M12)
Transit	057	08:25	03	57.17	12	05.64	3.953	12.094	234	10.0															transit to CTD station (2 knots until TOBI is tied up)
Transit	057	09:00	04	00.68	12	10.62	4.011	12.177	233	12.0	3980														Transit to CTD position (speed up to 9 knots)
Transit	057	09:30	04	03.98	12	15.52	4.066	12.259	240	11.2	4049														Transit to CTD position
Transit	057	09:39	04	04.47	12	16.01	4.075	12.267																	Slowing down
CTD-01	057	09:42	04	04.52	12	16.06	4.075	12.268	281		3910														On station
CTD-01	057	09:54	04	04.60	12	16.18	4.077	12.270	189	0.6	4005														CTD in water
CTD-01	057	10:30	04	04.61	12	16.22	4.077	12.270	232	0.5				1680											Not picking up bottom on bathymetry screen.
CTD-01	057	11:00	04	04.57	12	16.18	4.076	12.270	133	0.2				3382											
CTD-01	057	11:01	04	04.58	12	16.18	4.076	12.270	186	0.2				3384		3500				Depth > cable out					Small particle peak. Red = CTD in Db not TOBI in m.
CTD-01	057	11:08	04	04.60	12	16.19	4.077	12.270			4858			3726		3800				Depth > cable out					On Bottom- Bottle 1
CTD-01	057	11:15	04	04.60	12	16.19	4.077	12.270	165	0.2	4858														Winch up 100m
CTD-01	057	11:19	04	04.61	12	16.19	4.077	12.270	002	0.6	4858			3627		3700				Depth > cable out					Bottle 2
CTD-01	057	11:24	04	04.60	12	16.21	4.077	12.270	321	0.5				3530		3600				Depth > cable out					Bottle 3
CTD-01	057	11:28	04	04.60	12	16.21	4.077	12.270	146	0.7				3481		3550				Depth > cable out					Bottle 4
CTD-01	057	11:31	04	04.62	12	16.20	4.077	12.270	114	0.2				3458		3525				Depth > cable out					Bottle 5
CTD-01	057	11:34	04	04.63	12	16.20	4.077	12.270	141	0.6				3432		3500				Depth > cable out					Bottle 6
CTD-01	057	11:39	04	04.64	12	16.20	4.077	12.270	251	0.1				3408		3475				Depth > cable out					Bottle 7
CTD-01	057	11:42	04	04.64	12	16.20	4.077	12.270	064	0.0				3383		3450				Depth > cable out					Bottle 8
CTD-01	057	11:46	04	04.64	12	16.21	4.077	12.270	072	0.7				3335		3400				Depth > cable out					Bottle 9
CTD-01	057	11:50	04	04.63	12	16.21	4.077	12.270	357	0.4				3237		3300				Depth > cable out					Bottle 10
CTD-01	057	11:54	04	04.63	12	16.22	4.077	12.270	344	0.4				3140		3200				Depth > cable out					Bottle 11
CTD-01	057	12:00	04	04.62	12	16.23	4.077	12.271	184	0.3				2945		3000				Depth > cable out					Bottle 12
CTD-01	057	12:08	04	04.65	12	16.23	4.078	12.271	194	0.1				2700		2750				Depth > cable out					Bottle 13
CTD-01	057	12:17	04	04.70	12	16.23	4.078	12.271	101	0.7				2457		2500				Depth > cable out					Bottle 14
CTD-01	057	12:25	04	04.69	12	16.26	4.078	12.271		1.1				2204		2250				Depth > cable out					Bottle15
CTD-01	057	12:35	04	04.66	12	12.27	4.078	12.205		0.2				1970		2003				Depth > cable out					Bottles 16-24
CTD-01	057	13:15	04	04.81	12	16.29	4.080	12.272																	CTD on deck
CTD-01	057	13:53	04	05.15	12	16.40	4.086	12.273																	
TOBI TEST	057	13:53	04	05.10	12	16.40	4.085	12.273																	hove to
TOBI TEST	057	14:08	04	05.50	12	16.40	4.092	12.273																	umbilical streaming test
																									SAPS weight in water
Transit	057	14:28	04				4.000																		test end
Transit	057	15:02	04	10.80	12	17.50	4.180	12.292	198	4.9	4076														
RC-01	057	15:10	04	11.10	12	17.40	4.185	12.290			3055														On station RC01.Hove to.s
RC-01	057	16:02	04	11.10	12	17.40	4.185	12.290			3055														
RC-01	057	16:05							300	1.5															Chipper in water
RC-01	057	16:10	04	11.10	12	17.50	4.185	12.292																	MAPR in water
RC-01	057	16:30	04	11.11	12	17.70	4.185	12.295																	
RC-01	057	17:10	04	11.31	12	18.05	4.189	12.301			3131			3235											Chipper on bottom. Start recovery
RC-01	057	17:52	04				4.000																		Stop recovery. Winch problem.
RC-01	057	18:05	04	11.70	12	18.40	4.195	12.307			3142			1215											Restart winch. Continue recovery
RC-01	057	18:25	04	11.70	12	18.50	4.195	12.008																	MAPR on deck
RC-01	057	18:30	04	11.65	12	18.56	4.194	12.309	272	1.1	3111														RC01 on deck
Transit	057	18:32																							Transit to RC02
Transit	057	19:25	04	08.90	12	17.40	4.148	12.290	019	8.9	3387														
Transit	057	20:00	04	05.43	12	19.26	4.091	12.321	287	8.4	3659														

Operation	JD	Time	Latitude (S) deg	Latitude (S) min	Longitude (W) deg	Longitude (W) min	Dec.Lat	Dec.Lon	CMG	SMG	Depth	Swath/ TOBI Line	#	TOBI W/o	Alt	z(m)	HDG	Plotted Position Dec.Lat	Dec.Lon	(m) L-bck	Lat Deg.	Lat Min	Lon Deg	Lon Min	Comments
Transit	057	20:04	04	05.63	12	19.50	4.094	12.325	154	1.1															**End of transit - hove-to**
Transit	057	20:30	04	05.91	12	19.60	4.099	12.327	194	1.1															**hove-to**
Transit	057	20:47	04	06.09	12	19.50	4.102	12.325	085	4.4															**transit to CTD 02**
Transit	057	21:00	04	05.13	12	18.29	4.086	12.305	044	10.0															**transit to CTD 02**
Transit	057	21:30	04	01.95	12	14.95	4.033	12.249	044	10.0															**transit to CTD 02**
CTD-02	057	21:45	04	00.31	12	13.10	4.005	12.218	129	0.5	4222														**On station**
CTD-02	057	21:56	04	00.34	12	13.08	4.006	12.218	161	0.5															
CTD-02	057	22:30	04	00.34	12	13.05	4.006	12.218	082	0.2				1670											
CTD-02	057	23:00																							**3295db/3250m - peak in transmisometer**
CTD-02	057	23:02												4120											**3400m - another peak in transmisometer**
CTD-02	057	23:17												4120		4140				**Depth > cable out**					**bottles 1 + 2**
CTD-02	057	23:25												3980		4000				**Depth > cable out**					**bottles 3 + 4**
CTD-02	057	23:35												3780		3800				**Depth > cable out**					**bottles 5 + 6**
CTD-02	057	23:42												3580		3600				**Depth > cable out**					**bottles 7 + 8**
CTD-02	057	23:48												3482		3500				**Depth > cable out**					**bottles 9 + 10**
CTD-02	057	23:54												3382		3400				**Depth > cable out**					**bottles 11 + 12**
CTD-02	058	00:00												3282		3300				**Depth > cable out**					**bottles 13 + 14**
CTD-02	058	00:04												3183		3200				**Depth > cable out**					**bottles 15 + 16**
CTD-02	058	00:10												3084		3100				**Depth > cable out**					**bottles 17 + 18**
CTD-02	058	00:16												2984		3000				**Depth > cable out**					**bottles 19 + 20**
CTD-02	058	00:29												2486		2500				**Depth > cable out**					**bottles 21 + 22**
CTD-02	058	00:43												1987		2000				**Depth > cable out**					**bottles 23 + 24**
CTD-02	058	01:27	04	00.31	12	13.13	4.005	12.219						0		0				**190**					**CTD on deck**
Transit	058	01:33	04	00.40	12	13.11	4.007	12.219	207	4.0	4241														**Transit to RC02**
RC-02	058	02:25	04	05.98	12	18.12	4.100	12.302	150	0.4	3527														**on station RC02**
RC-02	058	02:45												0											**RC02 in water**
RC-02	058	02:47	04	06.07	12	18.13	4.101	12.302			3537			20											**MAPR13 in water**
RC-02	058	03:56	04	06.10	12	18.10	4.102	12.302			3535			3689											**Chipper on bottom**
RC-02	058	04:01	04	06.17	12	18.14	4.103	12.302																	**Hauling in**
RC-02	058	04;55	04	06.45	12	17.89	4.108	12.298			3524			0											**Chipper on deck. Small sediment sample.**
Transit	058	05:30	04	06.30	12	18.18	4.105	12.303	192	5.0	3589														**transit to RC03**
RC-03	058	06:05	04	08.70	12	18.18	4.145	12.303	116	1.0															**On station RC03. Positioning ship.**
RC-03	058	06:11	04				4.000				3331														**Wire paying out. MAPR 13 on wire**
RC-03	058	06:30	04	08.70	12	18.11	4.145	12.302			3320			1209											
RC-03	058	07:05	04	08.70	12	18.11	4.145	12.302			3304			3205											**Wire paying out.**
RC-03	058	07:11	04	08.70	12	18.11	4.145	12.302			3350			3470											**Chipper on bottom. Start recovery**
RC-03	058	07:14																							**Start chipper recovery. Hauling.**
RC-03	058	07:32	04	08.70	12	18.00	4.145	12.300			3312			1958											**Recovering chipper.**
RC-03	058	08:00	04	08.57	12	18.02	4.143	12.300			3331			15											**MAPR on-board**
RC-03	058	08:04												-7						**Depth > cable out**					**Chipper on-board**
Transit	058	08:15	04	08.96	12	17.96	4.149	12.299	170	10.5	3324														**Transit to RC04**
Transit	058	08:30	04	11.09	12	17.65	4.185	12.294	169	9.7	3060														**Transit to RC04**
RC-04	058	08:52	04	13.88	12	17.18	4.231	12.286	170	0.2	2900														**On station RC04**
RC-04	058	08:57												20											**Chiiper wet**
RC-04	058	09:01									2950														**MAPR wet**
RC-04	058	09:30									2970			1895											**wire paying out**
RC-04	058	09:43									2962			3032											**Chipper on bottom**
RC-04	058	09:44									2957			3019											**raise chipper - stead for second impact**
RC-04	058	09:45									2948			3032											**chipper on bottom, again - recovering**
RC-04	058	10:00									2922			2050											**Recovering chipper.**
RC-04	058	10:28																							**MAPR on board**
RC-04	058	10:33																							**Chipper on board**

Transit	058	10:40	04	13.77	12	17.06	4.230	12.284	070	2.0																**Transit to TOBI station 2**
Transit	058	11:00	04	11.65	12	17.60	4.194	12.293	340	10.4	2979															
Transit	058	11:30	04	11.84	12	19.19	4.197	12.320	345	10.7	3615															
Transit	058	11:45	04	05.50	12	19.26	4.092	12.321	127	0.7	3656															**On station for TOBI2. Waiting for TOBI to be ready.**
Transit	058	12:00	04	05.22	12	19.24	4.087	12.321	106	0.3	3658															
Transit	058	12:28	04	05.51	12	19.57	4.092	12.326	274	0.6	3672															**Waiting for TOBI**
Transit	058	12:53																								**TOBI ready for deployment**
Transit	058	13:02	04	05.49	12	19.56	4.092	12.326	185	0.9	3658															**Preparing TOBI**
TOB-02	058	13:14																								**1st MAPR - M12 on + Batfish in**
TOB-02	058	13:19																								**2nd MAPR - M13 on**
TOB-02	058	13:24																								**3rd MAPR - M6 on**
TOB-02	058	13:29																								**4th MAPR - M29 on**
TOB-02	058	13:50																								**TOBI in water**
TOB-02	058	14:12																								**depressor weight in water**
TOB-02	058	14:16																								**5th MAPR - M8 in**
TOB-02	058	14:22																								**6th MAPR - M9 in**
TOB-02	058	14:30	04	06.22	12	19.45	4.104	12.324	176	1.5	3540	17		315		147	131	4.101	12.327	**469**						**Veering 50m/min**
TOB-02	058	14:35																								**Reduce veering to 40m/min**
TOB-02	058	15:00	04	06.53	12	18.60	4.109	12.310	074	2.1	3537	17		1448		909	106	4.106	12.322	**1317**						
TOB-02	058	15:30	04	05.82	12	17.73	4.097	12.296	061	2.0	3541	17		2714		1656	59	4.108	12.314	**2340**						
TOB-02	058	16:00	04	04.98	12	17.03	4.083	12.284	043	2.5	3725	17		3826		2154	52.3	4.102	12.308	**3352**						
TOB-02	058	16:20																								**Restart 3.5kHz recording, roll 2.**
TOB-02	058	16:30	04	04.09	12	16.32	4.068	12.272	022	2.2	3976	17		5020	967	2746	50.2	4.094	12.303	**4392**	**4**	**6.20**	**12**	**17.80**		
TOB-02	058	16:45	04				4.000							5571		3069				**4839**						**veer to 10**
TOB-02	058	16:58	04	03.33	12	15.73	4.056	12.262	025	1.6	4179	17		5700		3176				**4923**	**4**	**5.60**	**12**	**17.40**		**veer to 15m/min**
TOB-02	058	17:09									4001	17		5865		3262				**5064**						**winch stopped**
TOB-02	058	17:16									4142	17		5866		3295				**5043**						**veer to 10, LSS > 33**
TOB-02	058	17:18									4140	17		5891		3292				**5075**						**veer to 15m/min**
TOB-02	058	17:30	04	02.60	12	15.08	4.043	12.251	042	1.6	4250	17		6062	469	3345	47.1	4.076	12.286	**5246**	**4**	**4.90**	**12**	**16.95**		
TOB-02	058	17:42	04				4.000				4267	17		6253	415	3464				**5396**						**winch stopped**
TOB-02	058	17:45										17		6253	357	3494				**5376**						**haul 10m/min**
TOB-02	058	17:47										17		6235	300	3501				**5349**						**haul 20m/min**
TOB-02	058	17:49										17		6180	262	3499				**5284**						**nephels .035-.040**
TOB-02	058	17:51										17		6130	350	3479				**5237**						**Haul 10m/m**
TOB-02	058	17:55										17		6099	382	3441				**5226**						**winch stopped**
TOB-02	058	17:56										17		6100	357	3429				**5235**						**veer 10m/min**
TOB-02	058	17:58												6118	545	3424				**5260**						**veer 15m/min**
TOB-02	058	18:00	04	01.88	12	14.51	4.031	12.242	062	2.0	4249	17		6141	546	3426	45	4.065	12.276	**5287**	**4**	**4.20**	**12**	**16.25**		**LSS 0.038**
TOB-02	058	18:30	04	01.10	12	13.90	4.018	12.232	035	1.3	4327	17		6585	490	3656	44	4.055	12.267	**5667**	**4**	**3.25**	**12**	**15.70**		
TOB-02	058	18:45												6794	420	3765				**5845**						
TOB-02	058	18:57												6797	397	3762				**5851**						**veer 10m/min**
TOB-02	058	19:00	04	60.30	12	13.23	5.005	12.221	037	2.0	4284	17		6827	479	3747	44.3	5.043	12.258	**5897**	**4**	**2.60**	**12**	**15.30**		
TOB-02	058	19:26												7085	413	3827				**6152**						**winch stopped**
TOB-02	058	19:30	03	59.56	12	12.57	3.993	12.210	020	2.2	4245	17		7086	385	3833	44.6	4.032	12.249	**6150**	**4**	**20.20**	**12**	**15.00**		
TOB-02	058	20:00	03	58.77	12	11.92	3.980	12.199	028	2.7	4111	17		7086	412	3757	44.5	4.020	12.238	**6198**	**4**	**1.40**	**12**	**14.00**		
TOB-02	058	20:30	03	57.98	12	11.31	3.966	12.189	060	2.9	4334	17		7086	458	3721	44	4.007	12.228	**6220**	**4**	**0.40**	**12**	**13.80**		
TOB-02	058	21:00	03	57.19	12	10.61	3.953	12.177	023	2.6	4455	17		7086	494	3693	44.1	3.994	12.216	**6238**	**3**	**59.90**	**12**	**12.90**		
TOB-02	058	21:11												7086												**Haul 10m/m**
	CD169 leg1: science log											**Swath/**								**Plotted Position**						
	SHIP		**Latitude (S)**		**Longitude (W)**							**TOBI**		**TOBI**												**Comments**
Operation	**JD**	**Time**	**deg**	**min**	**deg**	**min**	**Dec.Lat**	**Dec.Lon**	**CMG**	**SMG**	**Depth**	**Line**	**#**	**W/o**	**Alt**	**z(m)**	**HDG**	**Dec.Lat**	**Dec.Lon**	**L-bck**	**Deg.**	**Min**	**Deg**	**Min**		
TOB-02	058	21:20												7002												**Winch stopped**
TOB-02	058	21:25	03	56.50	12	10.00	3.942	12.167	026	1.9	4348	17		7002												**A/C for WP15**
TOB-02	058	21:30	03	56.30	12	09.90	3.938	12.165	026	3.0	4406	18		7002	484	3547	44.5	3.979	12.205	**6227**	**3**	**58.00**	**12**	**11.10**		**on line 18**
TOB-02	058	21:54												7002												**Veer at 10 m/m**
TOB-02	058	22:00	03	55.37	12	09.33	3.923	12.156	044	2.6	4209	18		7059	765	3524	44.4	3.964	12.196	**6306**	**3**	**58.20**	**12**	**11.50**		**nephels 0.038**
TOB-02	058	22:20												7243												**Increase veer to15m/m**
TOB-02	058	22:30	03	54.44	12	08.75	3.907	12.146	057	2.3	4140	18		7404	697	3676	40.3	3.953	12.185	**6617**	**3**	**57.30**	**12**	**10.90**		
TOB-02	058	22:40												7549												**Winch stopped**
TOB-02	058	22:50												7549												**veer 10m/min**
TOB-02	058	23:00	03	53.46	12	08.15	3.891	12.136	027	2.6	4103	18		7662	586	3772	41.1	3.938	12.177	**6859**	**3**	**57.00**	**12**	**10.30**		
TOB-02	058	23:09												7733												**Winch stopped**

TOB-02	058	23:30	03	52.55	12	07.59	3.876	12.127	053	2.2	3993	18		7733	450	3828	38.9	3.925	12.166	6909	3	55.90	12	9.80	Haul 10m/m
TOB-02	058	23:36												7654											Increase haul to 15m/m
TOB-02	058	23:50	03	51.93	12	07.21	3.866	12.120	055	2.5	3888	18		7446											A/C for W/P 16
TOB-02	059	00:00	03	51.59	12	07.06	3.860	12.118	033	2.6	3806	19		7260	399	3624	37	3.907	12.153	6481	3	54.70	12	8.90	
TOB-02	059	00:12									4216			7033											reduce to 10m/min
TOB-02	059	00:15	03	50.93	12	07.98	3.849	12.133	350	2.5	4206			7013	610	3483	36.7	3.895	12.167	6277	3	53.68	12	10.03	stop hauling
TOB-02	059	00:29	03	50.42	12	07.06	3.840	12.118	337	2.4	3601	19		7013	526	3509	35.9	3.886	12.151	6262	3	53.70	12	8.30	
TOB-02	059	00:35												7013											Haul 10 m/min
TOB-02	059	00:40												6941											Haul 20 m/min
TOB-02	059	00:50												6728											stop hauling
TOB-02	059	01:00	03	49.20	12	07.23	3.820	12.121	354	2.5	3300	19		6728	563	3338	26	3.869	12.145	6032	3	52.50	12	7.80	
TOB-02	059	01:15												6728											Veer at 10 m/min
TOB-02	059	01:25												6821											
TOB-02	059	01:29	03	48.03	12	07.42	3.801	12.124	345	2.4	3548	19		6821	510	3308	11.6	3.855	12.135	6155	3	41.30	12	7.30	
TOB-02	059	01:39												6821											Haul 10 m/min
TOB-02	059	02:00	03	46.81	12	07.61	3.780	12.127	347	2.0	3556	19		6631	516	3103	1.4	3.835	12.128	6050	3	50.10	12	7.00	
TOB-02	059	02:08												6555											Winch stopped
TOB-02	059	02:30	03	45.57	12	07.80	3.760	12.130	330	2.5	3380	19		6555	480	3004	358	3.814	12.128	6016	3	48.80	12	7.10	
TOB-02	059	02:51												6555											Veering at 10m/min
TOB-02	059	03:00	03	44.37	12	07.97	3.740	12.133	347	2.2	3545	19		6645	429	3014	358	3.795	12.131	6112	3	47.80	12	7.40	
TOB-02	059	03:02												6661											Stopped winch
TOB-02	059	03:14												6661											Veering at 10m/min
TOB-02	059	03:30	03	43.01	12	08.18	3.717	12.136	351	2.5	3490	19		6830	504	3024	358	3.774	12.134	6314	3	46.30	12	7.70	
TOB-02	059	03:31												6835											Veering at 20 m/min
TOB-02	059	03:42												7068											Stopped winch
TOB-02	059	03:45												7068											Hauling @ 15 m/min
TOB-02	059	03:46												7050											Increase hauling to 25 m/min
TOB-02	059	03:58	03		12		3.000	12.000						6806											Stopped winch
TOB-02	059	04:00	03	41.71	12	08.40	3.695	12.140	001	2.5	3500	19		6806	500	2981	356	3.752	12.136	6308	3	45.00	12	8.00	
TOB-02	059	04:04												6827	564	2980	358	######	######	6332					veer 15m/min
TOB-02	059	04:26												7163											winch stopped
TOB-02	059	04:30	03	40.44	12	08.55	3.674	12.143	355	2.8	3500	19		7164	479	3130	358	3.734	12.140	6634	3	43.90	12	8.25	
TOB-02	059	04:48												7164											Engine speed dropped 5rpm
TOB-02	059	04:56												7164	460										haul at 5m/min
TOB-02	059	05:00	03	39.32	12	08.80	3.655	12.147	332	1.2	3542	19		7147	450	3189	359	3.715	12.146	6586	3	42.90	12	8.30	
TOB-02	059	05:02												7139											haul at 15m/min
TOB-02	059	05:03												7123											Haul at 20m/min, engine speed back up by 5 rpm
TOB-02	059	05:09												7000											haul at 25m/min
TOB-02	059	05:12												6917											Haul at 10m/min
TOB-02	059	05:14												6894											winch stopped
TOB-02	059	05:30	03	38.14	12	08.91	3.636	12.149	328	2.2	3530	19		6894	394	3186	394	3.683	12.181	6304	3	41.80	12	8.20	
TOB-02	059	05:46												6894											haul 20m/min
TOB-02	059	05:47												6880											
TOB-02	059	05:55												6687											lss>0.038, haul 10m/min
TOB-02	059	05:58												6677											winch stopped
TOB-02	059	06:00	03	36.89	12	09.14	3.615	12.152	252	2.2	3598	19		6677	406	3088	359	3.670	12.151	6110	3	40.50	12	8.25	
TOB-02	059	06:12												6677											haul 10

	CD169 leg1: science log											Swath/							Plotted Position						
	SHIP		Latitude (S)		Longitude (W)							TOBI		TOBI						(m)	Lat		Lon		Comments
Operation	JD	Time	deg	min	deg	min	Dec.Lat	Dec.Lon	CMG	SMG	Depth	Line	#	W/o	Alt	z(m)	HDG	Dec.Lat	Dec.Lon	L-bck	Deg.	Min	Deg	Min	
TOB-02	059	06:15												6651											winch stopped
TOB-02	059	06:24												6651											veer 10m/min
TOB-02	059	06:28												6695											veer 15m/min
TOB-02	059	06:31	03	35.54	12	09.27	3.592	12.155	017	2.9	3566	19		6738	508	3046	359	3.649	12.154	6200	3	39.25	12	8.80	
TOB-02	059	06:35												6797											At WP 17, winch stopped
TOB-02	059	06:58												6797											haul 15m/min
TOB-02	059	07:00	03	34.41	12	09.23	3.574	12.154	005	1.8	3515	20		6782	293	3138	0.6	3.630	12.154	6202	3	38.00	12	8.75	haul 20m/min
TOB-02	059	07:04												6697											haul 25m/min
TOB-02	059	07:13												6483											Winch stopped
TOB-02	059	07:27												6483											haul 10
TOB-02	059	07:30	03	33.31	12	09.18	3.555	12.153	013	2.2	3611	20		6443	291	3106	4.4	3.608	12.157	5835	3	38.20	12	8.30	
TOB-02	059	07:32												6438											haul 15m/min
TOB-02	059	07:45												6231											winch stopped

TOB-02	059	07:51	03	32.55	12	09.14	3.543	12.152	018	2.2				6231														**increase ship speed to 2.5**
TOB-02	059	08:00	03	32.20	12	09.11	3.537	12.152	359	2.8	3825	20		6231	387	3081	6	3.587	12.157	**5606**		**3**	**35.20**		**12**	**9.20**	
TOB-02	059	08:30	03	31.03	12	09.08	3.517	12.151	017	1.9	3753	20		6231	454	3071	8.5	3.568	12.159	**5612**		**3**	**34.00**		**12**	**9.50**	
TOB-02	059	08:35												6231													**Veer 10 m/m**
TOB-02	059	08:41	03	30.56	12	09.06	3.509	12.151	005	2.5	3773	20		6293	478	3080	6.8	3.561	12.157	**5678**		**3**	**33.40**		**12**	**9.25**	**Winch stopped. Engine down: bow thruster only.**
TOB-02	059	08:50	03	30.25	12	09.06	3.504	12.151	000	1.4	3802	20		6293	435	3095	6.3	3.555	12.157	**5669**							
TOB-02	059	08:51												6293													**Haul 15 m/m**
TOB-02	059	08:59	03	30.00	12	09.06	3.500	12.151	350	1.3	3775	20		6190	479	3124	6.3	3.550	12.157	**5534**		**3**	**33.00**		**12**	**9.50**	**Increase haul 20 m/m**
TOB-02	059	09:03												6095													**Increase haul 25 m/m**
TOB-02	059	09:10	03	29.73	12	09.07	3.496	12.151	349	1.7	3663	20		5900													
TOB-02	059	09:20	03	29.46	12	09.06	3.491	12.151	004	1.4	3726	20		5700													
TOB-02	059	09:30	03	29.14	12	09.03	3.486	12.151	029	2.1	3835	20		5415	827	2958	5.9	3.528	12.155	**4726**		**3**	**31.80**		**12**	**9.20**	
TOB-02	059	09:42	03	28.77	12	09.06	3.480	12.151	010	1.7	3812	20		5107													
TOB-02	059	09:50	03	28.53	12	08.98	3.476	12.150	002	1.8	3790	20		4918													
TOB-02	059	09:52												4866													**Increase haul 60m/m - Bow thruster stopped**
TOB-02	059	09:53																									**Decrease haul 20m/m - bow thruster on again**
TOB-02	059	10:00	03	28.30	12	09.03	3.472	12.151	359	2.0	3695	20		4651	916	2747	4.9	3.507	12.154	**3943**		**3**	**30.40**		**12**	**9.30**	**Decrease haul 10 m/m**
TOB-02	059	10:01												4640													**Winch stopped**
TOB-02	059	10:10	03	27.94	12	08.99	3.466	12.150	007	2.1	3680	20		4640													
TOB-02	059	10:20	03	27.69	12	09.02	3.462	12.150	005	1.8	3731	20		4640													
TOB-02	059	10:30	03	27.38	12	09.03	3.456	12.151	011	2.0	3743	20		4641	926	2765	2.9	3.492	12.152	**3917**		**3**	**29.50**		**12**	**9.00**	
TOB-02	059	10:35												4641													**veer 10m/min**
TOB-02	059	10:40	03	26.99	12	08.98	3.450	12.150	358	1.9	3706	20		4693													
TOB-02	059	10:50	03	26.68	12	08.94	3.445	12.149	015	1.8	3717	20		4778													
TOB-02	059	11:00	03	26.30	12	08.90	3.438	12.148	005	1.8	3725	20		4880	974	2757	360	3.477	12.148	**4217**		**3**	**26.30**		**12**	**9.10**	
TOB-02	059	11:10	03	25.97	12	08.88	3.433	12.148	015	2.1	3712	20		4972													
TOB-02	059	11:20	03	25.61	12	08.88	3.427	12.148	007	2.1	3691	20		5061													**Main engine repaired**
TOB-02	059	11:24												5097													**Increase veer to 20m/m - Back on main propulsion**
TOB-02	059	11:30	03	25.27	12	08.92	3.421	12.149	348	1.6	3613	20		5242	812	2864	6.7	3.463	12.154	**4580**		**3**	**28.00**		**12**	**9.10**	
TOB-02	059	11:38												5378													**Decrease veer 10m/m**
TOB-02	059	12:00	03	24.39	12	08.84	3.407	12.147	000	2.1	3464	20		5597	501	3161	5.8	3.450	12.152	**4809**		**3**	**27.00**		**12**	**9.00**	**A/C for W/P 18**
TOB-02	059	12:30	03	23.41	12	08.95	3.390	12.149	332	2.0	3528	21		5797	372	3272	6.9	3.435	12.155	**4975**		**3**	**26.00**		**19**	**9.00**	
TOB-02	059	12:44												5793													**haul at 10 m/min**
TOB-02	059	12:47												5740													**haul at 35 m/min**
TOB-02	059	12:48												5715													**haul at 20 m/min**
TOB-02	059	12:51												5662													**winch stopped**
TOB-02	059	12:56												5662													**haul at 10 m/min**
TOB-02	059	13:00	03	22.37	12	09.14	3.373	12.152	349	2.0	3300	21		5626	379	3104	1.5	3.417	12.153	**4882**		**3**	**24.85**		**12**	**8.85**	
TOB-02	059	13:30	03	21.32	12	09.39	3.355	12.157	333	2.5	3502	21		5389	250	2839	357	3.399	12.154	**4771**		**3**	**23.80**		**12**	**9.00**	
TOB-02	059	13:35												5389													**Veer at 20 m/min**
TOB-02	059	13:51												5717													**Stopped winch**
TOB-02	059	14:00	03	20.14	12	09.69	3.336	12.162	351	2.0	3470	21		5718	479	2881	356	3.382	12.158	**5129**		**3**	**22.60**		**12**	**8.90**	
TOB-02	059	14:10																									**Veer at 20 m/min**
TOB-02	059	14:22												5949													**winch stopped**
TOB-02	059	14:27												5949													**Veer at 15 m/min**

	CD169 leg1: science log											**Swath/**		**TOBI**						**Plotted Position**						
	SHIP		**Latitude (S)**		**Longitude (W)**							**TOBI**		**TOBI**						**(m)**	**Lat**		**Lon**		**Comments**
Operation	**JD**	**Time**	**deg**	**min**	**deg**	**min**	**Dec.Lat**	**Dec.Lon**	**CMG**	**SMG**	**Depth**	**Line**	**#**	**W/o**	**Alt**	**z(m)**	**HDG**	**Dec.Lat**	**Dec.Lon**	**L-bck**	**Deg.**	**Min**	**Deg**	**Min**	
TOB-02	059	14:30	03	19.11	12	09.97	3.319	12.166	340	2.0	3706	21		5995	286	2984	352	3.367	12.159	**5390**	**3**	**21.90**	**12**	**9.20**	**Winch stopped , hauling at 30 m/min.**
TOB-02	059	15:00	03	17.97	12	10.19	3.300	12.170	359	2.0	3540	21		5129	852	2524	348	3.341	12.161	**4655**	**3**	**20.60**	**12**	**10.45**	**RECOVERING TOBI**
TOB-02	059	15:30	03	16.80	12	10.47	3.280	12.175	352	2.3	3667	21		4214		2030	348	3.314	12.167	**3883**	**3**	**18.80**	**12**	**10.00**	
TOB-02	059	16:00	03	15.61	12	10.75	3.260	12.179	344	2.1	3667	21		3280		1601	351	3.288	12.175	**3053**					
TOB-02	059	16:30	03	14.50	12	10.78	3.242	12.180	025	2.9	3557	21		2251		1193	355	3.261	12.178	**2099**					
TOB-02	059	17:00	03	14.60	12	10.05	3.243	12.168	003	121.0	3667	21		1043		769	60.5	3.247	12.175	**895**					
TOB-02	059	17:25																							**MAPR 9 inboard**
TOB-02	059	17:31																							**MAPR 8 inboard**
TOB-02	059	17:35																							**depressor inboard**
TOB-02	059	18:00																							**TOBI inboard**
TOB-02	059	18:14																							**MAPR 29 inboard**
TOB-02	059	18:18																							**MAPR 6 inboard**
TOB-02	059	18:22																							**MAPR 13 inboard**
TOB-02	059	18:25																							**MAPR 12 inboard**
TOB-02	059																								**Batfish inboard**

Transit	059	18:35	03	15.20	12	09.30	3.253	12.155	163	5.0	3012														**o/c for w.p. 20 (start TOBI 3)**
Transit	059	19:03	03	10.09	12	08.33	3.168	12.139	163	7.9	3263														**3.5kHz switched off, end of roll 2.**
Transit	059	19:30	03	22.60	12	07.30	3.377	12.122	166	8.2	3045														
Transit	059	20:00	03	26.40	12	06.40	3.440	12.107	171	7.7	3314														**End of log until TOBI 3 deployment JD 60 am.**
Transit	060	07:30	04	50.00	11	40.28	4.833	11.671	165	7.8	2985														
Transit	060	08:00	04	53.86	11	39.83	4.898	11.664	162	8.2	3264														
TOB-03	060	08:14	04	55.21	11	38.62	4.920	11.644																	**On station TOBI 03**
TOB-03	060	08:30	04	55.85	11	38.36	4.931	11.639																	**Transited to new start position**
TOB-03	060	08:32																							**BAT fish and MAPR 12 in water**
TOB-03	060	08:36																							**MAPR 13 in water**
TOB-03	060	08:40																							**MAPR 6 in water**
TOB-03	060	08:45																							**MAPR 29 in water**
TOB-03	060	08:57																							**TOBI in water**
TOB-03	060	09:20																							**Bomb in water**
TOB-03	060	09:23																							**MAPR 8 in water**
TOB-03	060	09:28																							**MAPR 9 in water**
TOB-03	060	09:30	04	55.83	11	38.54	4.931	11.642	230	0.2	3422	22		122											
TOB-03	060	10:00	04	56.36	11	38.34	4.939	11.639	145	1.5	3424	22		1333											
TOB-03	060	10:30	04	57.18	11	37.99	4.953	11.633	141	2.7	4464	22		2532											
TOB-03	060	11:00	04	58.02	11	37.65	4.967	11.628	155	1.5	4713	22		3714											
TOB-03	060	11:24	04	58.65	11	37.41	4.978	11.624	190	1.8	4397	22		4715											**Start turn**
TOB-03	060	11:33	04	58.88	11	37.25	4.981	11.621	148	1.8	4335	22		5064											**Turn finished. On line 22**
TOB-03	060	12:00	04	59.48	11	36.73	4.991	11.612	133	2.6	4458	22		6091	370	4134	163	4.951	11.625	**4663**	**4**	**58.90**	**11**	**38.60**	**Winch stopped**
TOB-03	060	12:04												6091											**Haul at 20 m/min**
TOB-03	060	12:10												5990											**Stopped winch**
TOB-03	060	12:15												5990											**veer 10m/min**
TOB-03	060	12:30	05	00.20	11	35.99	5.003	11.600	128	1.5	4656	22		6176	634	3964	155	4.963	11.619	**4926**	**4**	**58.40**	**11**	**38.00**	
TOB-03	060																								
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TOB-03	060	13:00	05	01.08	11	35.45	5.018	11.591	169	2.3	4716	23		6302	558	3791	143	4.980	11.619	**5224**	**4**	**59.09**	**11**	**37.80**	**ON LINE 23, TOBI offset 750m to west by current.**
TOB-03	060	13:26												6302											**veer 20 m/min**
TOB-03	060	13:30	05	02.13	11	35.25	5.036	11.588	166	2.5	4070	23		6402	749	3647	151	4.992	11.611	**5452**	**4**	**59.70**	**11**	**36.50**	

	CD169 leg1: science log											**Swath/**								**Plotted Position**					
	SHIP		**Latitude (S)**		**Longitude (W)**							**TOBI**		**TOBI**						**(m)**	**Lat**		**Lon**		**Comments**
Operation	**JD**	**Time**	**deg**	**min**	**deg**	**min**	**Dec.Lat**	**Dec.Lon**	**CMG**	**SMG**	**Depth**	**Line**	**#**	**W/o**	**Alt**	**z(m)**	**HDG**	**Dec.Lat**	**Dec.Lon**	**L-bck**	**Deg.**	**Min**	**Deg**	**Min**	
TOB-03	060	13:44												6663											**Stopped winch**
TOB-03	060	14:00	05	03.17	11	35.08	5.053	11.585	180	2.2	4072	23		6663	775	3706	157	5.005	11.605	**5727**	**5**	**0.70**	**11**	**35.60**	
TOB-03	060	14:30	05	04.32	11	34.86	5.072	11.581	171	2.5	4150	23		6664	591	3547	167	5.020	11.593	**5832**	**5**	**1.25**	**11**	**35.30**	
TOB-03	060	14:38												6664											**veer at 15 m/min**
TOB-03	060	15:00	05	05.41	11	34.70	5.090	11.578	173	2.8	4162	23		6997	518	3701	171	5.035	11.587	**6128**	**5**	**2.20**	**11**	**35.50**	**Stopped winch**
TOB-03	060	15:17												6997											**Veer at 10 m/m**
TOB-03	060	15:26												7093											**Stopped winch**
TOB-03	060	15:30	05	06.60	11	34.47	5.110	11.575	163	2.6	4026	23		7093	470	3561	175	5.053	11.580	**6324**	**5**	**3.20**	**11**	**35.20**	
TOB-03	060	15:50												7093											**Veer at 15 m/min**
TOB-03	060	16:00	05	07.68	11	34.29	5.128	11.572	176	1.7	3970	23		7260	546	3618	177	5.069	11.575	**6484**	**5**	**3.95**	**11**	**34.95**	
TOB-03	060	16:15												7471											**winch stopped**
TOB-03	060	16:25	05				5.000							7471											**Haul at 10m/min**
TOB-03	060	16:30	05	08.73	11	34.10	5.146	11.568	160	1.2	3762	23		7419	331	3753	174	5.086	11.575	**6590**	**5**	**4.75**	**11**	**34.70**	
TOB-03	060	16:32												7399											**haul at 15m/min**
TOB-03	060	16:39												7298											**winch stopped**
TOB-03	060	16:50	05	09.44	11	33.94	5.157	11.566	154	2.5		24													**o/c at WP 22**
TOB-03	060	17:00	05	09.80	11	33.80	5.163	11.563	160	2.0	3736	24		7298	334	3698	175	5.105	11.568	**6482**	**5**	**5.95**	**11**	**34.30**	**Haul at 10m/min**

TOB-03	060	17:02												7269													haul at 20m/min
TOB-03	060	17:22												6873													winch stopped
TOB-03	060	17:30	05	10.75	11	33.52	5.179	11.559	156	3.1	3758	24		6873	390	3527	171	5.124	11.567	6089	5	7.40	11	34.25			
TOB-03	060	17:40												6873													Haul 20 m/min nephels 0.047
TOB-03	060	17:44												6809													haul 25m/min nephs 0.045
TOB-03	060	17:46												6700													haul 30 m/min nephels 0.044
TOB-03	060	17:50												6560													Haul 15 m/min
TOB-03	060	17:58	05				5.000							6510													Haul 25 m/min
TOB-03	060	18:00	05	11.62	11	33.25	5.194	11.554	162	1.8	3752	24		6468	246	3475	170	5.143	11.563	5645	5	8.50	11	34.25			
TOB-03	060	18:07												6286													Haul 10m/min
TOB-03	060	18:10												6274													Winch stopped
TOB-03	060	18:12																									haul
TOB-03	060	18:13																									haul 25m/min
TOB-03	060	18:17																									haul 15m/min
TOB-03	060	18:23												6056													Winch stopped
TOB-03	060	18:26												6058													veer 10m/min
TOB-03	060	18:30	05	12.69	11	32.84	5.212	11.547	171	1.6	3660	24		6114	461	3240	169	5.164	11.557	5375	5	9.60	11	33.90			
TOB-03	060	18:46												6254													Stopped winch
TOB-03	060	19:00	05	13.70	11	32.54	5.228	11.542	157	2.8	3608	24		6254	436	3244	168	5.179	11.553	5537	5	11.00	11	33.50			veer 10m/min
TOB-03	060	19:05												6316													veer 15m/min
TOB-03	060	19:17												6483													winch stopped
TOB-03	060	19:30	05	14.84	11	36.16	5.247	11.603	161	2.2	3496	24		6483	379	3231	170	5.195	11.612	5810	5	11.95	11	33.30			
TOB-03	060	19:42												6483													veer 10m/min
TOB-03	060	20:00	05	15.99	11	31.78	5.267	11.530	154	2.7	3409	24		6661	417	3172	173	5.212	11.536	6047	5	12.90	11	32.95			
TOB-03	060	20:06	05	16.24	11	31.67	5.271	11.528						6720													winch stopped
TOB-03	060	20:30	05	17.14	11	31.41	5.286	11.524	175	2.1	3423	24		6720	322	3124	170	5.231	11.533	6140	5	13.95	11	32.50			Haul 10 m/min
TOB-03	060	20:48												6558													Increase haul to 15 m/m
TOB-03	060	20:51	05	17.91	11	31.18	5.299	11.520	164	2.4	3289	24		6489	334	3053	151	5.251	11.546	5916							
TOB-03	060	21:00	05	18.21	11	31.11	5.304	11.519	165	2.6	3350	24		6392	408	3005	170	5.251	11.528	5832	5	15.30	11	32.10			winch stopped
TOB-03	060	21:30	05	19.45	11	31.03	5.324	11.517	172	1.8	3325	25		6391	392	3085	172	5.272	11.524	5787	5	16.50	11	31.50			
TOB-03	060	21:32												6391													haul 10m/m
TOB-03	060	21:40												6313													Winch stopped
TOB-03	060	22:00	05	20.62	11	31.07	5.344	11.518	173	2.5	3399	25		6313	381	3024	176	5.292	11.521	5732	5	17.50	11	30.40			
TOB-03	060	22:03												6313													haul 10m/m
TOB-03	060	22:08												6270													winch stopped
TOB-03	060	22:30	05	21.86	11	31.09	5.364	11.518	183	1.5	3395	25		6270	348	2916	182	5.312	11.516	5741	5	18.80	11	31.20			
TOB-03	060	22:36												6270													haul at 10 m/min
TOB-03	060	22:45												6185													Winch stopped
TOB-03	060	23:00	05	23.80	11	31.13	5.397	11.519	190	3.1	3491	25		6185	442	2891	188	5.346	11.512	5658	5	20.20	11	31.20			
TOB-03	060	23:30	05	24.17	11	31.20	5.403	11.520	169	2.2	3631	25		6185	457	2923	189	5.352	11.512	5641	5	21.10	11	31.10			
TOB-03	061	00:00	05	25.34	11	31.28	5.422	11.521	182	2.6	3684	25		6185	442	2955	190	5.372	11.512	5623	5	22.30	11	31.20			

	CD169 leg1: science log											Swath/								Plotted Position						
	SHIP		Latitude (S)		Longitude (W)							TOBI		TOBI						(m)	Lat		Lon		Comments
Operation	JD	Time	deg	min	deg	min	Dec.Lat	Dec.Lon	CMG	SMG	Depth	Line	#	W/o	Alt	z(m)	HDG	Dec.Lat	Dec.Lon	L-bck	Deg.	Min	Deg	Min	
TOB-03	061	00:09												6185											
TOB-03	061	00:17												6267											
TOB-03	061	00:29	05	26.51	11	31.32	5.442	11.522	171	2.4	3823	25		6266	479	3015	186	5.390	11.517	5683	5	23.25	11	31.00	
TOB-03	061	00:38												6266											veer at 10 m/min
TOB-03	061	01:00	05	27.77	11	31.36	5.463	11.523	184	2.2	3730	25		6510	533	3083	190	5.410	11.513	5924	5	24.56	11	31.30	
TOB-03	061	01:01												6515											veer at 15 m/min
TOB-03	061	01:17												6752											Stopped winch
TOB-03	061	01:34	05	29.15	11	31.47	5.486	11.525	154	1.7	3707	25		6752	571	3168	186	5.430	11.519	6153	5	25.90	11	31.10	veer at 15 m/min
TOB-03	061	01:47												6941											stoppen die vinchen
TOB-03	061	02:00	05	30.16	11	31.49	5.503	11.525	193	2.5	3570	25		6941	516	3261	188	5.446	11.517	6317	5	26.65	11	31.20	
TOB-03	061	02:30	05	31.35	11	31.53	5.523	11.526	181	2.0	3710	25		6941	555	3257	107	5.506	11.581	6319	5	28.00	11	31.50	
TOB-03	061	02:31												6941											Veer at 10 m/min
TOB-03	061	02:42												7055											Stopped winch
TOB-03	061	02:49												7055											haul at 10 m/min
TOB-03	061	03:00	05	32.44	11	31.61	5.541	11.527	180	2.3	3600	25		6977	358	3310	187	5.484	11.519	6332	5	29.00	11	31.36	
TOB-03	061	03:06												6977											turned at WP24
TOB-03	061	03:25					######	######						6977				######	######						haul @ 15 m/min
TOB-03	061	03:30	05	33.69	11	31.53	5.562	11.526	180	2.2	3870	26		6842	273	3245	186	5.505	11.520	6214	5	30.50	11	31.40	
TOB-03	061	03:34												6793											Winch stopped

TOB-03	061	03:50												6793														**haul at 10 m/min**
TOB-03	061	03:57												6726														**stopped winch**
TOB-03	061	04:00	05	34.93	11	31.42	5.582	11.524	181	2.5	3762	26		6727	513	3153	186	5.527	11.518	**6132**	**5**	**32.00**	**11**	**31.60**				
TOB-03	061	04:06												6726														**veer 10m/min**
TOB-03	061	04:30	05	36.19	11	31.32	5.603	11.522	186	2.5	3587	26		6997	457	3245	183	5.545	11.519	**6389**	**5**	**32.75**	**11**	**31.75**				
TOB-03	061	05:00	05	37.49	11	31.25	5.625	11.521	173	3.3	3734	26		7311	379	3298	183	5.564	11.518	**6715**	**5**	**33.95**	**11**	**31.45**				**winch stopped**
TOB-03	061	05:30	05	38.74	11	31.15	5.646	11.519	188	2.7	3730	26		7311	417	3247	182	5.584	11.517	**6740**	**5**	**35.25**	**11**	**31.40**				
TOB-03	061	05:36												7311														**haul 15m/min**
TOB-03	061	05:40												7227														**Haul 20 m/min**
TOB-03	061	05:47												7121														**winch stopped**
TOB-03	061	06:00	05	39.08	11	31.08	5.651	11.518	180	2.3	3892	26		7121	501	3142	181	5.592	11.517	**6580**	**5**	**36.60**	**11**	**31.30**				
TOB-03	061	06:03												7121														**veer 10m/min**
TOB-03	061	06:13												7221														**winch stopped**
TOB-03	061	06:18																										**problems port side of tobi swath bathymetry**
TOB-03	061	06:27																										**tried to reboot tobi swath, no effect**
TOB-03	061	06:30	05	41.28	11	30.98	5.688	11.516	170	1.9	3895	26		7221	440	3213	182	5.628	11.514	**6657**	**5**	**37.75**	**11**	**31.20**				
TOB-03	061	06:35																										**tried to reboot tobi swath, no effect**
TOB-03	061	06:39												7221														**veer 10**
TOB-03	061	06:48												7310														**winch stopped**
TOB-03	061	06:56												7310														**veer 10m/min**
TOB-03	061	07:00	05	42.57	11	30.90	5.710	11.515	171	2.2	3863	26		7345	441	3209	182	5.648	11.513	**6797**	**5**	**39.00**	**11**	**31.10**				
TOB-03	061	07:03																										**reboot attempt tobi swath, no result**
TOB-03	061	07:12																										**tobi swath back on its own**
TOB-03	061	07:22												7567														**winch stopped**
TOB-03	061	07:23																										**ship slowed to <2.5 to lower tobi**
TOB-03	061	07:30	05	43.80	11	30.80	5.730	11.513	184	1.3	3687	26		7567	519	338	183	5.660	11.510	**7749**	**5**	**39.80**	**11**	**31.00**				
TOB-03	061	07:47												7567														**haul 5m/min**
TOB-03	061	07:51												7543														**haul 10m/min**
TOB-03	061	08:00	05	44.88	11	30.72	5.748	11.512	175	2.3	3740	26		7458	367	3450	183	5.686	11.509	**6802**	**5**	**41.05**	**11**	**30.85**				
TOB-03	061	08:30	05	46.02	11	30.65	5.767	11.511	155	2.4	3742	26		7138	276	3350	182	5.708	11.509	**6493**	**5**	**42.40**	**11**	**30.70**				**Winch stopped**
TOB-03	061	09:00	05	47.22	11	30.54	5.787	11.509	165	2.1	3584	26		6946	321	3321	184	5.730	11.505	**6291**	**5**	**43.80**	**11**	**30.30**				
TOB-03	061	09:18												6687														**Winch stopped**
TOB-03	061	09:30	05	48.33	11	30.46	5.806	11.508	187	3.4	3714	26		6687	428	3206	184	5.751	11.504	**6058**	**5**	**45.00**	**11**	**30.70**				
TOB-03	061	09:47	05	49.07	11	30.31	5.818	11.505	177	2.3		26																**Start turn**
TOB-03	061	09:58	05	49.46	11	30.32	5.824	11.505	171	1.5		27																**On Line 27**
TOB-03	061	10:02	05	49.63	11	30.31	5.827	11.505	165	1.3	3550	27		6687	389	3208	184	5.772	11.501	**6057**	**5**	**46.30**	**11**	**30.40**				
TOB-03	061	10:30	05	50.64	11	30.15	5.844	11.503	161	3.4	3444	27		6620	391	3227	183	5.790	11.500	**5970**	**5**	**47.20**	**11**	**30.50**				**Winch stopped**
TOB-03	061	10:36										27		6620														**Haul 10m/m**
TOB-03	061	11:00	05	51.84	11	29.92	5.864	11.499	186	3.1	3371	27		6570	328	3181	180	5.810	11.499	**5939**	**5**	**48.95**	**11**	**30.40**				

	CD169 leg1: science log											**Swath/**								**Plotted Position**						
	SHIP		**Latitude (S)**		**Longitude (W)**							**TOBI**		**TOBI**						**(m)**	**Lat**		**Lon**		**Comments**
Operation	**JD**	**Time**	**deg**	**min**	**deg**	**min**	**Dec.Lat**	**Dec.Lon**	**CMG**	**SMG**	**Depth**	**Line**	**#**	**W/o**	**Alt**	**z(m)**	**HDG**	**Dec.Lat**	**Dec.Lon**	**L-bck**	**Deg.**	**Min**	**Deg**	**Min**	
TOB-03	061	11:10												6481											**Winch stopped**
TOB-03	061	11:15	05	52.42	11	29.82	5.874	11.497	175																**Check ship on track**
TOB-03	061	11:22												6481											**haul 15m/min**
TOB-03	061	11:30	05	52.94	11	29.72	5.882	11.495	176	2.1	3351	27		6364	329	3091	178	5.830	11.498	**5753**	**5**	**50.00**	**11**	**30.02**	**nephels 0.04**
TOB-03	061	12:00	05	54.06	11	29.52	5.901	11.492	175	2.0	3473	27		5913	468	2898	175	5.853	11.496	**5344**	**5**	**51.25**	**11**	**29.90**	
TOB-03	061	12:30	05	56.19	11	29.28	5.937	11.488	170	2.1	3349	27		5452	594	2689	174	5.892	11.493	**4933**	**5**	**52.50**	**11**	**29.60**	
TOB-03	061	12:45												5238											**stopped winch**
TOB-03	061	12:47												5238											**veer at 15 m/min**
TOB-03	061	12:48												5283											**Veer at 20 m/min**
TOB-03	061	13:00	05	56.41	11	29.07	5.940	11.485	180	2.4	3407	27		5547	709	2736	178	5.895	11.486	**5015**	**5**	**53.70**	**11**	**29.40**	
TOB-03	061	13:15												5812											**veer at 10 m/min**
TOB-03	061	13:18												5833											**stop winch**
TOB-03	061	13:30	05	57.56	11	28.87	5.959	11.481	172	2.0	3222	27		5832	564	2868	174	5.912	11.486	**5268**	**5**	**54.80**	**11**	**29.10**	
TOB-03	061	14:00	05	58.72	11	28.66	5.979	11.478	172	2.6	3188	27		5831	455	2835	174	5.931	11.483	**5285**	**5**	**55.80**	**11**	**29.10**	
TOB-03	061	14:30	05	59.84	11	28.35	5.997	11.473	174	2.4	3167	27		5829	407	2871	176	5.950	11.476	**5263**	**5**	**57.30**	**11**	**28.70**	
TOB-03	061	14:34												5829											**haul at 10 m/min**
TOB-03	061	14:43												5739											**stop winch**
TOB-03	061	14:48												5739											**haul at 10 m/min**
TOB-03	061	14:54												5665											**haul at 20 m/min**
TOB-03	061	15:03	06	01.02	11	27.98	6.017	11.466	166	2.4	3105	27		5460	417	2782	176	5.973	11.470	**4888**	**5**	**58.50**	**11**	**28.50**	
TOB-03	061	15:24												5092											**stop winch**

TOB-03	061	15:30	06	01.96	11	27.69	6.033	11.462	150	1.8	3047	27		5092	511	2594	169	5.992	11.469	4572	5	59.50	11	28.20	
TOB-03	061	16:00	06	03.14	11	27.35	6.052	11.456	162	2.3	2950	27		5093	442	2581	164	6.012	11.467	4581	6	1.00	11	27.85	
TOB-03	061	16:11												5093											haul 10m/min
TOB-03	061	16:22												4987											winch stopped
TOB-03	061	16:30	06	04.15	11	27.03	6.069	11.451	164	1.8	2963	27		4987	405	2591	171	6.029	11.457	4451	6	1.85	11	27.50	
TOB-03	061	16:45												4986											haul 10m/min
TOB-03	061	17:00	06	05.21	11	26.65	6.087	11.444	170	2.2	2964	27		4852	396	2551	169	6.048	11.452	4317	6	3.00	11	27.20	
TOB-03	061	17:13												4852											veer 10m/min
TOB-03	061	17:26												4957											winch stopped
TOB-03	061	17:30	06	06.32	11	26.27	6.105	11.438	158	2.6	3001	27		4958	411	2551	166	6.066	11.448	4441	6	3.70	11	26.70	
TOB-03	061	17:44												4957											haul 15m/min
TOB-03	061	18:00	06	07.44	11	25.91	6.124	11.432	160	2.3	3043	27		4736	406	2410	162	6.087	11.444	4267	6	5.20	11	26.50	Stop winch
TOB-03	061	18:23												4736											veer 10m/min
TOB-03	061	18:30	06	08.55	11	25.55	6.143	11.426	160	3.2	3070	27		4790	488	2420	165	6.105	11.436	4324	6	5.90	11	26.25	veer 15m/min
TOB-03	061	18:39												4923											winch stopped
TOB-03	061	19:00	06	09.67	11	25.20	6.161	11.420	167	2.7	3254	27		4923	440	2463	168	6.122	11.429	4453	6	7.10	11	25.95	
TOB-03	061	19:26												4923											veer 15m/min
TOB-03	061	19:30	06	10.84	11	24.83	6.181	11.414	166	3.4	3232	27		4988	553	2445	170	6.140	11.421	4538	6	8.60	11	25.55	
TOB-03	061	20:00	06	11.98	11	24.47	6.200	11.408	150	2.8	3364	27		5440	465	2638	171	6.155	11.415	4948	6	9.50	11	25.15	
TOB-03	061	20:21												5741											winch stopped
TOB-03	061	20:30	06	13.12	11	24.09	6.219	11.402	150	2.1	3070	27		5741	428	2759	169	6.172	11.411	5225	6	10.30	11	24.70	
TOB-03	061	21:00	06	14.16	11	23.78	6.236	11.396	156	1.5	3254	27		5739	417	2788	171	6.189	11.404	5206	6	11.30	11	24.60	
TOB-03	061	21:20												5739											Haul 10 m/min
TOB-03	061	21:30	06	15.30	11	23.36	6.255	11.389	158	1.8	3321	27		5624	289	2782	168	6.210	11.399	5078	6	12.70	11	24.30	
TOB-03	061	22:00	06	16.44	11	23.03	6.274	11.384	167	2.0	3293	27		5464	452	2676	168	6.230	11.393	4954	6	13.90	11	23.80	
TOB-03	061	22:05												5464											Veer 10 m/m
TOB-03	061	22:30	06	17.54	11	22.70	6.292	11.378	168	2.5	3342	27		5724	461	2777	168	6.246	11.388	5195	6	14.90	11	23.50	
TOB-03	061	22:40												5831											winch stopped
TOB-03	061	23:00	06	18.59	11	22.36	6.310	11.373	157	2.8	3472	27		5832	245	2905	172	6.263	11.379	5247	6	15.80	11	23.20	
TOB-03	061	23:05												5832											haul 15m/min
TOB-03	061	23:13												5714											decrease haul 10 m/m
TOB-03	061	23:19												5658											winch stopped
TOB-03	061	23:30	06	19.68	11	21.96	6.328	11.366	160	2.0	3355	27		5658	441	2838	170	6.282	11.374	5085	6	17.20	11	23.00	
TOB-03	062	00:00	06	20.78	11	21.64	6.346	11.361	173	2.6	3361	27		5803	397	2904	172	6.299	11.367	5214	6	18.00	11	22.80	
TOB-03	062	00:30	06	21.86	11	21.29	6.364	11.355	158	2.6	3564	27		5802	355	2950	172	6.318	11.361	5186	6	18.90	11	22.20	
TOB-03	062	01:00	06	22.85	11	20.98	6.381	11.350	155	1.7	3546	27		5801	431	2989	167	6.335	11.360	5162	6	20.10	11	21.80	
TOB-03	062	01:17												5801											haul at 25 m/min

	CD169 leg1: science log											Swath/								Plotted Position					
	SHIP		Latitude (S)		Longitude (W)							TOBI		TOBI						(m)	Lat		Lon		Comments
Operation	JD	Time	deg	min	deg	min	Dec.Lat	Dec.Lon	CMG	SMG	Depth	Line	#	W/o	Alt	z(m)	HDG	Dec.Lat	Dec.Lon	L-bck	Deg.	Min	Deg	Min	
TOB-03	062	01:26												5547											haul at 10 m/min
TOB-03	062	01:27												5538											stopped winch
TOB-03	062	01:30	06	23.94	11	20.60	6.399	11.343	155	2.5	3552	27		5538	539	2862	171	6.355	11.350	4931	6	21.35	11	21.47	
TOB-03	062	01:51												5538											Chucking out at 15m/min
TOB-03	062	02:00	06	25.11	11	20.23	6.419	11.337	171	2.4	3521	27		5675	653	2830	164	6.374	11.350	5109	6	22.50	11	21.00	
TOB-03	062	02:28												6106											stopped winch
TOB-03	062	02:30	06	26.37	11	19.87	6.440	11.331	168	2.7	3525	27		6106	378	2954	173	6.390	11.337	5534	6	23.70	11	20.65	
TOB-03	062	03:00	06	27.48	11	19.47	6.458	11.325	153	1.8	3504	28		6105	475	2923	167	6.409	11.336	5550	6	24.70	11	20.30	
TOB-03	062	03:18												6105											veer 10 m/min
TOB-03	062	03:27												6189											stopped winch
TOB-03	062	03:33	06	28.79	11	19.00	6.480	11.317	159	2.6	3544	28		6189	493	2959	169	6.430	11.326	5626	6	26.00	11	19.90	
TOB-03	062	04:00	06	29.80	11	18.60	6.497	11.310	162	2.1	3629	28		6198	513	2958	162	6.448	11.326	5637	6	26.60	11	20.20	
TOB-03	062	04:04												6198											veer 15m/min
TOB-03	062	04:18												6405											winch stopped
TOB-03	062	04:30	06	31.00	11	18.22	6.517	11.304	164	2.2	3747	28		6406	407	3036	169	6.465	11.314	5831	6	28.05	11	19.20	
TOB-03	062	04:52	06											6406											veer 10m/min
TOB-03	062	05:02	06	32.23	11	17.84	6.537	11.297	156	2.6	3773	28		6518	460	3066	168	6.484	11.308	5942	6	29.20	11	18.75	
TOB-03	062	05:21																							5 mins TOBI swath lost, then back on its own again.
TOB-03	062	05:30	06	33.26	11	17.45	6.554	11.291	152	2.2	3781	28		6786	398	3206	172	6.499	11.299	6171	6	30.30	11	18.55	winch stopped
TOB-03	062	05:39																							ship slowed to around 2.2
TOB-03	062	05:54																							veer 10m/min
TOB-03	062	06:00	06	34.40	11	17.04	6.573	11.284	161	2.1	3708	28		6847	485	3230	168	6.518	11.296	6227	6	31.30	11	18.20	
TOB-03	062	06:07												6910											winch stopped

TOB-03	062	06:20												6910													**haul 10m/min**
TOB-03	062	06:30	06	34.48	11	16.69	6.575	11.278	158	2.2	3776	28		6722	344	3323	168	6.521	11.289	**6033**	**6**	**32.40**	**11**	**17.70**			
TOB-03	062	06:46												6515													**winch stopped**
TOB-03	062	06:50												6515													**haul 15m/min**
TOB-03	062	06:52												6569													**COMPLETE POWER FAILURE**
TOB-03	062	07:08																									**Some power back, no winch, incr. speed to 2.9kts**
TOB-03	062	07:15	06	37.00	11	16.75	6.617	11.279																			**TOBI back, got position from bridge**
TOB-03	062	07:17																									**a/c back to wp 28**
TOB-03	062	07:21																									**21 minutes of data lost**
TOB-03	062	07:30	06	37.19	11	16.68	6.620	11.278	171	2.6				6545	593	3166	174	6.566	11.284	**5918**	**6**						**limited power,no winch**
TOB-03	062	07:33																									**winch power back**
TOB-03	062	07:45	06	38.35	11	16.51	6.639	11.275	168	1.8				6483	589	3136	179	6.586	11.276	**5864**	**6**	**35.20**	**11**	**16.95**			**winch figure changed when got data from winch log.**
TOB-03	062	07:55												6484													**veer 15m/min**
TOB-03	062	08:00	06	38.84	11	16.35	6.647	11.273	177	1.5				6551	556	3137	182	6.593	11.270	**5941**	**6**	**35.90**	**11**	**16.85**			
TOB-03	062	08:28												6961													**Winch stopped**
TOB-03	062	08:30	06	39.91	11	16.02	6.665	11.267	160	1.1	3771	28		6961	381	3400	179	6.608	11.268	**6264**	**6**	**36.50**	**11**	**17.00**			
TOB-03	062	08:50																									**Ships power lost**
TOB-03	063	08:53																									**Ships power back**
TOB-03	062	08:58																									**power back to winches**
TOB-03	062	09:00												6961													**haul 30 m/min**
TOB-03	062	09:02	06	41.08	11	15.94	6.685	11.266	154	2.8		28		6794	274		175	######	######								
TOB-03	062	09:07												6716													**decrease haul 10 m/m**
TOB-03	062	09:10																									**winch stopped**
TOB-03	062	09:16	06	41.62	11	15.81	6.694	11.264	160	1.0	3698	28		6689	561	3279	173	6.639	11.270	**6020**	**6**	**38.40**	**11**	**16.60**			
TOB-03	062	09:30	06	42.14	11	15.62	6.702	11.260	157	1.7		28		6689	521	3287	175	6.648	11.265	**6016**	**6**	**39.20**	**11**	**16.10**			**no water depth - haul 15 m/m**
TOB-03	062	10:00	06	43.22	11	15.28	6.720	11.255	169	2.3	3230	28		6252	567	3078	174	6.669	11.260	**5632**	**6**	**40.40**	**11**	**16.00**			
TOB-03	062	10:30	06	44.31	11	14.96	6.739	11.249	138	3.1	3043	28		5794	771	2893	171	6.692	11.257	**5210**	**6**	**41.50**	**11**	**15.50**			
TOB-03	062	10:32												5765													**Increase haul to 25m/m - RecoveringTOBI**
TOB-03	062	10:35																									**Increase haul to 40m/m**
TOB-03	062	10:45	06	44.89	11	14.77	6.748	11.246	139	2.8	3040	28		5281	616	2645	171	6.705	11.253	**4761**							
TOB-03	062	11:00	06	45.44	11	14.61	6.757	11.244	138	3.0	3102	28		4683	868	2359	173	6.719	11.248	**4235**							
TOB-03	062	11:30	06	46.48	11	14.34	6.775	11.239	196	3.1	3260			3422	998	1849	173	6.747	11.242	**3069**							
TOB-03	062	12:00	06	47.55	11	14.07	6.793	11.235	163	2.4				2309													
TOB-03	062	12:30	06	48.63	11	13.84	6.811	11.231	168	2.0	3764			1186													
TOB-03	062	13:00																									**TOBI surfaced**
	CD169 leg1: science log											**Swath/**								**Plotted Position**							
	SHIP		**Latitude (S)**		**Longitude (W)**							**TOBI**		**TOBI**						**(m)**	**Lat**		**Lon**		**Comments**		
Operation	**JD**	**Time**	**deg**	**min**	**deg**	**min**	**Dec.Lat**	**Dec.Lon**	**CMG**	**SMG**	**Depth**	**Line**	**#**	**W/o**	**Alt**	**z(m)**	**HDG**	**Dec.Lat**	**Dec.Lon**	**L-bck**	**Deg.**	**Min**	**Deg**	**Min**			
TOB-03	062	13:01																									**6th MAPR on board (M9) - long fishing line around it**
TOB-03	062	13:06																									**End of fishing line**
TOB-03	062	13:16																									**5th MAPR on board (M8) -clear of line**
TOB-03	062	13:20																									**Depressor weight on board**
TOB-03	062	13:40																									**TOBI on board**
TOB-03	062	13:52																									**3.5Hz fish on board**
TOB-03	062	13:53																									**4th MAPR on board (M29)**
TOB-03	062	13:55																									**10Hz fish on board**
TOB-03	062	13:56																									**3rd MAPR on board (M6)**
TOB-03	062	14:00																									**2nd MAPR on board (M13)**
TOB-03	062	14:05																									**1st MAPR on board (M12) and batfish**
Transit	062	14:07	06	50.22	11	14.04	6.837	11.234	243	5.7	4013																**In transit**
Transit	062	14:31	06	51.49	11	17.87	6.858	11.298	252	10.9																	**On course for Ascension**
Transit	063	08:38	07	51.06	14	21.74	7.851	14.362	244	11.0																	**Approaching Ascension**
Transit	063	09:15	07	54.00	14	25.02	7.900	14.417	104	4.4																	**Arrived, Ascension, for boat transfer.**

END OF CD169 LEG 1

	CD169 Leg2: science log															
			Lat. (South)		Long. (West)					BRIDGET etc						
Operation	Jday	Time	Deg	Min	Deg	Min	CMG	SMG	Wat. deptl	Wire Out	Depth	Layback	Altitude	Comments		
	063	17:00												Under way from Ascension		
Transit	063	17:00	7	54.59	14	25.28	272	5.4						On way to CTD 03		
Transit	063	17:30	7	53.39	14	25.82	035	8.3						On way to CTD 03		
	064	05:30	6	18.13	13	22.45	031	10.2						transit to CTD station		
	064	06:00	6	13.26	13	19.37	035	10.5								
	064	07:00	6	6.40	13	14.93	195	1.0						10kHz fish in water, on station		
CTD03	064	07:15												Waiting for CTD winch		
CTD03	064	07:21												plug in sensors		
CTD03	064	07:23	6	6.33	13	14.93			3447					CTD in water		
CTD03	064	08:28	6	6.27	13	14.78	131	1.0	3440					CTD on bottom		
CTD03	064	08:32												Error = no bottle fire confirmation		
CTD03	064	08:40								3390	3400			attempt manual fire (Bottles 1 & 2)		
CTD03	064	08:55								3000	3017			attempt manual fire (Bottles 3 & 4)		
CTD03	064	09:05								2500	2513			attempt manual fire (Bottles 5 & 6)		
CTD03	064	09:17								2000	2004			attempt manual fire (Bottles 7 & 8)		
CTD03	064	09:38								1000	1003			attempt manual fire (Bottles 9 & 10)		
CTD03	064	09:58								10	15			attempt manual fire (Bottles 11 & 12)		
CTD03	064	10:02	6	6.75	13	14.31								CTD on deck, no bottles fired		
CTD03	064	10:04												Fe & Mn sensors unplugged		
Test 2	064	13:18	5	41.90	13	0.00	103	3390.0								
Test 2	064	13:27												Re-positioning to avoid fishing buoy		
Test 2	064	13:35	5	42.06	12	59.98	153	3392.0						On station - CTD04		
Test 2	064	13:38												CTD in water		
Test 2	064	13:40												start pay-out to 500m for test firing 50m/m		
Test 2	064	13:50												All stop 500m		
Test 2	064	13:51	5	42.07	13	0.01								firing all bottles successfully		
Test 2	064	13:52												bringing CTD up to surface		
Test 2	064	14:05												CTD on deck - all fired		
CTD04	064	14:30	5	42.48	12	59.56	145	1.0	3401	0	0	**190**		CTD in water		
CTD04	064	15:31	5	42.52	12	59.56	140	1.3	3481	3340				CTD on bottom		
CTD04	064	15:32							3481	3340	3360			Fire bottles 1 & 2		
CTD04	064	15:40								3180	3200			Fire bottles 3 & 4		
CTD04	064	15:49								2981	3000			Fire bottles 5 & 6		
CTD04	064	15:58								2782	2800			Fire bottles 7 & 8		
CTD04	064	16:07							3399	2584	2600			Fire bottles 9 & 10		
CTD04	064	16:17								2389	2400			Fire bottles 11 & 12		
CTD04	064	16:25								2192	2200			Fire bottles 13 & 14		
CTD04	064	16:34								1990	1999					
CTD04	064	16:47								1492	1502			Fire bottles 17 & 18		
CTD04	064	17:00								990	1000			Fire bottles 19 & 20		
CTD04	064	17:14								491	500			Fire bottles 21 & 22		
CTD04	064	17:26								3	10			Fire bottles 23 & 24		
CTD04	064	17:29	5	42.57	12	59.31	177	0.5	3397					CTD on deck		
transit	064	18:23	5	37.50	12	56.10	052	10.0	3425					In transit to seg 2 RC05		
transit	064	19:03	5	34.50	12	52.10	056	10.8	3430					In transit to seg 2 RC05		
transit	064	19:30	5	31.90	12	48.50	057	10.7	3268					In transit to seg 2 RC05		
transit	064	20:00	5	29.20	12	44.80	057	11.0	3283					In transit to seg 2 RC05		
transit	064	20:30	5	26.11	12	40.84	053	10.9	3126					In transit to seg 2 RC05		
transit	064	21:00	5	22.79	12	33.43	050	10.9	3156					In transit to seg 2 RC05		
transit	064	21:31	5	19.34	12	33.60	052	10.7	2748					In transit to seg 2 RC05		
	CD169 Leg2: science log															
			Lat. (South)		Long. (West)					BRIDGET etc						
Operation	Jday	Time	Deg	Min	Deg	Min	CMG	SMG	Wat. deptl	Wire Out	Depth	Layback	Altitude	Comments		
transit	064	22:02	5	16.00	12	29.81	052	10.8	3109					In transit to seg 2 RC05		
transit	064	22:32	5	12.83	12	26.19	055	10.7	2678					In transit to seg 2 RC05		
transit	064	23:03	5	9.58	12	22.45	057	10.9	3646					In transit to seg 2 RC05		
RC05	064	23:30	5	7.04	12	19.36	070	6.3	3365					Slowing down for RC05		
RC05	064	23:45	5	6.88	12	19.18	137	1.2	3371					on station rc05		
RC05	064	23:55								0	3411			chipper in water		
RC05	064	23:59								26	3362			MAPR in water		

RC05	065	00:10	5	6.88	12	19.19			3381	700	3381			75m/min		
RC05	065	00:10	5	6.89	12	19.22			3375	1500	3375			80m/min		
RC05	065	00:30	5	6.92	12	19.21			3396	2340	3396			82m/min		
RC05	065	00:40	5	6.92	12	19.18			3394	3106	3394			80m/min		
RC05	065	00:42	5	6.91	12	19.17			3380	3464	3380	**948**		HIT- tension .47 to .31		
RC05	065	00:47	5	6.92	12	19.17			3400	3464	3400	**853**		off bottom		
RC05	065	00:55	5	6.93	12	19.17			3336	2966	2966	**190**		75m/min		
RC05	065	01:10	5	6.88	12	19.22			3425	1960	3425			80m/min		
RC05	065	01:23	5	6.83	12	19.26			3339	732	3339			86m/min		
RC05	065	01:33	5	6.79	12	19.30			3342	55	3342			35m/min		
RC05	065	01:37	5	6.79	12	19.35			3415	20	3415			MaPR on board		
RC05	065	01:39	5	6.79	12	19.35								RCO5 on deck- few specks- soft btm		
transit	065	02:00	5	6.54	12	18.24			3549	0	3549			in transit to seg 2 RC06		
transit	065	02:15	5	6.14	12	16.81			3683	0	3683			in transit to seg 2 RC06		
transit	065	02:20	5	6.00	12	16.35			3754	0	3754			Simrad line 55 started-\mbeam went off		
transit	065	02:30	5	6.12	12	16.12			3695		3695			multibeam run over target area		
transit	065	02:25	5	6.23	12	17.21			3599		3599			changing course for northern high target		
transit	065	02;45	5	5.57	12	17.67			3505		3505			in transit to seg 2 RC06		
transit	065	03:00	5	4.25	12	17.84			3641		3641			in transit to seg 2 RC06		
transit	065	03:25	5	3.99	12	17.37			3642		3642			in transit to seg 2 RC06 (arriving)		
RC06	065	03:37	5	3.99	12	17.29			3629		3629			RC06 on station		
RC06	065	03:40	5	3.98	12	17.29			3629		3629			Chipper in water		
RC06	065	03:43	5	4.00	12	17.29			3625		3625			MAPR in water, 20 up cable		
RC06	065	04:00	5	4.00	12	17.28			3646		3646			65m/min		
RC06	065	04:40	5	4.02	12	17.29			3602		3602			60m/min		
RC06	065	04:42	5	4.02	12	17.29			3599	3753	3599	**1254**		Hit, rc06 up to 3700m then back down for 2nd hit		
RC06	065	04:48	5	4.03	12	17.29			3599	2753	3599			2nd hit		
RC06	065	05:47	5	4.07	12	12.23			3614	20				MAPR off		
RC06	065	05:51												RC06 on deck		
Transit	065	05:57								**LINE**				Transit to WP 29, line 29		
Transit	065	06:02	5	4.16	12	17.83	334	9.1	3634					Transit to WP 29		
Transit	065	06:30	5	4.41	12	20.35	323	11.1	3312							
Transit	065	07:00	4	56.07	12	24.18	321	11.0	2848							
Transit	065	07:13	4	54.05	12	25.90	a/c	11.0	2794					a/c at WP 29 sol 29		
Swath	065	07:17	4	53.53	12	26.15	352	11.1	2798	29				o/c line 29		
Swath	065	07:30	4	51.26	12	26.70	350	11.0	2620	29						
Swath	065	08:00	4	46.40	12	27.90	351	11.1	2681	29						
transit	065	08:15	4	43.93	12	28.26	110	8.4	3054					A/C at W/P 30 - transit to trans stn		
transit	065	08:30	4	45.65	12	27.18	132	9.5	3012							
TX01	065	08:51	4	1.96	12	25.55	134	1.6	2773					slow to deploy USBL		
TX01	065	09:15	4	47.13	12	25.52	128	1.4	2780					slow transit to transponder deployment		
TX01	065	09:30	4	47.54	12	25.08	132	5.7	2807					who knows!!!		
TX01	065	09:38												transponder D in water		
TX01	065	10:00	4	47.91	12	24.72	130	2.2	2859							
TX01	065	10:04	4	47.96	12	24.69	131	2.4	2874					weight in water - eventually!!!!		
TX01	065	10:51	4	47.29	12	24.16	134	1.6	2937					Transponder D on bottom		
TX01	065	11:00	4	47.42	12	24.09	135	2.8	2909							
TX01	065	11:30	4	48.48	12	24.16	183	2.3	2959							
	CD169 Leg2: science log															
			Lat. (South)		**Long. (West)**					**BRIDGET etc**						
Operation	**Jday**	**Time**	**Deg**	**Min**	**Deg**	**Min**	**CMG**	**SMG**	**Wat. depth**	**Wire Out**	**Depth**	**Layback**	**Altitude**	**Comments**		
TX01	065	11:55	4	48.55	12	25.30	312	2.1	2624					end of transponder test survey		
transit	065	12:00	4	48.42	12	1.07	045	2.1	2622					transit to CTD05 (at 5knts)		
	065															
CTD05	065	13:09	4											sensor plugged in		
CTD05	065	13:12	4	45.98	12	23.01	296	0.5	3209					CTD in water		
CTD05	065	13:19												stopped @ 50m CTD software problems		
CTD05	065	13:24												CTD coming up		
CTD05	065	13:27												CTD suspended to restart and reset software		
CTD05	065	13:33												CTD back in water, to 5m		
CTD05	065	13:39												CTD going down 20m/min to 100m		
CTD05	065	13:44												CTD at 100m hold for computer restart, now lost graphical interface		
CTD05	065	13:56												CTD going down, no plots but digital data, background nephels are 90.379-90.352		
CTD05	065	14:04												Off position by .5 miles, we are drifting back that way, ship wil do it		
CTD05	065	14:15	4	45.95	12	23.11								Drifting to station		
CTD05	065	14:30	4	45.94	12	23.20	119	1.1	3165					Drifting to station		
CTD05	065	14:45	4	45.36	12	23.41	124	1.0	3127					Drifting to corect position		
CTD05	065	14:51												Winch stopped at bottom of cast		

CTD05	065	14:53	4	45.89					3146					Fire bottles 1 and 2		
CTD05	065	14:53	4	45.89	12	23.46								Software crash as tried to fire		
CTD05	065	14:58												CTD coming up, BROKEN!		
CTD05	065	15:30	4	45.98	12	23.57	122	1.5	2712					CTD coming up		
CTD05	065	15:52												on surface one bottle fired		
CTD05	065	15:54												On deck		
CTD05	065	15:55												unplug sensor		
Transit	065	16:06												in transit to BGT01		
Transit	065	16:30	4	43.82	12	24.62	355	3.7	3205					in transit to BGT01		
BGT01	065	16:45	4	43.01	12	24.99	129	0.8	3249					On station BGT01		
BGT01	065	17:10	4	43.26	12	25.07	129	1.7	3237	21				BGT in water		
BGT01	065	17:13							3056	70				nB Clock on bgt is ship +30 minutes		
BGT01	065	17:30	4	43.42	12	24.97	117	2.5	3113	383	392			Excursions on all analog traces(Trans, neph and alt0		
BGT01	065	18:00	4	43.56	12	24.62	112	2.1	3207	1051	1054			bGTstill malfunctioning		
BGT01	065	18:12					110	1.8	3292	1310	1302	**335**		Veer increaseto 30 m/min		
BGT01	065	18:30	4	43.70	12	24.30	112	2.1	3291	1856	1865					
BGT01	065	18:32												Reboot BRIDGET, try to kickstart analogue Tx/Rx. No A value		
BGT01	065	18:35												No change. Reboot logging.		
BGT01	065	18:36												No result. Proceed to fulldepth, then recovery.		
BGT01	065	19:01	4	43.80	12	23.90	112	2.1	3238	2750	2720	**595**		Winch stop		
BGT01	065	19:05								2750				Fire bottle no.1 - confirmed		
BGT01	065	19:07												veer at 30m/m		
BGT01	065	19:13								2923				stop winch		
BGT01	065	19:15												haul at 45m/m to targeth depth 2800m		
BGT01	065	19:17								2802				fire bottle no.2 - confirmed - haul at 45m/m		
BGT01	065	19:19								2751				fire bottle no. 3 - confirmed		
BGT01	065	19:21								2701				fire bottle no. 4 - confirmed		
BGT01	065	19:23								2651				fire bottle no. 5- confirmed		
BGT01	065	19:26								2599				fire bottle no. 6 - confirmed		
BGT01	065	19:28								2545				fire bottle no. 7 - confirmed		
BGT01	065	20:00	4	44.42	12	23.12	116	2.6	3234	1238				resume recovery		
BGT01	065	20:05								1024				fire bottle no. 8 - confirmed		
BGT01	065	20:06								1024				fire bottle no. 9 - confirmed		
BGT01	065	20:07								1024				fire bottle no. 10 - confirmed		
BGT01	065	20:08								1024				fire bottle no. 11 - confirmed		
BGT01	065	20:16												Resume haul 35m/m		
BGT01	065	20:31	4	44.73	12	23.05	114	1.7	3189	450						
BGT01	065	20:55								-12				BRIDGET on deck		
	CD169 Leg2: science log															
			Lat. (South)		**Long. (West)**					**BRIDGET etc**						
Operation	**Jday**	**Time**	**Deg**	**Min**	**Deg**	**Min**	**CMG**	**SMG**	**Wat. depth**	**Wire Out**	**Depth**	**Layback**	**Altitude**	**Comments**		
	065	21:00	4	44.95	12	23.05	120	1.0	3145							
transit	065	21:30	4	45.97	12	22.48	124	4.4	3097					Transit to transponder A Deployment		
TX02	065	22:00	4	47.07	12	21.53	116	2.1	2977					slowing down for deployment		
TX02	065	22:08	4	47.19	12	21.42	119	1.5						At transponder B station		
TX02	065	22:10												Transponder B in water		
TX02	065	22:20	4	47.28	12	21.33	116	1.9						weight in water - transit to transponder a deployment		
transit	065	22:30	4	47.60	12	21.49	188	5.0						Transit to transponder A deployment		
TX03	065	23:00	4	49.45	12	22.50	189	2.9						slowing down for deployment		
TX03	065	23:16	4	49.53	12	22.50	099	2.5						Transponder A in water		
TX03	065	23:21	4	49.53	12	22.47	107	3.0						Weight in water - transit to survey-in transponder B		
transit	065	23:30	4	49.43	12	22.38	056	3.4						Transit to transponder A survey-in		
hove-to	065	23:32												Hove-to - problems "hearing" transponder A		
hove-to	065	00:00	4	48:96	12	0.95	117	2.1						Hove-to		
TX02	066	00:24	4	49.16	12	22.41	100	2.4						moving to start surveying xpdr b		
TX02	066	02:00	4	48.20	12	22.27	103		2978					finished surveying xpdr b, moving to drop xpdr A		
TX03	066	02:23	4	49.46	12	22.57	105		2977					started to stream xpdr A		
TX03	066	02:40	4	49.53	12	22.47	108		2977					xpdr a weight away		
	066	04:15	4	50.34	12	23.70	152		2918					Heaving to for USBL pod recovery		
Transit	066	04:50												Underway for DUM 01deployment		
Transit	066	05:00	4	50.70	12	24.30	316	7.2	2621					Transit to DUM 01 deployment site (Shallowest at 2475m)		
DUM1	066	05:24	4	48.80	12	26.14								On station DUM 01		
DUM1	066	05:30												Weight in water		
DUM1	066	05:37												Pinger on		
DUM1	066	05:40								58				MAPR 12 on wire		
DUM1	066	05:45								108				MAPR 13 on wire		
DUM1	066	05:50								158				MAPR 6 on wire		
DUM1	066	05:54								208				MAPR 29 on wire		

DUM1	066	06:00								258				MAPR 8 on wire		
DUM1	066	06:05								308				MAPR 9 on wire		
DUM1	066	06:08	4	49.70	12	26.40	129	1.7	2631							
DUM1	066	06:50	4	50.30	12	26.40	133	1.6	2650	2031						
DUM1	066	07:00	4	50.50	12	26.40	132	1.5	2682	2222			**400**			
DUM1	066	07:12							2688	2300			**600**	Stopped winch, start survey to WP34		
DUM1	066	07:30	4	50.85	12	25.43	077	4.0	2517	2301			**1000**			
DUM1	066	07:50						2.0	2442				**1000(Est)**	Veer at 30 m/min		
DUM1	066	08:00	4	50.54	12	24.41	086	3.1	2540	2663						
DUM1	066	08:05								2750				Winch stopped		
DUM1	066	08:15	4	50.42	12	23.99	088	2.6	2852	2749						
DUM1	066	08:30	4	50.27	12	23.60	061	1.1	2947	2826						
DUM1	066	08:45	4	50.17	12	23.16	094	1.7	3041	3373						
DUM1	066	08:52												Winch stop		
DUM1	066	08:53												Haul 40m/min		
DUM1	066	09:00	4	50.06	12	22.80	071	1.1	3013	3374						
DUM1	066	09:10												Winch stop - hove-to		
DUM1	066	09:15	4	49.96	12	22.41	236	0.1	3003	2959						
DUM1	066	09:30	4	44.99	12	22.47	289	0.1		2958						
DUM1	066	09:35								2958			**400**	cable swinging under ship		
DUM1	066	09:38	4	50.02	12	22.47	094	0.3	3968	2958			**350**			
DUM1	066	09:45												veering		
DUM1	066	09:45	4	50.05	12	22.43	092	0.9	3009							
DUM1	066	09:49								3100				winch stop		
DUM1	066	09:58												haul 29m/m		
DUM1	066	10:02								3000				winch stop		
DUM1	066	10:03	4	49.94	12	22.33	044	0.8	2998	3000				under way 1.5knts		
DUM1	066	10:15	4	49.81	12	22.21	046	1.8	2985	3001						
	CD169 Leg2: science log															
			Lat. (South)		**Long. (West)**					**BRIDGET etc**						
Operation	**Jday**	**Time**	**Deg**	**Min**	**Deg**	**Min**	**CMG**	**SMG**	**Wat. deptl**	**Wire Out**	**Depth**	**Layback**	**Altitude**	**Comments**		
DUM1	066	10:30	4	49.64	12	22.07	016	1.1	2976	3002						
DUM1	066	10:45	4	49.47	12	21.91	013	1.2	2957	3003	2750	**1396**				
DUM1	066	11:00	4	49.25	12	21.75	014	1.1	2915	3004						
DUM1	066	11:15	4	49.09	12	21.60	053	1.0	2873	3004						
DUM1	066	11:30	4	48.90	12	21.39	039	1.1	2932	3005						
DUM1	066	11:40								3005				Haul 20m/m		
DUM1	066	11:43								2950				winch stop		
DUM1	066	11:45	4	48.68	12	21.22	357	2.9	2917	2950						
DUM1	066	11:46												A/C for W/P 35		
DUM1	066	12:00	4	48.32	12	21.27	315	2.1	2873	2450						
DUM1	066	12:10												pinger on bottom trace lost		
DUM1	066	12:13												450 alt veer @20m/min		
DUM1	066	12:15	4	48.10	12	22.00	200	2.0						40m/min		
DUM1	066	12:18												50m/min		
DUM1	066	12:23														
DUM1	066	12:30	4	48.04	12	25.55	280	2.0	3025	3553			**300**			
DUM1	066	12:35								3707			**250**			
DUM1	066	12:40	4	47.99	12	22.97	272	2.3	4085	4000			**175**	turning simrad em12 on		
DUM1	066	12:41								4070			**150**	stopping winch		
DUM1	066	12:45	4	47.96	12	23.17	285	2.6		4071			**175**			
DUM1	066	12:51	4	47.93	12	23.40	274	3.2	4091	4137				down at 20m/min		
DUM1	066	12:55	4	47.92	12	23.55	273	2.0		4150				down at 40m/min		
DUM1	066	13:05	4	47.90	12	24.00	291	2.4		4561				down at 38m/min		
DUM1	066	13:15	4	47.88	12	24.39	274	3.4		5026			**175**	down at 38m/min		
DUM1	066	13:20								5026			**175**	stopped veering		
DUM1	066	13:21												Increased ship's speed 1/4 knot		
DUM1	066	13:25	4	47.84	12	24.89	267	3.1		5026			**200**	bottom should be rising up soon		
DUM1	066	13:30								5026			**300**			
DUM1	066	13:35	4	47.80	12	25.40	290	3.0		5026			**300**	decreasing to 1.5 knots (down 1/4 knot)		
DUM1	066	13:42												10m/min up then 30m/min up		
DUM1	066	13:45	4	47.72	12	25.84	275	2.4	35545	4880				starting turn at 6 degrees per minute- end of line		
DUM1	066	13:55	4	47.72	12	25.85	275	2.4		4880			**?**	turning and veering in at 30m/min		
DUM1	066	14:00	4	47.42	12	26.44	313	2.6		4404			**?**	40m/min up and turning		
DUM1	066	14:10	4	47.84	12	26.79	330	3.9		3945				40km/min up- wire compromising block-		
DUM1	066	14:25	4	46.42	12	27.17	334	2.6		3398				40m/min up and turning		
DUM1	066	14:30	4	46.09	12	27.34				3145			**650?**	40m/min up- will come to 1000m w/o		
DUM1	066	14:45	4	45.38	12	27.60	357	2.3		2540				40m/min up- will come to 1000m w/o		

DUM1	066	15:15	4	44.80	12	28.10	336	1.6		1653				40m/min up- will come to 1000m w/o		
DUM1	066	15:50	4	43.36	12	29.03	298	4.1		1500				turning for WP40 to start next DUM line		
DUM1	066	16:00	4	43.24	12	29.77	268	3.6		1500				turning for WP40 to start next DUM line		
DUM1	066	16:17	4	43.70	12	30.70	230	4.1	3654	1500				turning for WP40 to start next DUM line		
DUM1	066	16:30	4	44.34	12	31.05	194	3.0	2900	1500						
DUM1	066	16:48	4	44.89	12	30.82	113	2.0	2872	1500				haul at 35m/min		
DUM1	066	16:56	4	45.02	12	30.59	107	2.2		1254				stopped winch		
DUM1	066	17:00	4	45.05	12	30.46	122	2.0	2857	1254						
DUM1	066	17:05					098							o/c		
DUM1	066	17:06												switch simrad off line 58		
DUM1	066	17:30	4	45.17	12	29.59	095	1.6	2841	1254						
DUM1	066	18:00	4	45.25	12	28.73	097	1.8	2575	1254						
DUM1	066	18:15	4	45.32	12	28.28	108	1.6	2875	1254						
DUM1	066	18:25	4	45.36	12	28.00	094	2.5		1254				Simrad back on line 59		
DUM1	066	18:30	4	45.38	12	27.86	084	1.4	2975	1254						
DUM1	066	18:45	4	45.45	12	27.43	107	1.1	2908	1254						
DUM1	066	18:58	4	45.52	12	27.07	210	0.5	2893	1254				ship speed dropped to cause line to drop		
DUM1	066	19:00	4	45.53	12	27.07	109	0.5	2892	1254				Veer at 40m/min		
	CD169 Leg2: science log															
			Lat. (South)		**Long. (West)**					**BRIDGET etc**						
Operation	**Jday**	**Time**	**Deg**	**Min**	**Deg**	**Min**	**CMG**	**SMG**	**Wat. deptl**	**Wire Out**	**Depth**	**Layback**	**Altitude**	**Comments**		
DUM1	066	19:15	4	45.58	12	26.90	167	1.3	2892	1855						
DUM1	066	19:30	4	45.61	12	26.72	101	1.2	2877	2455						
DUM1	066	19:45	4	45.60	12	26.50	101	1.1	2861	2834				Winch stopped. Ahead at 1.5SMG		
DUM1	066	19:52	4											Veer at 20m/min		
DUM1	066	19:57	4											Stopped winch		
DUM1	066	20:00	4	45.68	12	26.15	069	1.4	2875	2915						
DUM1	066	20:06								2915				Veering at 20 m/min		
DUM1	066	20:07								2962				Stopped winch		
DUM1	066	20:15	4	45.70	12	25.82	099	1.0	2853	2963						
DUM1	066	20:19												Veer 20m/m		
DUM1	066	20:22								3032				Winch stop		
DUM1	066	20:30	4	45.71	12	25.51	068	1.1		3039				Veer 20m/m		
DUM1	066	20:34								3100				stopped		
DUM1	066	20:45	4	45.75	12	25.18	074	1.1		3010						
DUM1	066	20:51								3010				veering 20m/m		
DUM1	066	20:52								3124				winch stopped		
DUM1	066	21:00	4	45.81	12	24.85	100	1.6	3029	3125				veering 20m/m		
DUM1	066	21:08								3279				winch stopped		
DUM1	066	21:15	4	45.85	12	24.51	093	2.4	3033	3279						
DUM1	066	21:30	4	45.91	12	24.16	098	1.5	3136	3280						
DUM1	066	21:45	4	45.95	12	23.78	118	1.6	3134	3281						
DUM1	066	22:00	4	45.99	12	23.42	094	2.4	3157	3281						
DUM1	066	22:15	4	46.07	12	23.08	096	2.6	3196	3282						
DUM1	066	22:30	4	46.13	12	22.71	094	2.4	3135	3282				veer 20m/m		
DUM1	066	22:45	4	46.19	12	22.37	094	2.6	3174	3563				stop winch		
DUM1	066	23:00	4	46.24	12	22.00	092	2.4	3197	3563						
DUM1	066	23:15	4	46.26	12	21.64	093	2.5	3118	3564						
DUM1	066	23:30	4	46.28	12	21.27	095	2.6	3404	3565				A/C for W/P 38		
DUM1	066	23:45	4	46.42	12	20.02	120	2.2	3305	3565						
DUM1	067	00:05	4	46.90	12	20.81	161	1.9	3576	3566				turning for wp38		
DUM1	067	00:15	4	47.21	12	21.01	185	1.7	3573	3566			**220?**	turning for wp38		
DUM1	067	00:30	4	47.55	12	21.58	229	1.7	4765	3567			**225?**	start of 3rd line; pinger trace bad		
DUM1	067	00:45	4	47.61	12	22.16	268	2.0	4624	3567			**175?**	pinger trace bad		
DUM1	067	01:00	4	47.54	12	22.75	294	2.0	4497	3567			**150?**	pinger trace bad; turned off bow thruster		
DUM1	067	01:10	4	47.39	12	23.25	299	2.4		3755			**1100**	paying out at 30m/min		
DUM1	067	01:20	4	47.30	12	23.61	292	2.0		3755			**300-1100**			
DUM1	067	01:30	4	47.20	12	23.94	296	1.1		3755			**700**	slowing the ship to close to a stop, wire too high		
DUM1	067	01:45	4	47.12	12	24.20	299	0.8		3764			**600**	trace is back- lowering at 30m/min		
DUM1	067	01:55	4	47.06	12	24.40		0.8	2949	4150			**150**	good trace		
DUM1	067	02:15	4	46.93	12	24.70	289	0.9	2930	4011			**120**	hauling in at 20m/min		
DUM1	067	02:30	4	46.80	12	24.92	288	1.0		3916				hauling in at 10m/min		
DUM1	067	02:45	4	46.66	12	25.23	284	0.9		3735			**190**	stopped hauling in		
DUM1	067	03:00	4	46.54	12	25.53	282	1.0		3727			**150**			
DUM1	067	03:15	4	46.40	12	25.86	284	0.9		3638			**100**			
DUM1	067	03:25	4	46.32	12	26.05	281	1.1		3632				Hauling in for recovery at 40m/min		
DUM1	067	04:00	4	46.04	12	27.08	281	2.4		2232				Hauling in for recovery at 40m/min		
DUM1	067	04:15	4	45.07	12	27.92	280	2.7		1626						

DUM1	067	04:30	4	45.72	12	28.71	282	2.7		1106						
DUM1	067	04:55												Manoever ship for MAPR recovery		
DUM1	067	05:17								330				MAPR inboard (308 m ref. Wire out)		
DUM1	067	05:22								270				MAPR inboard (258 m ref. Wire out)		
DUM1	067	05:28								219				MAPR inboard (208 m ref. Wire out)		
DUM1	067	05:33								170				MAPR inboard (158 m ref. Wire out)		
DUM1	067	05:38								120				MAPR inboard (108 m ref. Wire out)		
DUM1	067	05:43								69				MAPR inboard (58 m ref. Wire out)		
	CD169 Leg2: science log															
			Lat. (South)		**Long. (West)**					**BRIDGET etc**						
Operation	**Jday**	**Time**	**Deg**	**Min**	**Deg**	**Min**	**CMG**	**SMG**	**Wat. deptl**	**Wire Out**	**Depth**	**Layback**	**Altitude**	**Comments**		
DUM1	067	05:46								61				MAPR inboard (50 m ref. Wire out)		
DUM1	067	05:55														
transit	067	06:04	4	46.87	12	30.74	152	1.1	2778					In transit to RC07		
transit	067	06:15												USBL pod retracted, transit to station RC07		
transit	067	06:30	4	47.13	12	29.73	087	9.2	2652							
transit	067	07:00	4	41.86	12	25.31	085	10.7	2854							
RC7	067	07:29	4	46.78	12	23.37	113	1.1	3070					Onstation RC07		
RC7	067	07:34	4	46.80	12	23.38								RC07 in water		
RC7	067	07:38	4	46.85	12	23.40			3070	50				MAPR in water		
RC7	067	07:52												Stopwinch recover RC and reposition		
RC7	067	08:00	4	47.15	12	23.40										
RC7	067	08:13	4	47.04	12	23.43			3029					MAPR out of water		
RC7	067	08:16	4	47.05	12	23.42								RC07 on deck		
transit	067	08:17												Reposition to RC07		
RC7	067	08:37	4	46.63	12	23.20			3055					Onstation RC07 - In water		
RC7	067	08:40	4	46.64	12	23.20			3055					MAPR in water		
RC7	067	09:00	4	46.76	12	23.23			3058	1410				paying out at 74 m/min		
RC7	067	09:15	4	46.82	12	23.24			3069	2390						
RC7	067	09:24	4	46.84	12	23.24			3129	3141				chipper on bottom		
RC7	067	09:27							3045	3148				chipper on bottom again - recovering		
RC7	067	09:35												chipper possibly lodged		
RC7	067	09:40												problems with winch		
RC7	067	10:00	4	46.93	12	23.33				3082				still problems with winch		
RC7	067	10:30	4	46.99	12	23.38				3082				winch brake problems		
RC7	067	10:35												winch repaired		
RC7	067	11:00	4	46.98	12	23.44				1155				recovering chipper		
RC7	067	11:16												MAPR on deck		
RC7	067	11:19												chipper on deck		
RC7	067	11:30	4	46.97	12	23.29	045	3.8	3129					Transit to RC08		
RC8	067	11:33	4	46.03	12	22.51								onRC08 station		
RC8	067	12:02	4	46.06	12	22.55	264	0.4						RC08 in water		
RC8	067	12:09	4	46.11	12	22.55	165	0.1						mapr on wire at 20m		
RC8	067	12:35	4	46.24	12	22.55	122	0.9	3125	1760				down at 67m/min		
RC8	067	12:45	4	46.22	12	22.60	128	1.1	3114	2888				70m/min		
RC8	067	12:57	4	46.24	12	22.62	133	1.3	3143	3231				Hit on bottom tension 50 to32		
RC8	067	13:02	4	46.27	12	22.61	063	0.5	3118	3231				2nd hit on bottom tension 50 to 32		
RC8	067	13:30	4	42.27	12	22.62	124	1.5	3102	1766				60m/min		
RC8	067	13:45	4	46.27	12	22.61	124	1.2	3108	838				60m/min		
RC8	067	14:00	4	46.25	12	22.60	239	0.9	3123	0				mapr off and rc8 on deck		
transit	067	14:14	4	47.06	12	22.17	142	9.1	3002					transit to ABE launch site		
transit	067	14:30	4	48.46	12	21.26	129	2.6	2884					transit to ABE150 launch site		
transit	067	14:45	4	48.49	12	21.16	126	1.1	2883					on station; stem down		
CTD3	067	15:00	4	48.50	12	21.15	131	1.3	2883					CTD test with mapr- set up		
Test3	067	15:14	4	48.53	12	21.14	223	0.5	2880					CTD in water		
Test3	067	15:25	4	48.51	12	21.17	285	1.0						CTDat 500m		
Test3	067	15:42												on deck		
ABE-01	067	16:20	4	48.50	12	21.10	289	1.1	2879					on station ABE-01. Deployment prep.		
ABE-01	067	16:25												Start ABE-01 launch		
ABE-01	067	16:32												weight in water		
ABE-01	067	16:34												ABE in water		
ABE-01	067	16:35	4	48.41	12	21.17	090	0.7	2879					Release pin out. ABE on descent		
ABE-01	067	17:00	4	48.43	12	21.20	097	1.1								
ABE-01	067	17:30	4	48.43	12	21.21	216	0.2	2880					ABE descending		
ABE-01	067	18:00	4	48.87	12	21.25	007	0.4	2934					transit to ctd station 06		
	CD169 Leg2: science log															
			Lat. (South)		**Long. (West)**					**BRIDGET etc**						

Operation	Jday	Time	Deg	Min	Deg	Min	CMG	SMG	Wat. depth	Wire Out	Depth	Layback	Altitude	Comments		
CTD06	067	18:30	4	49.43	12	21.89	166	0.4	2923					on station ctd 06		
CTD06	067	18:43	4	49.50	12	21.87	181	0.9	2973					CTD06 inn water		
CTD06	067	19:12	4	49.74	12	21.82			2962		1200			V4 (OBS) dead		
CTD06	067	19:45								2880	2890			Bottles 1&2 fired Nephs 0.040		
CTD06	067	19:49								2840	2845			Bottles 3&4 fired Nephs 0.039		
CTD06	067	19:53								2800	2804			Bottles 5&6 fired Nephs 0.042		
CTD06	067	19:58								2760	2766			Bottles 7&8 fired Nephs >0.051		
CTD06	067	20:00								2750	2759			Bottles 9&10 fired Nephs >0.06		
CTD06	067	20:03								2740	2749			Bottles 11&12 fired Nephs 0.049		
CTD06	067	20:08								2720	2730			Bottles 13&14 fired Nephs 0.049		
CTD06	067	20:14								2680	2692			Bottles 15&16 fired Nephs 0.040		
CTD06	067	20:18								2640	2653			Bottles 17&18 fired Nephs 0.039		
CTD06	067	20:24								2500	2512			Bottles 19&20 fired Nephs 0.039		
CTD06	067	20:39								1988	2000			Bottles 21&22 fired Nephs 0.038		
CTD06	067	21:20								5	10			Bottles 23&24 fired Nephs 0.078		
CTD06	067	21:25	4	49.91	12	21.57			2977					CTD06 on deck		
CTD07	067	23:15	4	46.98	12	23.64			3079					CTD 06 in water		
CTD07	068	00:16	4	46.95	12	23.55			3049					CTD on bottom		
CTD07	068	00:17								2980	2995			fire bottles 1 & 2, neph 46mv		
CTD07	068	00:20								2960	2975			fire bottles 3+4, neph 50mv		
CTD07	068	00:25								2910	2924			fire bottles 5+6, neph 55mv		
CTD07	068	00:28								2862	2875			fire bottles 7+8, neph 56mV		
CTD07	068	00:34								2810	2825			fire bottles 9+11, neph 60mV		
CTD07	068	00:37								2760	2775			fire bottles 13+15, neph 40mV		
CTD07	068	00:50								2487	2500			fire bottles 17+18, neph 40mV		
CTD07	068	01:02								1987	2000			fire bottles 19, 20, 21, 23, 24 neph 40mV		
CTD7	068	01:42	4	46.98	12	23.61			3049					CTD on deck		
transit	068	02:30	4	48.13	12	23.40	156	2.0	2930					transit to RC9		
RC9	068	03:00	4	48.04	12	22.95	258	0.3	2962	60				RC9 and mapr in water		
RC9	068	03:35	4	48.89	12	22.92	126	0.6	2959	2291				70m/min		
RC9	068	03:44	4	48.89	12	22.91	169	0.4	2959	3034				Hit bottom, then up 100m at 10m/min		
RC9	068	03:50	4	48.89	12	22.90	144	0.4	2960	3034				2nd Hit, recovering chipper		
RC9	068	04:40												Chipper inboard		
Transit	068	04:45												Start transit to RC10		
Transit	068	05:00	4	48.80	12	22.70	030	4.0	2984							
Transit	068	05:30	4	47.60	12	27.00	035	3.5	3021							
RC10	068	05:35												On station RC10. Start chipper deployment		
RC10	068	05:40												Chipper in water		
RC10	068	05:43	4	47.67	12	22.00			2999					mAPR 13 on wire. Deployment at 70m/min		
RC10	068	06:24												Tension off wire (0.4 to 0.1, then back to 0.4)		
RC10	068	06:28												Tension off wire (0.425 to 0.125, then back to 0.425)		
RC10	068	06:33							3011	3086				1st hit bottom at 70 m/min(wire reading at 'pull-out')		
RC10	068	06:37												2nd hit bottom at 40 m/min. Recovering chipper		
RC10	068	07:00	4	47.70	12	22.04			3005	1851						
RC10	068	07:32												chipper on deck - in transit RC11		
RC11	068	08:00	4	48.60	12	22.10	177	3.1	2939							
RC11	068	08:30	4	50.45	12	22.17	166	4.2	3018							
RC11	068	08:43	4	50.93	12	22.25								on station RC11		
RC11	068	08:48							3025	0				chipper in water		
RC11	068	08:51							3025	20				MAPR in water		
RC11	068	08:55								504				spike on load monitor		
	CD169 Leg2: science log															
			Lat. (South)		**Long. (West)**					**BRIDGET etc**						
Operation	**Jday**	**Time**	**Deg**	**Min**	**Deg**	**Min**	**CMG**	**SMG**	**Wat. depth**	**Wire Out**	**Depth**	**Layback**	**Altitude**	**Comments**		
RC11	068	09:40								3155				chipper on bottom		
RC11	068	09:43								3155				wire under tension		
RC11	068	09:44								3155				on bottom again - recovering		
RC11	068	10:00	4	51.02	12	22.16			3031							
RC11	068	10:30	4	51.10	12	22.16			3039	535						
RC11	068	10:39								19				MAPR on deck		
RC11	068	10:45								1				chipper on deck		
transit	068	11:01	4	50.84	12	21.95	352	4.4	3054							

transit	068	11:30	4	48.70	12	21.88	003	2.9	2907							
CTD08	068	11:36	4	48.60	12	21.82			2910					On station CTD08		
CTD08	068	11:50							2898	0				CTD in water		
CTD08	068	12:15	4	48.64	12	21.77	256	0.1	4074	1025				60m/min		
CTD08	068	12:47	4	48.65	12	21.81			2893					CTD on bottom		
CTD08	068	12:52								2852				fire 1+2		
CTD08	068	12:57							2811	2825				fire 3 + 4 No neph so use trans 90.01		
CTD08	068	13:00							2786	2800				fire 5 + 6 89.988		
CTD08	068	13:03							2761	2775				fire 7 + 8 trans 89.988		
CTD08	068	13:06							2751	2765				fire 9+10, trans 89.988		
CTD08	068	13:09							2736	2750				fire 11+ 12, trans 89.963		
CTD08	068	13:13							2711	2725				fire 13 + 14, trans 89.939		
CTD08	068	13:16							2626	2700				fire 15 + 16, trans 90.012		
CTD08	068	13:32							2000	2010				fire 17 + 22		
CTD08	068	14:11	4	48.52	12	21.85			2923					CTD on deck		
CTD08	068															
CTD08	068	14:45												finish ctd sampling ,hydrowire fix		
	068															
DEAD	068	15:00												hydrowire operations		
CTD09	068	19:25												resume science		
CTD09	068															
CTD09	068	19:31	4	47.63	12	22.08			2998					CTD in water		
CTD09	068	19:52												stop winch to test things		
CTD09	068	19:53												winch going again		
CTD09	068	20:32	4	47.68	12	22.03			3129	2950	2965			CTD on bottom		
CTD09	068	20:40								2970	2985			fire bottles 1 + 2 trans 89.817		
CTD09	068	20:45								2936	2951			fire 3 and 4, trans 89.792		
CTD09	068	20:48								2911	2929			fire 5 and 6,trans 89.68		
CTD09	068	20:51								2911	2929			fire 7 and 8, trans 89.792		
CTD09	068	20:53								2861	2875			fire 9 and 10, trans 89.917		
CTD09	068	20:57								2811	2825			fire 11 and 12, trans 89.817		
CTD09	068	21:13								2000	2011			fire bottles 13-24, trans 89.841		
CTD09	068	21:55	4	47.67	12	21.90				-4				CTD on deck		
transit	068	22:31	4	47.61	12	23.68	292	4.9						transit to ABE recovery		
recovery	068	22:45	4	47.44	12	24.58	192	1.5						slowing down at ABE recovery location		
recovery	068	23:00	4	47.33	12	24.93	141	1.1						awaiting ABE to surface		
recovery	068	23:30	4	47.36	12	24.85	136	1.0								
recovery	068	23:40												ABE on surface		
recovery	068	23:46												manouvering towards ABE		
recovery	069	00:32												ABE on deck, end of dive150		
RC12	069	01:42	4	46.02	12	23.71				20				Chipper in water, Mapr 13 attached		
RC12	069	01:52	4	46.02	12	23.71								hydraulic pipe rupture- standing by		
RC12	069	03:40	4	46.00	12	23.71	136	1.1	3066					starting back down 30m/min then 60m/min		
	CD169 Leg2: science log															
			Lat. (South)		**Long. (West)**					**BRIDGET etc**						
Operation	**Jday**	**Time**	**Deg**	**Min**	**Deg**	**Min**	**CMG**	**SMG**	**Wat. deptl**	**Wire Out**	**Depth**	**Layback**	**Altitude**	**Comments**		
RC12	069	04:35	4	45.97	12	23.84	135	1.3	3062	3237				1st hit at 60m/min		
RC12	069	04:39												2nd hit at 40m/min. Recovering chipper		
RC12	069	05:40												Chipper inboard. Start transit		
	069	06:00	4	46.83	12	24.92	200	5.4	2917					confirmed on BRIDGEthat USBL pob retracted		
RC13	069	06:18												On station RC13 - hove-to		
RC13	069	06:32	4	47.44	12	24.66			2837					RC13 chipper deployed at 60m/m		
RC13	069	07:15							2831	2947				1st hit at 60m/min		
RC13	069	07:19	4	47.36	12	24.65								2nd hit at 40m/min. Recovering chipper		
RC13	069	08:11												MAPR on deck		
transit	069	08:15												Chipper on deck -transit to RC14		
RC14	069	09:00	4	49.59	12	24.05			2916					on station RC14 - chipper in water		
RC14	069	09:07							2916					MAPR in water		
RC14	069	10:02							2884	3030				chipper on bottom		
RC14	069	10:03							2886	3025				tension back on wire		
RC14	069	10:06							1898	3027				chipper on bottom again		
RC14	069	11:00												MAPR on deck		
transit	069	11:05												Chipper on deck - transit to RC15		
RC15	069	11:28	4	50.15	12	23.71			3048					on station RC15		
RC15	069	11:31								0				Chipper in water		

RC15	069	11:34							3001	20				MAPR in water		
RC15	069	12:00	4	50.20	12	23.25	133	1.2	3051	1660				down at 60m/min		
RC15	069	12:30	4	50.13	12	23.12	134	0.9	3051					hit bottom and then upto 3100wire out		
RC15	069	12:38	4	50.13	12	23.12	135	0.8	3046					2nd hit		
RC15	069	13:40	4	50.18	12	23.23	129	1.0	3029					rc15 on ndeck		
transit	069	13:50	4	49.34	12	23.12	092	9.4	2991					transit to abe launch site/stem check		
	069	14:00	4	48.53	12	48.53								hove to near abe launch site. Stem down		
	069	14:30	4	48.52	12	48.52	136	1.6	2992					will dunk ctd to 500m for cleaning		
	069	15:15	4	48.69	12	48.69	128	1.1	2983					settinng up for abe deck test		
	069	16:00	4	48.78	12	48.78	124	1.6	2985					conducting abe deck test		
	069	16:30	4	48.57	12	48.57	147	1.3	2979					still doing abe deck tests		
test 4	069	17:05	4	48.76	12	23.00								CTD in water		
test 4	069	17:20	4	48.68	12	23.01	121	1.4	2977					CTD at 500 m to fire all bottles		
test 4	069	17:36	4	48.60	12	23.03	119	1.0	2988					CTD on deck		
ABE 02	069	18:04	4	48.45	12	22.95								ABE passed deck test		
ABE 02	069	18:53	4	48.57	12	22.95	125	1.6	2986					ABE in water		
CTD10	069	19:50	4	48.02	12	22.48			3003					CTD in water		
CTD10	069	20:54	4	47.95	12	22.51				2970	2985			CTD on bottom, Bottles 1 & 2		
CTD10	069	20:58								2945	2960			Bottles 3 & 4		
CTD10	069	21:02								2925	2940			Bottles 5 & 6		
CTD10	069	21:06								2883	2900			Bottles 7 & 8		
CTD10	069	21:10								2835	2850			Bottles 9 & 10		
CTD10	069	21:14								2810	2825			Bottles 11 & 12		
CTD10	069	21:18	4	47.96	12	22.50				2785	2800			Bottles 13 & 14		
CTD10	069	21:21								2760	2775			Bottles 15 & 16		
CTD10	069	21:26								2745	2760			Bottles 17 & 18		
CTD10	069	21:31	4	47.96	12	22.49				2725	2740			Bottles 19 & 20		
CTD10	069	21:35								2685	2700			Bottles 21 & 22		
CTD10	069	21:39								2585	2600			Bottles 23 & 24		
CTD10	069	22:28	4	47.98	12	22.45			3006					CTD on deck		
CTD	069	22:31												Stem Up		
	CD169 Leg2: science log															
			Lat. (South)		**Long. (West)**					**BRIDGET etc**						
Operation	**Jday**	**Time**	**Deg**	**Min**	**Deg**	**Min**	**CMG**	**SMG**	**Wat. depth**	**Wire Out**	**Depth**	**Layback**	**Altitude**	**Comments**		
Transit	070	00:50	4	37.06	12	25.94	148	8.0	3386					transiting to Dredge 01 position		
DR01	070	01:30	4	38.27	12	25.46	116	0.4						DR-01 in water, mapr and pinger on at 150m		
DR01	070	01:45	4	38.29	12	25.46	112	0.4		600				DR-01down at 50m/min		
DR01	070	02:08	4	38.29	12	25.30	262	0.4	3596	1700				50m/min		
DR01	070	02:45	4	38.30	12	25.35	248	0.0		3255				50m/min switched controls to lab		
DR01	070	03:00	4	38.33	12	25.35	319	0.2		3646				DR01 on bottom- forward at 0.5 knots		
DR01	070	03:15	4	38.40	12	25.26	065	0.3		3744				50m pinger altitude		
DR01	070	03:30	4	38.51	12	25.18	118	0.8		3729				Nibbles		
DR01	070	03:55	4	38.73	12	24.18	196	0.8		3857				Bites at 50m off		
DR01	070	04:13	4	38.96	12	24.77	119	0.7		4013				Paying out at 15m/m		
DR01	070	04:47	4	39.13	12	24.73	120	0.7						small bites		
DR01	070	05:35	4	39.08	12	24.77	120	0.7		3481				off bottom- very slow coming up- bottom followed		
DR01	070	05:44	4	39.05	12	24.70	090	0.1	3477	3400				Hauling at 30 m/min		
DR01	070	06:00	4	39.11	12	24.80	160	1.0	3471					Hauling at 35 m/min		
DR01	070	07:35												Dredge on deck. Set course for WP 41 (No. TBC)		
Swath	070	08:00	4	39.84	12	23.19	076	8.7	3605							
Swath	070	08:17	4	39.46	12	20.61	110	8.5	2669					A/C onto survey line		
Swath	070	08:54	4	44.20	12	19.12	174	9.1	2229					EM12 logging bad data. Logging off.Abandon survey. A/C to ABE 2 site		
Swath	070	09:35	4	48.10	12	22.51	178	1.1	2999					EOT to ABE2. USBL deployment		
Swath	070	09:50												USBL deployed		
Swath	070	10:00	4	48.17	12	22.52	311	0.3	2002							
CTD 11	070	10:48	4	48.52	12	22.33	311	0.3	2983					CTD in water		
CTD 11	070	11:46	4	48.57	12	22.33	256	0.1	2979					CTD on bottom		
CTD 11	070	11:49												fire 1 + 2, V3=.026, trans=89.963		
CTD 11	070	11:54												Bottles 3 & 4, v3 .027, trans 89.963		
CTD 11	070	11:58												Bottles 5 & 6, v3 .028, trans 89.915		
CTD 11	070	12:03												Bottles 7 & 8, v3 .031, trans 89.719		

CTD 11	070	12:07												Bottles 9 & 10, v3 .031, trans 89.744		
CTD 11	070	12:10												Bottles 11 & 12, v3 .o31, trans 89.817		
CTD 11	070	12:13												Bottles 13 & 14, v3 0.024, trans 89.988		
CTD 11	070	12:16												Bottles 15 & 16, v3 .026, trans 89.988		
CTD 11	070	12:20	4	48.53	12	22.38			2984					Bottles 17 & 18, v3 .024, trans 89.988		
CTD 11	070	12:28												Bottles 19 & 20, v3 .024, trans 90.012		
CTD 11	070	12:39												Bottles 21 & 22, v3 0.024 trans 90.012		
CTD 11	070													Bottles 23 & 24		
CTD 11	070	13:21	4	48.55	12	22.45								CTD on deck		
	070	17:00	4	47.50	12	23.20								ABE on deck. USBL transponder up.		
Swath	070	17:25					105	8.1	2946					In transit to swath survey. E Seg 2.		
Swath	070	18:00	4	48.72	12	19.17	103	9.1	2079							
Swath	070	18:14	4	48.52	12	17.89	345	9.7	1565					A/C at WP41		
Swath	070	18:32	4	45.60	12	18.70	348	10.1	2065							
Swath	070	19:11	4	39.33	12	20.20		8.9	2423					A/C at WP42 for Dredge station 2		
Swath	070	19:16					204	8.9						O/C		
Swath	070	19:45	4	43.50	12	22.90	204	9.1	3307							
DR02	070	19:50	4	44.19	12	23.20	204	0.4	3228					Hove to on station		
DR02	070	20:10	4	44.33	12	23.41	156	0.4	3228					DR02 in water		
DR02	070	20:20	4	44.37	12	23.46	213	1.6	3218					Pinger and mapr on, then down at 30m/min		
DR02	070	21:50	4	44.29	12	22.97	243	1.6		3354				dredge on bottom - winch stop - speed to 1knts		
DR02	070	21:54												veer 10m/m		
DR02	070	22:05												winch stop		
DR02	070	22:10							3247	3449						
DR02	070	22:13								3449				veer 5m/m		
	CD169 Leg2: science log															
			Lat. (South)		**Long. (West)**					**BRIDGET etc**						
Operation	**Jday**	**Time**	**Deg**	**Min**	**Deg**	**Min**	**CMG**	**SMG**	**Wat. depth**	**Wire Out**	**Depth**	**Layback**	**Altitude**	**Comments**		
DR02	070	22:20							3249	3500				winch stop		
DR02	070	22:21							3249	3475				haul 10m/m		
DR02	070	22:24								3475				winch stop		
DR02	070	22:25								3446				haul 10m/m		
DR02	070	22:28							3241	3480				stop winch - veer 10m/m		
DR02	070	22:31												increase veer 15m/m		
DR02	070	22:36							3232	3555				stop veer - haul 10m/m		
DR02	070	22:45												increase haul 15m/m		
DR02	070	22:50							3227	3395				dredge off bottom increase haul 50m/m		
DR02	071	00:20	4	45.05	12	21.87	088	0.9	3238	336				hauling in at 38m/min		
DR02	071	00:35	4	45.25	12	21.86			3220	144						
DR02	071	00:43	4	45.33	12	21.90								DR02 on deck		
Transit	071	00:50												In transit to CTD 12		
CTD 12	071	01:25	4	47.83	12	27.50	262	0.1	3009					On station CTD broken		
CTD 12	071	02:00												CTD broken still		
CTD 12	071	03:30												CTD fixed b but leave for 30 mins to confirm		
CTD 12	071	04:14												sensor plugged in		
CTD 12	071	04:19	4	47.86	12	22.65			3022					CTD in water		
CTD 12	071	04:31												CTD modular errors, broken, bringing back		
CTD 12	071	04:37												CTD on deck and sensor off		
CTD 12	071	07:01	4	47.76	12	22.56			3005					sensor on		
CTD 12	071	07:04												CTD at 3m		
CTD 12	071	07:08												CTD ? on CTD stopped		
CTD 12	071	07:09												haul 30m/m		
CTD 12	071	07:13												on deck - sensor off		
hove to	071	10:10												ABE deck testing		
ABE3	071	10:30												ABE passed deck test		
ABE3	071	11:00												ABE ready - winch broken		
ABE3	071	11:45	4	48.61	12	22.44								Stand down - ABE probs		
ABE3	071	12:52	4	48.69	12	22.51			2988					ABE in water		
ABE3	071	14:00	4	48.96	12	22.28								ABE at 1430m depth		
ABE3	071	15:10	4	48.78	12	22.31								ABE 6min from starting line 1		
ABE3	071	15:30	4	48.74	12	22.41								ABE is off the mooring		
ABE3	071	16:10	4	48.86	12	22.56								On way to BGT-02		
ABE3	071	17:00	4	46.25	12	23.44	346	4.0	2002							
BGT2	071	17:12	4	45.61	12	23.62		0.5						On station BGT-02, manouvering ship		
BGT2	071	17:24	4	45.80	12	23.70	110	0.8	3225					Bridget in water		

BGT2	071	17:28												Stop for test at 50 m		
BGT2	071	17:28												Paying out at 30 m/min		
BGT2	071	17:29	4	45.90	12	23.70	175	1.0		92				10 kHz switched on		
BGT2	071	17:45	4	46.03	12	23.64	159	1.0	3063	537	554			spikes on nephels, BGT HDG 165°		
BGT2	071	18:00	4	46.10	12	23.50	163	1.1	3140	981	903	**573**		spikes on nephels, BGT HDG 141°		
BGT2	071	18:11												Bridget rebooted		
BGT2	071	18:15	4	46.23	12	23.50	114	0.8	3123	1460	1468			CTD crashed, BGT HDG 173°		
BGT2	071	18:30	4	46.30	12	23.40	135	0.6	3107	1904	1890	**420**				
BGT2	071	18:45	4	46.44	12	23.30	189	0.7	3084	2441	2424	**478**		Bridget reboot		
BGT2	071	19:00	4	46.52	12	23.21	187	0.9	3082	2813	2776	**645**		Bridget reboot		
BGT2	071	19:03								2900				Bridget reboot		
BGT2	071	19:15	4	46.70	12	23.08	140	0.5	3024	2901				Bridget DA down		
BGT2	071	19:18	4	46.75	12	23.00	143	0.9	3093	2901				hauling at 30m/min. At WP 43. Start survey line.		
BGT2	071	19:23												Bridget reboot		
BGT2	071	19:26												Bridget reboot		
BGT2	071	19:27	4	46.91	12	23.00	156	1.4	3096	2657	2547	**947**		stop winch. Pay out at 30 m/min		
	CD169 Leg2: science log															
			Lat. (South)		**Long. (West)**					**BRIDGET etc**						
Operation	**Jday**	**Time**	**Deg**	**Min**	**Deg**	**Min**	**CMG**	**SMG**	**Wat. depth**	**Wire Out**	**Depth**	**Layback**	**Altitude**	**Comments**		
BGT2	071	19:30												Bridget reboot		
BGT2	071	19:32												Stop winch. Reboot.		
BGT2	071	19:34							3093	2610	2630			Power off/reboot		
BGT2	071	19:44												Bridget back on. Veering at 30 m/min		
BGT2	071	19:57							3045	3074	2825	**1402**		Stop winch. Bridget crash.		
BGT2	071	20:01	4	47.46	12	22.77	139	0.9	3067	3074				BRIDGET re-boot		
BGT2	071	20:08							3051	3074	2804	**1450**		veer 30m/m		
BGT2	071	20:10							3038	3182	2857	**1591**		BRIDGET stop - re-boot		
BGT2	071	20:12												bottle 1 fired		
BGT2	071	20:13									2884			bottle 2 fired		
BGT2	071	20:14								3244	2890	**1664**		bridged stop - winchj stop		
BGT2	071	20:15												haul 30m/m (should be veering)		
BGT2	071	20:17												veer 30m/m bridget dead		
BGT2	071	20:20							3019	3237	2870	**1687**		bottle 3 failed - bridget dead - winch stop		
BGT2	071	20:21							3012	3237	2872	**1683**		bottle 3 fired - veer 30m/m		
BGT2	071	20:22							3001	3259				bridget dead - winch stop		
BGT2	071	20:24												back again - o, no, dead again		
BGT2	071	20:29							3018	3259	2885	**1706**	**120**	veer 30m/m		
BGT2	071	20:31	4	48.00	12	22.75	072	1.1	3013	3330						
BGT2	071	20:31							3011	3346	2967	**1737**		winch stop		
BGT2	071	20:34								3347			**76**	bottle 4 fired		
BGT2	071	20:34												bridget dead		
BGT2	071	20:37							3017	3347	2967	**1739**	**74**	haul 30m/m		
BGT2	071	20:37												bridget dead - winch stop		
BGT2	071	20:39							3015	3319	2940	**1730**		haul 30m/m		
BGT2	071	20:40												bridget dead - haul to 2500m		
BGT2	071	20:59	4	48.46	12	22.45	193	2.1	2991	2764						
BGT2	071	21:00							2980	2400	2023	**1481**		winch stop - bottle 5 failed		
BGT2	071	21:12							2983	2400				bottle 6 fired		
BGT2	071	21:15							2983	2400				haul 30 to recover		
BGT2	071	21:34	4	49.11	12	22.24	142	1.3	2956	1853						
BGT2	071	22:00	4	49.60	12	22.09	220	1.3	2987	1131						
BGT2	071	22:30	4	50.13	12	21.86	145	1.1	3006	219						
BGT2	071	22:36												Bridget on surface - all stop		
BGT2	071	22:49	4	50.34	12	21.89			3011	-9				Bridget on deck		
Transit	071	23:10	4	50.62	12	21.53	056	2.7	3007					Transit to RC16		
Transit	071	23:30	4	49.28	12	21.60	350	4.5	2886							
RC16	072	00:34	4	45.20	12	21.40	001	4.0	3352					heading toward RC16		
RC16	072	01:00	4	47.50	12	21.40	165	5.4	2962					heading toward RC16		
RC16	072	01:30	4	48.51	12	21.29	322	0.4	2911	50	2906			mapr on at 20m/min/ down at 25m/min		
RC16	072	01:50	4	48.51	12	21.30	000	0.1	2915	1000				down at 50m/min		
RC16	072	00:23	4	48.28	12	21.15	104	1.1	2906	2998				HIT on bottom		
RC16	072	02:29	4	48.28	12	21.30	102	0.9	2898	2998				2nd Hit on bottom		
RC16	072	02:45	4	48.28	12	21.30	164	0.2	2901	2300				hauling in at 60m/min		
RC16	072	03:00	4	48.57	12	21.13	003	0.2	2892	1317				hauling in at 60m/min		
RC16	072	03:40	4	48.20	12	22.05	357	0.2	2970					RC16 on deck		
Transit	072	03:45												Transit to ABE 2 recovery site		
ABE3	072	04:05	4	48.18	12	22.70	050	0.5	3014					Hove to on recovery site		

ABE3	072	05:45												ABE on surface		
ABE3	072	06:15	4	48.64	12	23.03	153	1.7	2994					ABE on deck		
Swath	072	06:45												USBL pod retracted. EM12 logging on		
Swath	072	07:00	4	49.79	12	21.70	124	7.3	2990					Transit to WP 45		
Swath	072	07:30	4	51.69	12	18.40	119	7.7	2272							
Swath	072	07:40	4	52.46	12	17.10		7.9	2533					at WP 45 A/C		
	CD169 Leg2: science log															
			Lat. (South)		**Long. (West)**					**BRIDGET etc**						
Operation	**Jday**	**Time**	**Deg**	**Min**	**Deg**	**Min**	**CMG**	**SMG**	**Wat. dept**	**Wire Out**	**Depth**	**Layback**	**Altitude**	**Comments**		
Swath	072	07:47	4	53.20	12	16.70	163	8.5	2578					on course 163 to WP 46		
CTD13	072	08:31	4	59.04	12	14.82	160	0.4	2679					Hove-to for CTD test dip		
CTD13	072	08:45												CTD test dip cancelled		
swath	072	09:03	4	59.09	12	14.81	165	0.9	2681					resume swath survey - swath angle increased to 120°		
Swath	072	09:31	5	1.99	12	13.91	160	8.8	2750							
Swath	072	10:00	5	6.23	12	12.66	161	9.9	3672							
Swath	072	10:12	5	7.86	12	12.09			3751					changing course		
CTD14	072	10:14	5	7.94	12	11.86	120	7.2						Heaving to for CTD wire test		
CTD14	072	10:22	5	8.19	12	11.68		0.3	3911					On station for CTD dip		
CTD14	072	10:30	5	8.12	12	11.41			3758					In water		
CTD14	072	10:55	5	8.17	12	11.71								At 1000m		
CTD14	072	10:57	5											Fire allbottles 1-24		
CTD14	072	11:20	5	8.18	12	11.66								CTD on deck		
Swath	072	11:26	5	8.18	12	11.66								resuming swath		
Swath	072	11:32	5	8.05	12	11.32	060	5.4	3758							
Swath	072	11:56	5	6.95	12	8.22	056	9.7	4034					starting turn		
Swath	072	12:30	5	2.51	12	9.60	342	9.6	2825					swath survery		
Swath	072	13:00	4	56.43	12	11.33	341	9.5	2304					swath survery		
Swath	072	13:30	4	52.22	12	12.62	346	9.1	2518					swath survery		
Swath	072	14:06	4	47.65	12	13.44	338	9.5	2132					swath survery		
Swath	072	14:30	4	44.05	12	15.91	343	10.0	1895					swath survery		
Swath	072	15:04	4	38.65	12	16.87	343	9.9	2087					swath survery		
Swath	072	15:30	4	34.36	12	19.09	262	10.0	2156					swath survery		
Swath	072	16:00	4	32.60	12	23.55	263	9.9	3233					swath survery		
Swath	072	16:30	4	38.85	12	28.47	246	9.1	3244					swath survery		
Swath	072	16:54	4	39.88	12	32.15	250	8.9	2986					starting turn		
Swath	072	17:00	4	40.37	12	32.58	198	8.3	2939					a/c w.p - o/c17:01		
Swath	072	17:30	4	44.70	12	33.95	197	8.5	2368							
Swath	072	17:37	4	45.87	12	34.08	171	7.6	2524					o/c		
Swath	072	18:00	4	49.68	12	33.29	173	7.8	2608							
Swath	072	18:06												a/c for ctd 014		
Transit	072	18:30	4	49.31	12	30.09	081	8.7	2665							
Transit	072	19:00	4	48.77	12	25.88	087	7.7	2779							
Transit	072	19:15	4	48.56	12	23.75	078	8.8	2997					heading for rc017		
Transit	072	19:30	4	48.53	12	22.60	082	2.0	2998					arriving on station rc017		
RC17	072	20:00	4	48.65	12	22.65	323	1.3	2988					RC17 in water		
RC17	072	20:03												MAPR on 20m		
RC17	072	20:59								3054	2986	**831**		on bottom		
RC17	072	21:00								3051				tension back		
RC17	072	21:00								3045	2986	**787**		steady cable		
RC17	072	21:05								3045				recovering		
RC17	072	22:00												MAPR on deck		
RC17	072	22:05												chipper on deck - transit to RC18		
RC18	072	22:25	4	47.80	12	22.47								At RC18		
Transit	072													RC18 cancelled - steaming to CTD 15		
CTD15	072	22:55	4	48.61	12	22.40			2988					Traget - 4 48.59 12 22.41		
CTD15	072	23:19												Pump on		
CTD15	072	23:21	4	48.56	12	22.39			2984	-2				CTD in water		
CTD15	072	23:35	4	48.57	12	22.38								ship's position check		
CTD15	073	00:00	4	48.55	12	22.39				1742						
CTD15	073	00:15	4	48.59	12	22.43			2985	2515						
CTD15	073	00:22	4	48.58	12	22.43			2986	2925				winch stop		
	CD169 Leg2: science log															
			Lat. (South)		**Long. (West)**					**BRIDGET etc**						
Operation	**Jday**	**Time**	**Deg**	**Min**	**Deg**	**Min**	**CMG**	**SMG**	**Wat. dept**	**Wire Out**	**Depth**	**Layback**	**Altitude**	**Comments**		
CTD15	073	00:25	4	48.58	12	22.43			2984	2925	2975			B# 1 & 2		

CTD15	073	00:31	4	48.58	12	22.41			2985	2880	2902			B# 3 & 4		
CTD15	073	00:35	4	48.57	12	22.41			2984	2830	2850			B# 5 & 6		
CTD15	073	00:45	4	48.56	12	22.40			2984	2780	2801			B# 7 & 8		
CTD15	073	00:52	4	48.58	12	22.42										
CTD15	073	00:58	4	48.59	12	22.42				2925	2947			B# 9 & 10		
CTD15	073	01:08	4	48.60	12	22.41				2830	2852			B#11		
CTD15	073	01:14	4	48.59	12	22.42				2800	2820			B#12		
CTD15	073	01:17	4	48.59	12	22.42				2782	2803			B#13		
CTD15	073	01:18	4		12									Calibration		
CTD15	073	01:19	4	48.59	12	22.41				2782	2802			B#14		
CTD15	073	01:34	4	48.59	12	22.42					2800					
CTD15	073	01:37	4	48.60	12					2925	2946			winch stop		
CTD15	073	01:42	4	48.60	12									WS		
CTD15	073	01:48	4	48.59	12									B# 15 & 16		
CTD15	073	01:52	4	48.59	12									B# 17 & 18		
CTD15	073	01:55	4	48.59	12									B# 19 & 20		
CTD15	073	02:01	4	48.59	12									B#21		
CTD15	073	02:14	4	48.59	12									B#22		
CTD15	073	02:17	4	48.59	12									B#23		
CTD15	073	02:27	4	48.59	12									B#24		
CTD15	073	02:28	4	48.59	12									Hauling		
CTD15	073	03:19	4	48.59	12	22.55								CTD in => 7 not closed, 8 => rope		
CTD15	073	03:20												Mn sensor off		
RC18	073	03:25												EMI2 line 081 started for RC18 survey		
RC18	073	05:28	4	47.73	12	22.45			3020					RC18 in water with MAPR 13		
RC18	073	06:24	4	47.78	12	22.53			3020	3109				Chipper hit bottom		
RC18	073	07:25	4											Chipper on deck. Transit to RC19		
RC19	073	07:44	4	48.07	12	22.67			3019					On station RC19		
RC19	073	07:48												in water		
RC19	073	08:48	4	48.04	12	22.60			3010	3091				chipper on bottom - recovery		
RC19	073	09:50												chipper on deck - transit to RC20		
Transit	073	10:00	4	47.69	12	22.59	328	6.5	3011					transit to RC20		
RC20	073	10:10	4	47.25	12	22.23	133		3100					RC20 in water		
RC20	073	10:12	4	47.25	12	22.23	246	0.4	3100	21				MAPR on wire		
RC20	073	11:11	4	47.25	12	22.85			3094	3174				chipper on bottom - wire on tension		
RC20	073	12:08												MAPR on deck		
RC20	073	12:11												Chipper on deck - transit to ABE153		
ABE153	073	13:10	4	48.57	12	22.76	214	0.5	2980					on station for ABE 153		
CTD16	073	13:23												stem down		
CTD16	073	14:23												Mn Sensor power on		
CTD16	073	14:25	4	47.82	12	22.61			3012					CTD in water		
CTD16	073	15:22	4	47.80	12	22.61			3023	2950	2962			winch stop - at bottom		
CTD16	073	15:32	4	47.80	12	22.61			3037	2700	2712			winch stop		
CTD16	073	15:45	4	47.79	12	22.59					2980			bottle 1 & 2 fired		
CTD16	073	15:47									2991			bottle 3 fired		
CTD16	073	15:47									2989			bottle 4 fired		
CTD16	073	15:48									2988			bottle 5 fired		
CTD16	073	15:51	4	47.81	12	22.59				2960	2973			winch stop		
CTD16	073	15:53									2997			bottle 6 fired		
	CD169 Leg2: science log															
			Lat. (South)		**Long. (West)**					**BRIDGET etc**						
Operation	**Jday**	**Time**	**Deg**	**Min**	**Deg**	**Min**	**CMG**	**SMG**	**Wat. depth**	**Wire Out**	**Depth**	**Layback**	**Altitude**	**Comments**		
CTD16	073	15:54								2990	3003			bottle 7 fired		
CTD16	073	15:54									3008			bottle 8 fired		
CTD16	073	15:54	4	47.81	12	22.59				3000	3014			bottle 9 fired		
CTD16	073	15:56									3009			bottle 10 fired		
CTD16	073	15:57									3006			bottle 11 fired		
CTD16	073	15:57									3002			bottle 12 fired		
CTD16	073	15:57									2996			bottle 13 fired		
CTD16	073										2992			bottle 14 fired		
CTD16	073	15:58									2990			bottle 15 fired		
CTD16	073	15:58									2985			bottle 16 fired		
CTD16	073	15:58				0.06					2981			bottle 17 fired		

CTD16	073	15:59									2971			bottle 18 fired		
CTD16	073	16:01	4	47.79	12	22.60			3017	2940	2954			bottle 19 fired		
CTD16	073	16:05							3011	2910	2924			bottle 20 fired		
CTD16	073	16:10								2861	2873			bottle 21 fired		
CTD16	073	16:14								2786	2850			bottle 22 fired		
CTD16	073	16:20								2786	2800			bottle 23 fired		
CTD16	073	16:27								2686	2700			bottle 24 fired		
CTD16	073	17:19												CTD on deck		
ABE153	073	19:59	4	48.08	12	22.76								ABE in water		
transit	073	20:45												transit to RC21		
RC21	073	21:30	4	50.15	12	22.01	004	0.5	3011					on station RC121		
RC21	073	21:35							3011	0				chipper in water		
RC21	073	21:37							3011	20				MAPR in water		
RC21	073	22:32	4	50.16	12	21.97			3012	3081				Chipper on bottom		
RC21	073	23:30												MAPR on deck		
Transit	073	23:32												Chipper on deck - transit to dredge 03		
Transit	074	00:00	4	48.76	12	22.38	333	4.6	2984							
DR03	074	00:57	4	46.35	12	23.19	289	0.3	3118	20				mapr and pinger on dredge in water		
DR03	074	01:10	4	46.35	12	23.15				500						
DR03	074	01:30	4	46.36	12	23.16	130	0.2	3118	1664				veering at 58m per min		
DR03	074	01:55	4	46.35	12	23.12	103	0.5	2925	3030				veer at 56m per min		
DR03	074	02:02	4	46.36	12	23.11	140	0.7	2741	3242				down at 10m-ship ahead 1 knot- dredge on bottom#		
DR03	074	02:16	4	46.50	12	23.20	111	1.5	2580	3325				dredging no real bites yet		
DR03	074	02:18								3319-3300				hauling in at 10 m per min		
DR03	074	02:21								3300-3395				paying out at 10m per min		
DR03	074	02:35	4	46.71	12	23.70	180	0.6		3395-3342				paying out at 10m per min		
DR03	074	02:45								3367-3381				getting small bites		
DR03	074	02:51	4	46.93	12	22.41	149	1.0						paying out at 10m per min		
DR03	074	02:57	4	46.93	12	22.41	149	1.0		3381-3405				paying out at 10m per min		
DR03	074	03:00								3405-3457				paying out at 15m/min		
DR03	074	03:05	4	47.02	12	22.23	140	0.9	3554	3457				bites on a lump, hauling up a little		
DR03	074	03:13	4	47.12	12	22.23	091	1.6	3511	3437-3390				paying in at 15m per min, little bite		
DR03	074	03:16	4	47.14	12	22.20	101	1.2	3426	3795				off bottom, up at 25m/min and then 60m/min		
DR03	074	03:45	4	47.45	12	21.87	155	1.0	4111	2232				hauling in at 53m/min		
DR03	074	04:50												Dredge on deck		
DR03	074	05:00	4	48.02	12	21.60	348	1.8						Start transit to ABE recovery site		
ABE153	074	06:00	4	47.51	12	22.77	072	0.3						Directly over ABE => cannot hear us?		
ABE153	074	07:10	4	47.50	12	22.70	026	1.1						No response from ABE		
	CD169 Leg2: science log															
			Lat. (South)		**Long. (West)**					**BRIDGET etc**						
Operation	**Jday**	**Time**	**Deg**	**Min**	**Deg**	**Min**	**CMG**	**SMG**	**Wat. dept**	**Wire Out**	**Depth**	**Layback**	**Altitude**	**Comments**		
(Transit)	074	07:30	4	47.90	12	22.60	073	1.2						Move to SAP 01 station		
SAP 01	074	08:00	4	48.62	12	22.38	035	0.3						on station		
SAP 01	074	08:36	4	48.63	12	22.36			2983					bomb in water		
SAP 01	074	08:42												pinger '@ 25m		
SAP 01	074	08:50												COSAP04 + MAPR 9 @ 50M		
SAP 01	074	08:57												COSAP03 + MAPR @ 75M		
SAP 01	074	09:04												COSAP02 + MAPR @ 100M		
SAP 01	074	09:16												COSAP03 + MAPR @ 125M		
SAP 01	074	09:26												SAPS wire transferred		
SAP 01	074	09:28												SAP deployed		
SAP 01	074	10:00	4	48.56	12	22.33			3057	934						
SAP 01	074	10:32	4	48.55	12	22.35				1805				10KHz off		
SAP 01	074	10:50								2120				SAPS cancelled - ABE ascending		
ABE153	074	13:55	4	49.80	12	22.04								ABE on deck		
CTD17	074	14:45	4	48.30	12	22.27			2966					on station ctd 17		
CTD17	074	14:50												Mn sensor on		
CTD17	074	14:48												CTD in water @7m		
CTD17	074	14:56												veer to 2900m wire out		
CTD17	074	16:04	4	48.34	12	22.30			2971	2940	2952			small temp anomaly		
CTD17	074	16:08								2917	2930			Fire 1+2, Bottom o f cast, trans=90.012		

CTD17	074	16:13									2941			Fire 3, temp anom		
CTD17	074	16:13									2948			Fire 4 temp anom		
CTD17	074	16:25	4	48.36	12	22.13			2963	2945	2947			Fire 5 temp anom		
CTD17	074	16:30								2900	2900	**190**		Start upcast,fire 6 and 7, trans 89.988		
CTD17	074	16:40								2800	2795	**357**				
CTD17	074	16:46								2700	2689	**433**		fire 8 and 9.trans 89.988		
CTD17	074	17:07								2000				fire 10 and 11, trans 90.012		
CTD17	074	17:44	4	48.11	12	21.86					2924			Fire all bottles		
CTD17	074	17:44												CTD on deck		
CTD17	074	17:46												Sensor off		
Transit	074	18:30												in transit to ABE-154 deployment site		
ABE154	074	19:00	4	48.59	12	27.73	024	0.4	2984					Hove to at ABE deployment site		
ABE154	074	20:39	4	48.63	12	22.71			2987					ABE154 in water		
Transit	074	21:31	4	48.84	12	22.50	098	1.7	2986					transit to dredge 04		
DR04	074	21:56	4	47.63	12	22.69	263	0.3	3043					on station RD04		
DR04	074	22:01												Dredge in water		
DR04	074	22:15												pinger and MAPR 150m on cable in water		
DR04	074	23:00	4	47.66	12	22.67				2129						
DR04	074	23:29							3050	3121				dredge on bottom		
DR04	075	00:00								3256						
DR04	075	00:10							3050	3295			**130**	nibbles hauling at 10m per min		
DR04	075	00:14								3295			**135**	stop winch		
DR04	075	00:20	4	48.31	12	22.30			3234	3286			**130**	veer at 10m per m in		
DR04	075	00:30	4	48.42	12	22.21	175	1.1	3200	3286			**110**			
DR04	075	00:40	4	48.57	12	22.13	168	1.2	3200	3286			**110**	pay out at 10 m per min		
DR04	075	00:50	4	48.71	12	22.03	168	1.3	3200	3286			**110**			
DR04	075	01:00	4	48.87	12	21.95	139	1.3	3200	3276			**110**			
DR04	075	01:10	4	48.98	12	21.83	125	1.4	3200	3276			**150**	off bottom		
DR04	075	01:30	4	44.19	12	21.62	125	1.3	2964	2490				up at 60m per min		
DR04	075	01:45	4	49.34	12	21.38	113	1.3	2893	2964				up at 53m/min		
DR04	075	02:30	4	49.72	12	20.98	117	1.2	2982	308				up at 20m/min		
DR04	075	02:45	4	44.96	12	20.85	110	0.3	2431	0				DR04 on deck		
RC22	075	03:35	4	49.24	12	21.89	110	0.7	2942	20				mapr on at 20m- down at 30m/min		
ABE154	075	03:45												off bottom		
	CD169 Leg2: science log															
			Lat. (South)		**Long. (West)**					**BRIDGET etc**						
Operation	**Jday**	**Time**	**Deg**	**Min**	**Deg**	**Min**	**CMG**	**SMG**	**Wat. dept**	**Wire Out**	**Depth**	**Layback**	**Altitude**	**Comments**		
RC22	075	04:31	4	49.28	12	21.89	120	0.5	2927	2971				Chipper on bottom		
RC22	075	05:28												Chipper back on deck		
ABE154	075	06:00	4	48.30	12	22.70	170	1.8	3012					hove to on ABE recovery site		
ABE154	075	06:33	4	48.30	12	22.56	068	1.2	3002					ABE on surface		
ABE154	075	06:51	4	48.39	12	22.45	048	0.3						ABE on deck		
CTD18	075	07:12	4	48.61	12	22.39	265	0.5	2984	2				on station for CTD 18		
CTD18	075	07:13												Mn sensor on		
CTD18	075	07:15	4	48.59	12	22.39	229	0.5	2984	2				CTD in water		
CTD18	075	08:08	4	48.56	12	22.43			2985		2475			veering		
CTD18	075	08:17	4	48.58	12	22.43			2986	2925	2940			winch stop		
CTD18	075	08:20	4	48.59	12	22.43			2987	2945	2959			winch stop		
CTD18	075	08:26	4	48.56	12	22.42			2984	2945	2959			bottles 1 & 2 fired		
CTD18	075	08:29								2935	2951			bottles 3 & 4 fired		
CTD18	075	08:31	4	48.56	12	22.41				2925	2940			bottles 5 & 6 fired		
CTD18	075	08:34	4	48.56	12	22.41			2984	2905	2920			bottles 7 & 8 fired		
CTD18	075	08:37								2885	2900			bottles 9 & 10 fired		
CTD18	075	08:40	4	48.57	12	22.41				2860	2875			bottles 11 & 12 fired		
CTD18	075	08:43	4	48.58	12	22.41				2835	2850			bottles 13 & 14 fired		
CTD18	075	08:46	4	48.59	12	22.42			2984	2810	2825			bottles 15 & 16 fired		
CTD18	075	08:49	4	48.58	12	22.42				2785	2800			bottles 17 & 18 fired		
CTD18	075	08:55							2987	2760	2775			bottles 19		
CTD18	075	08:56								2735	2750			bottles 20		
CTD18	075	08:58								2710	2725			bottles 21		
CTD18	075	09:05								2500	2514			bottles 22		
CTD18	075	09:16								2000	2011			bottles 23 & 24 fired		
CTD18	075	09:50	4	48.56	12	22.42								CTD on surface		
CTD18	075	09:53												CTD on deck		
CTD18	075	09:53												MN sensor off		
transit	075	10:30	4	48.07	12	22.64								transit to ABE155 region		
hove-to	075	11:03	4	48.43	12	22.48	118	0.3						awaiting ABE dive site location coordinates		
transit	075	11:30	4	48.64	12	22.31	019	2.9						transit to ABE155		

ABE155	075	11:40	4	48.06	12	22.70			3010					On station ABE155		
ABE155	075	11:53												suspension of deployment 30/60mins - camera overheating		
ABE155	075	12:51	4	48.02	12	22.68	290	0.9	3025					ABE155 launched		
SAP 02	075	13:17	4	48.49	12	22.34			2980					On station for SAP 02		
SAP 02	075	13:35	4	48.51	12	22.29			2967					Weight in water		
SAP 02	075	13:41	4						2985					Pinger in water		
SAP 02	075	13:47	4											SN0004 and MAPR12 in water		
SAP 02	075	13:53												SN0203 and MAPR8 in water		
SAP02	075	13:57												SN2002 and MAPR29 in water		
SAP02	075	14:02	4	48.48	12	22.34								SN005 and MAPR 9 in water		
SAP02	075	15:49	4	48.53	12	22.33				2700			**140**	winch stop		
SAP02	075	15:55	4	48.53	12	22.32				2770				In position - weight at 50m		
SAO02	075	16:16	4	48.54	12	22.33								Pumps started		
SAP02	075	17:00	4	48.54	12	22.26	293	0.8								
SAP02	075	17:16	4	48.54	12	22.27	356	0.1		2770						
SAP02	075	18:00	4	48.51	12	22.35	325	0.1		2769						
SAP02	075	18:16	4	48.53	12	22.31	125	0.4		2769				pumps finished		
SAP02	075	18:26												winch haul @ 40m/m		
SAP02	075	19:50												MAPR & SAP 1 on deck		
SAP02	075	19:55												MAPR & SAP 2 on deck		
SAP02	075	19:59												MAPR & SAP 3 on deck		
SAP02	075	20:05												MAPR & SAP 4 on deck		
SAP02	075	20:08												pinger on deck		
SAP02	075	20:13												weight on deck		
	CD169 Leg2: science log															
			Lat. (South)		**Long. (West)**					**BRIDGET etc**						
Operation	**Jday**	**Time**	**Deg**	**Min**	**Deg**	**Min**	**CMG**	**SMG**	**Wat. deptl**	**Wire Out**	**Depth**	**Layback**	**Altitude**	**Comments**		
transit	075	20:30												transit to BRIDGET03		
transit	075	21:05	4	47.03	12	23.95	345	4.0								
BGT03	075	21:30	4	44.85	12	24.62	044	1.7						manouvering on station		
BGT03	075	21:40	4	44.79	12	24.58	130	1.4						Deploying BRIDGET03		
BGT03	075	21:45												BRIDGET in water		
BGT03	075	21:53												BRIDGET recovery		
BGT03	075	22:15												BRIDGET on deck		
BGT03	075	22:31	4	44.97	12	24.44								Hove-to		
BGT03	075	23:00	4	45.03	12	24.42								New start poss 1 mile down the line		
BGT03	075	23:58	4	45.77	12	23.83								BRIDGET in water		
BGT03	076	00:22	4	46.08	12	23.61	130	0.9	3110	1328	1335	**#NUM!**		big rita going down		
BGT03	076	01:00	4	46.18	12	23.63	130	1.1	3131	1840	1836	**311**		big rita going down		
BGT03	076	01:30	4	46.44	12	23.38	131	1.1	3087	2733	2715	**503**	**212**	Mn, eh signal, no nephs		
BGT03	076	01:46	4	46.65	12	23.19	141	1.4	3135	2990	2980	**434**	**100**	fire bottle 1- nephs plume		
BGT03	076	02:00	4	46.78	12	23.12	140	1.2	3068	3013	2937	**862**	**75**	fire bottle 2- nephs plume		
BGT03	076	02:05	4	46.83	12	23.08	140	1.3	3100	2996	2975	**544**	**75**	fire bottle 3 - neph plume		
BGT03	076	02:19	4	46.99	12	22.96	140	1.2	3096	3188	3010	**1240**	**70**	fire bottle 4 - nephs plume		
BGT03	076	02:24	4	#REF!	12	#REF!	140	1.3	3096	3148	3030	**1044**	**50**	fire bottle 5 - nephs plume		
BGT03	076	02:30	4	47.20	12	22.80	140	1.3	3095	2974	2819	**1138**	**143**	fire bottle 6 - nephs plume		
BGT03	076	02:38					140	1.3	3095	3120	2950	**1206**	**95**	fire bottle7 - nephs + Mn plume		
BGT03	076	02:55							3085	3122	2937	**1249**	**100**	fire bottle 8 - neph + Mn plume		
BGT03	076	03:00	4	47.60	12	22.50	140	1.3	3042	3284	3081	**1327**	**27**	bottom of neph plume negative delta T		
BGT03	076	03:24	4	47.90	12	22.30	140	1.3	3006	3180	2966	**1337**	**73**	fire bottle 9 - neph plume. Then started hauling at 40m/min		
BGT03	076	03:34	4	48.00	12	22.20	140	1.2	2908	2800	2597	**1237**	**245**	fire bottle 10 - 160m above plume top.		
BGT03	076	04:04								1500						
BGT03	076	04:23												Chem sensor switched off		
BGT03	076	04:29	4	48.55	12	21.78	144	1.0	2918	560				BRIDGET switched off		
BGT03	076	04:53												BRIDGET on deck and secure		
transit	076	05:12	4	48.30	12	27.25	002							In transit to ABErecovery		
ABE	076	05:55												ABE on surface		
ABE	076	05:56												Transponder B popped		
ABE	076	06:22												ABE on deck		
TX recov	076	07:00												Transponder B spotted		
TX recov	076	07:06												Transponder D popped		
TX recov	076	07:17												Transponder B on deck		
TX recov	076	08:05												USBL recovery start		
TX recov	076	08:11												Transponder D on deck		
TX recov	076	08:38												USBL raised		
TX recov	076	09:05												Transponder A on deck		
transit	076	09:30	4	49.71	12	22.53		7.0						Search for transponder A(orig) Aborted - to Ascension		

								END OF SCIENCE FOR CD 1								
	077	08:50												Disemabarked science party, Ascension.		

Time (GMT)	Date	J day	Lat		Lon		EM12 Line No.	CMG	SMG	Water Depth	SVP	Comments
11:32	19/02/2005	50	10	34.21	-21	2.2	1		10.9			started logging/no SVP/no gyro
11:40	19/02/2005	50					1					gyro on
12:00	19/02/2005	50					1					slowed down to do 360 turn to empty sewer pipres
12:36	19/02/2005	50	10	28.65	-21	0.76	2	141	9	5159		finished flushing
17:37	19/02/2005	50	9	45.48	-20	30.48	3	147	11.12	4947		
23:05	19/02/2005	50	8	57.78	-19	59.32	4	143	11	3438		data deterioation - no SVP
08:56	20/02/2005	51	7	29.32	-19	2.11	5	142	11	4490		
15:03	20/02/2005	51	6	34.56	-18	26.96	6	148	11	4881		
22:01	20/02/2005	51	5	33.25	-17	47.53	7	146	11	5009		
09:19	21/02/2005	52	3	58.73	-16	46.7	8	146	10.6	4986		
14:48	21/02/2005	52	3	12.72	-16	17.2	9	150	10.8	4899		
20:04	21/02/2005	52	2	29.39	-15	51.5	10	150	9.6	5000		
08:16	22/02/2005	53	1	00.05	-14	59.67	11	146	10.3	3926		
14:52	22/02/2005	53	0	11.05	-14	31.3	12	141	10.7	3314		
16:23	22/02/2005	53										crossed the equator
09:01	23/02/2005	54	-2	00.33	-12	54.91	13	140	10.3	3941		
10:22	23/02/2005	54	-2	9.25	-12	48.53		140	10.6	3277		log off to apply SVP - derived from JR65 XBT
10:35	23/02/2005	54	-2	10.71	-12	47.47	14	140	10.3	2840	1	
17:37	23/02/2005	54	-2	55.98	-12	14.12	15	153	10.5	1881	1	at WP2 - start of work
19:37	23/02/2005	54	-3	13.48	-12	12.79	16	164	9.9	3907	1	at WP3
21:30	23/02/2005	54	-3	29.48	-12	10.27	17	162	10	3620	1	line no. change
00:02	24/02/2005	55	-3	52.23	-12	6.84	18	168	9.8	3688	1	at WP4
01:59	24/02/2005	55	-4	6.31	-12	17.91	19	176	9	3569	1	at WP5
04:11	24/02/2005	55	-4	25.39	-12	16.36	20	178	9.4	3528	1	at WP6
06:00	24/02/2005	55	-4	37.43	-12	26.94	21	157	8.6	3287	1	at WP7
06:25	24/02/2005	55	-4	40.9	-12	26.09	22	152	9.4	3300	1	change course, 15deg port
	24/02/2005	55	-4	48.35	-12	21.8	23	147	9.4	2947	1	change course
10:04	24/02/2005	55	-5	8.43	-12	18.39	24	155	8.7	3454	1	end of swath survey - TOBI deployment
13:02	24/02/2005	55	-5	11.69	-12	17.55	25	14	3.7	3345	1	start TOBI survey 01
19:28	24/02/2005	55	-4	58.37	-12	20.35	26	16	2.5	3591	1	
00:08	25/02/2005	56	-4	49.56	-12	22.84	27	10	2.6	3008	1	
07:30	25/02/2005	56	-4	34.57	-12	24.3	28	55	3.4	3726	1	
21:10	25/02/2005	56	-4	4.56	-12	16.33	29	61	2.9	3935	1	
07:34	26/02/2005	57	-3	56.29	-12	4.73		126	0.8	3477		log off - TOBI recovery
08:22	26/02/2005	57	-3	56.92	-12	5.27	30	226	8.5	3487	1	transit to CTD01
09:35	26/02/2005	57	-4	4.33	-12	15.99		192	3.8	4050		log off at CTD01
19:11	26/02/2005	57	-4	10.56	-12	17.97	31	25	9.7	3207	1	transit to TOBI 02 - re-deployment
20:00	26/02/2005	57	-4	5.64	-12	19.48		105	1.3	3714		hove-to for deployment
14:40	27/02/2005	58	-4	6.52	-12	19.23	32	118	2.7	3731	1	TOBI survey 02
07:31	28/02/2005	59	-3	33.25	-12	9.18	33	24	2.5	3678	1	
14:59	28/02/2005	59	-3	17.97	-12	10.19		5	2.5	3693	1	log off - TOBI recovery
18:35	28/02/2005	59	-3	15.07	-12	9.34	34	167	4.7	2988	1	log on - Transit to TOBI03
08:10	01/03/2005	60	-4	55.06	-11	38.65		154	5	3420		log off - TOBI deployment
10:27	01/03/2005	60	-4	57.08	-11	38.03	35	138	2.7	4464	1	lon og - TOBI03 survey
08:48	02/03/2005	61	-5	46.78	-11	30.58	36	160	3.3	3703	1	
16:36	02/03/2005	61	-6	4.38	-11	26.47	37	153	3.2	2970	1	
00:15	03/03/2005	62	-6	21.33	-11	21.47	38	144	3	3407	1	
06:52	03/03/2005	62										Ship lost power
08:02	03/03/2005	62	-6	38.97	-11	16.32	39					EM12 started
08:07	03/03/2005	62	-6	39.14	-11	16.27	39			3933		data flowing
09:38	03/03/2005	62	-6	42.14	-11	15.5	40			3292		logging resumed

09:51	03/03/2005	62										stop logging - mermaid re-boot
09:55	03/03/2005	62	-6	43	-11	15.3	41			3263		started logging
10:08	03/03/2005	62					43					trouble shooting
10:18	03/03/2005	62										stopped
10:19	03/03/2005	62	-6	44	-11	11.15	44			3060		CD169LEG2 START (FOR LOGGING PURPOSES ONLY)
12:59	03/03/2005	62										log-off TOBI recovery
Time (GMT)	Date	J day	Lat		Lon		EM12 Line No.	CMG	SMG	Water Depth	SVP	Comments
14:11	03/03/2005	62	-6	50.34	-11	14.47	45	245	9.2	4026	1	transit to Ascension
14:47	03/03/2005	62					46					changed transmit mode to deep
15:22	03/03/2005	62					47					changed transmit mode to Auto
09:26	04/03/2005	63	-7	54.58	-14	25.05		191	12.3	57		log-off - At Ascension
15:00	04/03/2005	63										Re-boot EM12 - data since power failure no good
16:55	04/03/2005	63					48					sacrificed line 48 for re-start
17:22	04/03/2005	63	-7	54.25	-14	26.11	49	81	9.3	75		log-on - leg 2
18:35	04/03/2005	63	-7	44.48	-14	19.47	50	29	11.4	2944		
07:29	05/03/2005	64	-6	6.33	-13	14.93				3459		stop logging - at CTD03
10:15	05/03/2005	64	-6	6.79	-13	14.07	51	56	4.8	3449	1	transit to CTD04
13:15	05/03/2005	64	-5	41.97	-13	0.05				3395	1	log-off - At CTD04
14:25	05/03/2005	64					52					line 52 sacrified - EM12 settings alterations
14:47	05/03/2005	64										log-off
18:04	05/03/2005	64	-5	41.79	-12	58.48	53	33	11	3391	1	Transit to Segment2
00:09	06/03/2005	65	-5	6.88	-12	19.2				3425		log-off at RC05
02:00	06/03/2005	65					55					log-on for RC05
06:05	06/03/2005	65	-5	3.63	-12	18.135	56	334	10.2	3538	1	line change - start transit to WP29 (west seg 2)
08:17	06/03/2005	65	-4	44.18	-12	28	57	132	8.3	3025	1	A/C - transit to transponder station
10:12	06/03/2005	65										log-off - line 57 mostly waste
12:41	07/03/2005	66					58				1	log on for DUM01.
18:26	07/03/2005	66	-4	45.38	-12	27.94	60	89	3	2865	1	change line no. line 59 not used, confusion!!!
07:33	08/03/2005	67	-4	46.79	-12	23.37						lof off for RC07
15:45	08/03/2005	67										EM12 shut down - interferance with ABE
05:00	11/03/2005	70	-4	39.13	-12	24.71	61					logging on. Transit to ABE02
												lines 61 to 69 useless. Problems with time difference
												between internal clock and input time from DGPS.
17:10	11/03/2005	70	-4	47.5	-12	23.21	70	119	1.4	3080	1	Log on
19:54	11/03/2005	70	-4	44.26	-12	23.23	71	154	1.5	3352	1	Rock dredge 02
00:01	12/03/2005	71	-4	44.87	-12	21.94		129	1.3	3270	1	log off
06:38	13/03/2005	72	-4	48.91	-12	22.95	72	135	1.7	2971	1	log on - start swath survey - WP45
08:29	13/03/2005	72	-4	58.96	-12	14.84		151	2.9	2695	1	log off - CTD test dip - changed beam angle to 120 from 105
09:01	13/03/2005	72	-4	59.09	-12	14.82	73					log on
10:12	13/03/2005	72	-5	7.86	-12	12.1	74	133	8.8	3755	1	AC wp 46
10:18	13/03/2005	72	-5	8.17	-12	11.66						log off CTD test dip
11:25	13/03/2005	72	-5	8.16	-12	11.66	75	125	1	3766	1	resume swath survey
11:59	13/03/2005	72	-5	6.63	-12	8.16	76	340	9.5	4042	1	AC at WP47
13:57	13/03/2005	72	-4	49.11	-12	13.51	77	343	9.5	2258	1	
15:26	13/03/2005	72	-4	36.25	-12	18.57	78	254	9.4	2147	1	
16:56	13/03/2005	72	-4	40.11	-12	32.39	79	204	8.24	2871	1	
18:06	13/03/2005	72	-4	49.82	-12	33.22	80	126	7.4	2632	1	AC - end swath survey - transit to CTD
19:20	13/03/2005	72	-4	48.53	-12	23.22		97	5	3001	1	log off - at CTD station
	14/03/2005	73					81				1	log on for ? - log not completed
09:39	14/03/2005	73	-4	48.16	-12	22.53						log off.
09:20	17/03/2005	76	-4	48.99	-12	23.34	82	120	5.4	3022	1	Log on for transit to Ascension
11:44	17/03/2005	76	-5	5.82	-12	27.01	83	192	8.9	3144	1	

15:12	17/03/2005	76	-5	38.63	-12	49.85	84	207	8.9	3312	1	
18:15	17/03/2005	76	-6	4.01	-13	7.51	85	207	8.9	3396		

Appendix E: CTD Configuration Files for CD 169

D.1) Original Configuration File

```
Date: 03/16/2005

ASCII file: C:\Program Files\Sea-Bird\Seasave-
Win32\CD169\CD169_main.con

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

Frequency channels suppressed : 0
Voltage words suppressed      : 0
Computer interface            : RS-232C
Scans to average              : 1
Surface PAR voltage added     : No
NMEA position data added      : Yes
Scan time added               : Yes

1) Frequency, Temperature
   Serial number : 4489
   Calibrated on : 12/29/04
   G             : 4.36985005e-003
   H             : 6.45644119e-004
   I             : 2.27228210e-005
   J             : 1.99064966e-006
   F0            : 1000.000
   Slope         : 1.00000000
   Offset        : 0.0000

2) Frequency, Conductivity
   Serial number : 3052
   Calibrated on : 12/30/04
   G             : -1.01167697e+001
   H             : 1.41046907e+000
   I             : 1.40888638e-004
   J             : 6.06099170e-005
   CTcor         : 3.2500e-006
   CPcor         : -9.57000000e-008
   Slope         : 1.00000000
   Offset        : 0.00000

3) Frequency, Pressure, Digiquartz with TC
   Serial number : 73299
   Calibrated on : 8 may 2002
   C1            : -5.087539e+004
   C2            : -2.199664e-002
   C3            : 1.589010e-002
   D1            : 3.721700e-002
   D2            : 0.000000e+000
   T1            : 3.011152e+001
   T2            : -2.857091e-004
   T3            : 4.528990e-006
   T4            : -5.484500e-011
   T5            : 0.000000e+000
   Slope         : 1.00000000
   Offset        : 0.00000
   AD590M        : 1.282874e-002
   AD590B        : -9.075593e+000
```

```
4) Frequency, Temperature, 2
   Serial number : 4490
   Calibrated on : 12/28/04
   G             : 4.40572536e-003
   H             : 6.48538846e-004
   I             : 2.30142379e-005
   J             : 2.02318152e-006
   F0            : 1000.000
   Slope         : 1.00000000
   Offset        : 0.0000

5) Frequency, Conductivity, 2
   Serial number : 3054
   Calibrated on : 12/22/04
   G             : -9.90666069e+000
   H             : 1.36319852e+000
   I             : -2.43252028e-004
   J             : 8.05596827e-005
   CTcor         : 3.2500e-006
   CPcor         : -9.57000000e-008
   Slope         : 1.00000000
   Offset        : 0.00000

6) A/D voltage 0, Oxygen, SBE 43
   Serial number : 0709
   Calibrated on : 6 aug 2004
   Soc           : 3.8260e-001
   Boc           : 0.0000
   Offset        : -0.4858
   Tcor          : 0.0010
   Pcor          : 1.35e-004
   Tau           : 0.0

7) A/D voltage 1, Free

8) A/D voltage 2, Altimeter
   Serial number :
   Calibrated on :
   Scale factor  : 1.000
   Offset        : 0.000

9) A/D voltage 3, Fluorometer, Chelsea Aqua 3
   Serial number : 88/2360/108
   Calibrated on : 17 nov 2004
   VB            : 0.287100
   V1            : 1.978300
   Vacetone      : 0.331500
   Scale factor  : 1.000000
   Slope         : 1.000000
   Offset        : 0.000000


10) A/D voltage 4, OBS, Seapoint Turbidity
    Serial number : 10491
    Calibrated on : 1 june 2004
    Gain setting  : 100 x
    Scale factor  : 1.000

11) A/D voltage 5, Free
```

```
12) A/D voltage 6, User Polynomial
    Serial number : 169
    Calibrated on : 9 nov 04
    Sensor name   :
    A0            : 0.00021513
    A1            : 0.00300000
    A2            : 0.00000000
    A3            : 0.00000000

13) A/D voltage 7, Transmissometer, Chelsea/Seatech/Wetlab CStar
    Serial number : 161/2642/002
    Calibrated on : 4 sept 1996
    M             : 20.0000
    B             : 0.0000
    Path length   : 0.250
```

D.2) Configuration File after Deck Unit Swap, Cast 006.

```
Date: 03/16/2005

ASCII file: C:\Program Files\Sea-Bird\Seasave-
Win32\CD169\CD169_main_SHIFT.con

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

Frequency channels suppressed : 0
Voltage words suppressed      : 0
Computer interface            : RS-232C
Scans to average              : 1
Surface PAR voltage added     : No
NMEA position data added      : No
Scan time added               : Yes

1) Frequency, Temperature
   Serial number : 4489
   Calibrated on : 12/29/04
   G             : 4.36985005e-003
   H             : 6.45644119e-004
   I             : 2.27228210e-005
   J             : 1.99064966e-006
   F0            : 1000.000
   Slope         : 1.00000000
   Offset        : 0.0000

2) Frequency, Conductivity
   Serial number : 3052
   Calibrated on : 12/30/04
   G             : -1.01167697e+001
   H             : 1.41046907e+000
   I             : 1.40888638e-004
   J             : 6.06099170e-005
   CTcor         : 3.2500e-006
   CPcor         : -9.57000000e-008
   Slope         : 1.00000000
   Offset        : 0.00000

3) Frequency, Pressure, Digiquartz with TC
```

```
   Serial number : 73299
   Calibrated on : 8 may 2002
   C1            : -5.087539e+004
   C2            : -2.199664e-002
   C3            : 1.589010e-002
   D1            : 3.721700e-002
   D2            : 0.000000e+000
   T1            : 3.011152e+001
   T2            : -2.857091e-004
   T3            : 4.528990e-006
   T4            : -5.484500e-011
   T5            : 0.000000e+000
   Slope         : 1.00000000
   Offset        : 0.00000
   AD590M        : 1.282874e-002
   AD590B        : -9.075593e+000

4) Frequency, Temperature, 2
   Serial number : 4490
   Calibrated on : 12/28/04
   G             : 4.40572536e-003
   H             : 6.48538846e-004
   I             : 2.30142379e-005
   J             : 2.02318152e-006
   F0            : 1000.000
   Slope         : 1.00000000
   Offset        : 0.0000



5) Frequency, Conductivity, 2
   Serial number : 3054
   Calibrated on : 12/22/04
   G             : -9.90666069e+000
   H             : 1.36319852e+000
   I             : -2.43252028e-004
   J             : 8.05596827e-005
   CTcor         : 3.2500e-006
   CPcor         : -9.57000000e-008
   Slope         : 1.00000000
   Offset        : 0.00000

6) A/D voltage 0, Oxygen, SBE 43
   Serial number : 0709
   Calibrated on : 6 aug 2004
   Soc           : 3.8260e-001
   Boc           : 0.0000
   Offset        : -0.4858
   Tcor          : 0.0010
   Pcor          : 1.35e-004
   Tau           : 0.0

7) A/D voltage 1, Free

8) A/D voltage 2, User Polynomial
   Serial number : 169
   Calibrated on : 11/04
   Sensor name   : BBRTD
   A0            : 0.00000000
   A1            : 1.00000000
   A2            : 0.00000000
```

```
   A3            : 0.00000000


9) A/D voltage 3, Fluorometer, Chelsea Aqua 3
   Serial number : 88/2360/108
   Calibrated on : 17 nov 2004
   VB            : 0.287100
   V1            : 1.978300
   Vacetone      : 0.331500
   Scale factor  : 1.000000
   Slope         : 1.000000
   Offset        : 0.000000

10) A/D voltage 4, OBS, Seapoint Turbidity
    Serial number : 10491
    Calibrated on : 1 june 2004
    Gain setting  : 100 x
    Scale factor  : 1.000

11) A/D voltage 5, Free

12) A/D voltage 6, Free

13) A/D voltage 7, Transmissometer, Chelsea/Seatech/Wetlab CStar
    Serial number : 161/2642/002
    Calibrated on : 4 sept 1996
    M             : 20.0000
    B             : 0.0000
    Path length   : 0.250
```

D.3) Configuration File after Sensor Re-Configuration, Cast 010.

```
Date: 03/16/2005

ASCII file: C:\Program Files\Sea-Bird\Seasave-
Win32\CD169\CD169_main_SHIFT.con

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

Frequency channels suppressed : 0
Voltage words suppressed      : 0
Computer interface            : RS-232C
Scans to average              : 1
Surface PAR voltage added     : No
NMEA position data added      : No
Scan time added               : Yes

1) Frequency, Temperature
   Serial number : 4489
   Calibrated on : 12/29/04
   G             : 4.36985005e-003
   H             : 6.45644119e-004
   I             : 2.27228210e-005
   J             : 1.99064966e-006
   F0            : 1000.000
   Slope         : 1.00000000
   Offset        : 0.0000
```

2) Frequency, Conductivity
   Serial number : 3052
   Calibrated on : 12/30/04
   G   : -1.01167697e+001
   H   : 1.41046907e+000
   I   : 1.40888638e-004
   J   : 6.06099170e-005
   CTcor   : 3.2500e-006
   CPcor   : -9.57000000e-008
   Slope   : 1.00000000
   Offset   : 0.00000

3) Frequency, Pressure, Digiquartz with TC
   Serial number : 73299
   Calibrated on : 8 may 2002
   C1   : -5.087539e+004
   C2   : -2.199664e-002
   C3   : 1.589010e-002
   D1   : 3.721700e-002
   D2   : 0.000000e+000
   T1   : 3.011152e+001
   T2   : -2.857091e-004
   T3   : 4.528990e-006
   T4   : -5.484500e-011
   T5   : 0.000000e+000
   Slope   : 1.00000000
   Offset   : 0.00000
   AD590M   : 1.282874e-002
   AD590B   : -9.075593e+000

4) Frequency, Temperature, 2
   Serial number : 4490
   Calibrated on : 12/28/04
   G   : 4.40572536e-003
   H   : 6.48538846e-004
   I   : 2.30142379e-005
   J   : 2.02318152e-006
   F0   : 1000.000
   Slope   : 1.00000000
   Offset   : 0.0000

5) Frequency, Conductivity, 2
   Serial number : 3054
   Calibrated on : 12/22/04
   G   : -9.90666069e+000
   H   : 1.36319852e+000
   I   : -2.43252028e-004
   J   : 8.05596827e-005
   CTcor   : 3.2500e-006
   CPcor   : -9.57000000e-008
   Slope   : 1.00000000
   Offset   : 0.00000

6) A/D voltage 0, Oxygen, SBE 43
   Serial number : 0709
   Calibrated on : 6 aug 2004
   Soc   : 3.8260e-001
   Boc   : 0.0000
   Offset   : -0.4858

```
   Tcor          : 0.0010
   Pcor          : 1.35e-004
   Tau           : 0.0

7) A/D voltage 1, Free

8) A/D voltage 2, User Polynomial
   Serial number : 169
   Calibrated on : 11/04
   Sensor name   : BBRTD
   A0            : 0.00000000
   A1            : 1.00000000
   A2            : 0.00000000
   A3            : 0.00000000

9) A/D voltage 3, Fluorometer, Chelsea Aqua 3
   Serial number : 88/2360/108
   Calibrated on : 17 nov 2004
   VB            : 0.287100
   V1            : 1.978300
   Vacetone      : 0.331500
   Scale factor  : 1.000000
   Slope         : 1.000000
   Offset        : 0.000000

10) A/D voltage 4, OBS, Seapoint Turbidity
    Serial number : 10491
    Calibrated on : 1 june 2004
    Gain setting  : 100 x
    Scale factor  : 1.000

11) A/D voltage 5, Free

12) A/D voltage 6, Free

13) A/D voltage 7, Transmissometer, Chelsea/Seatech/Wetlab CStar
    Serial number : 161/2642/002
    Calibrated on : 4 sept 1996
    M             : 20.0000
    B             : 0.0000
    Path length   : 0.250
```

Appendix F: Rock Sampling Stations

CD169 Rock Sample Stations and descriptions

Station	Target	Lat. (S)		Long. (W)		Depth	Wire	Rock	Sediment
		°		°		m	m	grammes, type, crystallinity	type
RC01	Central seg. 3: volcano	4	11.31	12	18.05	3131	3235	1g altered glass	calcarious
RC02	North Seg. 3 hummock	4	6.00	12	18.10	3550	3689	none	yellow calc.
RC03	Mid-north Seg. 3 volcano	4	8.75	12	18.10	3350	3470	5g glass	calcarious
RC04	Central Seg. 3 sheet flow	4	13.00	12	17.18	2900	3032	12g glass	calcarious
RC05	South Seg. 2: volcano	5	6.88	12	19.19	3362	3464	0.1g of glass	calcarious
RC06	Mid-south Seg. 2: volcano	5	4.02	12	17.29	3599	3573	10g glass	calcarious
RC07	Centre Seg. 2, plume max. (Mexican's Hat)	4	46.84	12	23.24	3129	3129	8g glass, 0.5g sulphide	Fe-oxides
RC08	Centre Seg. 2, mottled valley in sheet flow	4	46.24	12	22.62	3145	3231	4g glass	Fe-oxides
RC09	Centre Seg. 2, hummocks NE of central sheet flow	4	48.89	12	22.91	2959	3080	3g pl.-f glass	calcarious
RC10	Central Seg. 2: speckeled area (on TOBI image), eastside sheet flow	4	47.67	12	22.00	3010	3080	12g v-fresh glass	none
RC11	South central Seg. 2, southside sheet flow	4	50.97	12	22.25	3025	3153	10g pl.-phyric glass	Fe-oxides
RC12	Central-northern Seg. 2: hummocky volcano	4	46.00	12	23.70	3175	3190	5g alt. glass	Fe-oxides
RC13	Central westside Seg. 2: hummocky ridge	4	47.45	12	24.60	2900	3080	10g glass	Fe-oxides
RC14	Central westside Seg. 2: hummocky ridge	4	49.60	12	24.05	2910	2980	.1g glass	calcarious
RC15	Centre Seg. 2, southwest side of sheet flow	4	50.24	12	23.20	3100	3180	0.1g of glass	calcarious
RC16	Central-east flank Seg. 2, seamount	4	48.48	12	21.25	2911	2998	2g alt. glass	calcarious
RC17	Centre Seg. 2, collapse pits in sheet flow and Eh hotspot	4	48.65	12	22.65	2988	3054	20g v-fresh glass	none
RC18	Central Seg. 2: mound central north side of sheet flow Parson's Nose)	4	47.77	12	22.47	2980	3020	5g v-fresh glass	Fe-oxides
RC19	Central Seg. 2: Central-northside of sheet flow	4	48.07	12	22.61	2990	3020	20g v-fresh glass	none
RC20	Central Seg. 2, mound just north of centre of sheet flow	4	47.30	12	22.80	2970	3012	3g pl.-phyric alt. glass	none
RC21	Central Seg. 2, south-middle of sheet flow	4	50.19	12	21.98	3010	1050	50g v-fresh glass	none
RC22	Central Seg. 2, hummocky ridge within south-middle of sheet flow	4	49.28	12	21.90	2960	3015	3g pl.-phyric alt. glass	Fe-oxides
DR01	North Seg. 2 hummocky ridge and volcano	4	38.27	12	25.46	3686		250kg mixed plag-phyric basalt	calcarious
01-end		4	39.08	24.7	23.41	3481			
DR02	Mid-north Seg. 2 hummocky AVR	4	44.33	12	23.41	3288		50kg mixed plag-phyric basalt	calcarious
02-end		4	45.05	12	21.83	3238			
DR03	Central Seg. 2, below TOBI plume max. (Mexican's Hat)	4	46.37	12	23.12	3000		150kg of mixed sheet flow and pillows	calc & FeOx
03-end		4	47.02	12	22.84	3100	3400		
DR04	Centre Seg. 2, Parson's Nose to collapse pits: sheet flow area	4	47.64	12	22.70	3020		200kg of glassy sheet and pillow flows	calc & FeOx
04-end									