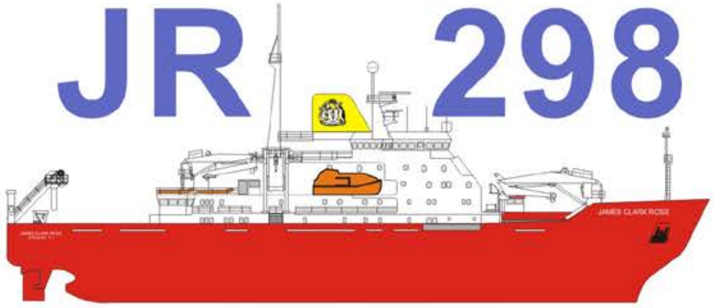
CRUISE REPORT

JR 298



RRS *JAMES CLARK ROSS*

Marine geology and geophysics

Antarctic Peninsula Pacific Margin and southern Bellingshausen Sea

January-March 2015

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R.D. Larter, J.E.T. Channell, C. Cook, E.J Gowland, A.G.C. Graham, K.L. Gunn,
F.J. Hernández-Molina, C.-D. Hillenbrand, K.A. Hogan, J. Horrocks, T.A.R.M. Jordan,
L. Pérez, R. Pietsch, A.M. Piotrowski, T.J. Williams, C. Xuan, A. England, P.E. Morgan,
S.D. Polfrey, M.O. Preston, J.C. Hancock, I. Miller and S.G. Paterson

Frontispiece. Top – An illustration of the quality and quantity of sea-floor sample that can be obtained using the new giant box corer. GBC731 is shown after insertion of sub-sample tubes and removal of box (photo - J. Hernández-Molina). Bottom – RRS *James Clark Ross* at Rothera Station in deteriorating weather conditions. The cruise was diverted to Rothera to uplift ex-Halley personnel who had been flown there on ALCI Basler aircraft because of concerns about the sea ice situation in the Weddell Sea (photo - C. Xuan).

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1. Summary

The main purpose of cruise JR298 was to collect marine geological and geophysical samples and data to support International Ocean Discovery Program (IODP) proposal 732-Full2, "Sediment drifts off the Antarctic Peninsula and West Antarctica" (Channell, Larter, Hillenbrand et al.). The ship time was allocated for this purpose on the basis of a Site Survey Investigation grant from the NERC UK-IODP Programme (NE/J006548/1: Depositional patterns and records in sediment drifts off the Antarctic Peninsula and West Antarctica) to R.D. Larter, C.-D. Hillenbrand (both BAS), D.A. Hodell (University of Cambridge) and A.G.C. Graham (University of Exeter). The data and samples collected will also be used in two Collaborative Gearing Scheme projects, an Antarctic Science Bursary project, a University of Cambridge PhD studentship, and within the National Capability remit of the BAS Science Teams in "Geology and Geophysics" and "Palaeoenvironments and Climate Change".

These projects are:

- Tracing and reconstructing the neodymium and carbon isotopic composition of circum-Antarctic waters (CGS-100, PI: A.M. Piotrowski, Department of Earth Sciences, University of Cambridge; cruise participants: A.M. Piotrowski and T.J. Williams).
- Structural characterisation of Late Quaternary sediments from West Antarctic contourite drifts using three dimensional X-ray imaging (CT-scanning) (CGS-98, PI: C. Ó Cofaigh, Department of Geography, Durham University; cruise participant: J. Horrocks)
- Tracing the Quaternary evolution of the Antarctic Peninsula and West Antarctic Ice Sheets using lead isotopes in ice-rafted feldspar mineral grains (Antarctic Science Bursary awarded to C. Cook).
- Seismic imaging of oceanographic structures and processes in the Southern Ocean south of the Polar Front (component of University of Cambridge/BP Institute PhD studentship; primary supervisor: N.J. White, Department of Earth Sciences, University of Cambridge; PhD student and cruise participant: K.L. Gunn).
- Modelling crustal structure across the Bellingshausen Gravity Anomaly and oceanic fracture zones formed at the Antarctic-Phoenix Ridge through integration of marine potential field and seismic data (Collaboration between two BAS Science Teams; cruise participant: T.A.R.M. Jordan).

The cruise also provided support for physical oceanography projects by deploying six Argo floats and rescuing a malfunctioning sea glider.

Towards the end of the cruise, RRS *James Clark Ros*s was diverted to Rothera to uplift 16 personnel who had been flown across from Halley in two ALCI Basler aircraft because the sea ice situation in the Weddell Sea was considered to pose a significant risk to the scheduled last call of the season at Halley by RRS *Ernest Shackleton*. This uplift resulted in a two-day delay to arrival at Punta Arenas at the end of the cruise, which was in addition to a two-day extension already agreed as a result of departure from Punta Arenas having been delayed by slow refuelling.

Adverse weather conditions, particularly during the first half of the cruise, resulted in more downtime than the amount of contingency time that had been allowed in the proposal. As a result, one less piston core and about 20% fewer line-km of seismic data were collected than had been planned. Nevertheless, the key objectives were achieved and the cores and data that were collected are of very good quality. The data and cores collected on cruise JR298, combined with existing data and cores, should satisfy all of the requirements of the Site Characterisation Panel and the Environmental Protection and Safety Panel of IODP. They will also provide a good basis for addressing the science objectives set out in the UK-IODP Site Survey Investigation proposal and those of the ancillary projects listed above.

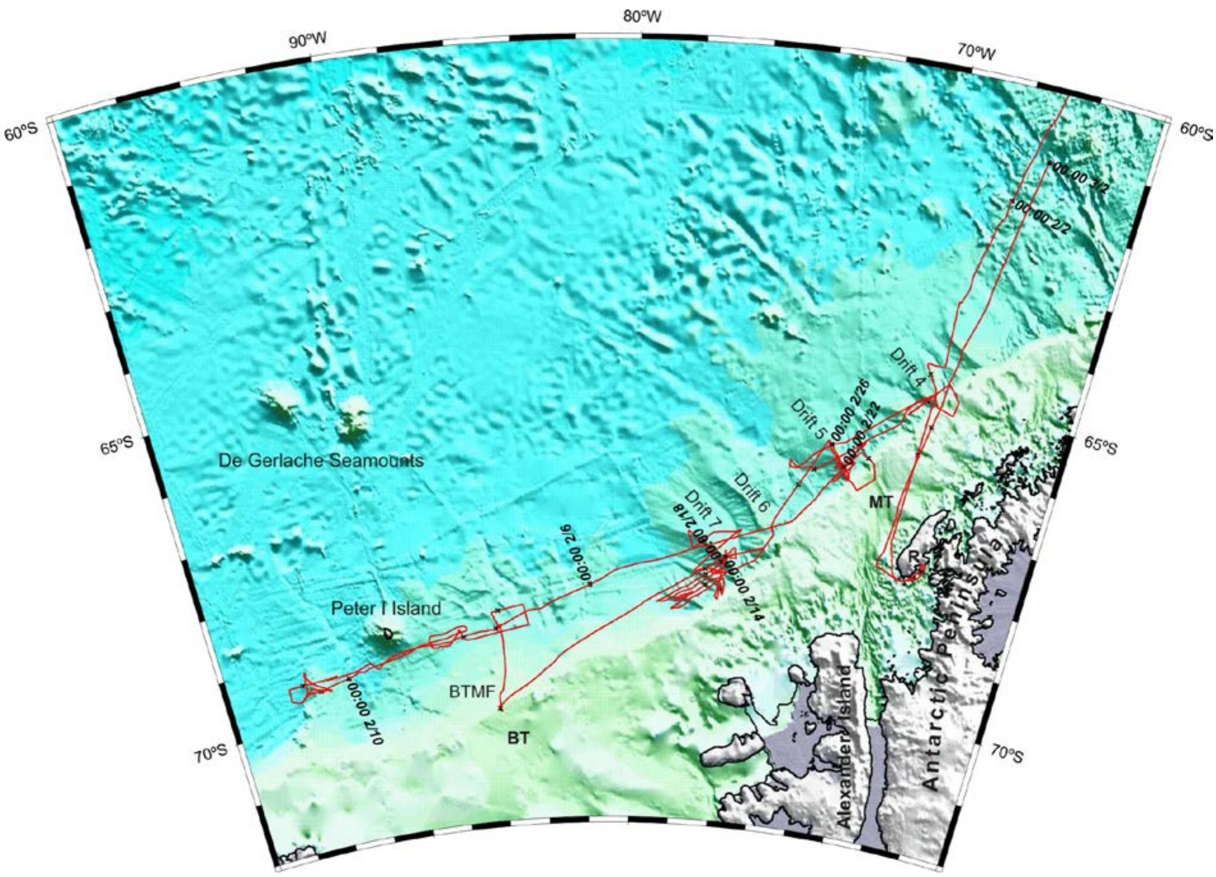

Figure 1. Track of RRS *James Clark Ross* during cruise JR298 (red) overlaid on shaded-relief display of International Bathymetric Chart of the Southern Ocean (IBCSO) bathymetry. A larger scale track chart is included as a fold out at the back of this report. BT – Belgica Trough; BTMF – Belgica Trough Mouth Fan; MT – Marguerite Trough; red dot labeled R – Rothera Station, Adelaide Island.

2. List of Personnel

2.1 Scientific and Technical (24)

R.D. Larter	BAS	Chief Scientist
C.-D. Hillenbrand	BAS	Marine Geologist
K.A. Hogan	BAS	Marine Geophysicist
T.A.R.M. Jordan	BAS	Geophysicist
E.J. Gowland	BAS	Data Manager
J.E.T. Channell	Univ. Florida	Palaeomagnetist
C. Cook	Univ. Florida	Marine Geologist/Geochemist
A.G.C. Graham	Univ. Exeter	Marine Geophysicist
F.J. Hernández-Molina	RHUL	Marine Geophysicist
L. Pérez	Univ. Granada	Marine Geophysicist
A.M. Piotrowski	Univ. Cambridge	Palaeoceanographer
C. Xuan	Univ. Southampton	Palaeomagnetist
K.L. Gunn	Univ. Cambridge	PhD student (Marine Geophysicist)
J. Horrocks	Univ. Durham/BAS	PhD student (Marine Geologist)
R. Pietsch	AWI	PhD student (Marine Geophysicist)
T.J. Williams	BAS/Univ. Cambridge	PhD student (Palaeoceanographer)
S.D. Polfrey	BAS	AME (Mechanical Engineer)
M.O. Preston	BAS	AME (Electronic Engineer)
P.E. Morgan	BAS	AME (Electronic Engineer)
A. England	BAS	ICT (Computing Engineer)
J.C. Hancock	EEL	Seismic Systems Engineer
I. Miller	EEL	Airgun Mechanic
S.G. Paterson	EEL	Seismic Systems Engineer
J. Hunt	BASMU	Doctor

BAS = British Antarctic Survey; AWI = Alfred Wegener Institute; RHUL = Royal Holloway University of London; AME = BAS Antarctic & Marine Engineering Section; BASMU = BAS Medical Unit; ICT = BAS Information Communications Technology Section; EEL = Exploration Electronics Ltd.

2.2 Ship's Company (29)

G.P. Chapman	Master
S.D. Evans	Chief Officer
C.W. Hipsey	2nd Officer
G.M. Delph	3rd Officer
L.A. Faulkner	Extra 3rd Officer
L.T. Parnell	Chief Engineer
S.A. Hussein	2nd Engineer
A.J. Hardy	3rd Engineer
S.J. Eadie	4th Engineer
C.A. Waddicor	Radio Officer
S.A. Wright	Deck Engineer
J.Z. Klepacki	Electrical Engineer
J.S. Gibson	Purser
G.M. Stewart	Bosun SciOps
C. Mullaney	Bosun
J.P. O'Duffy	Bosun's Mate
S.T. Crickmore	Seaman
M.P. Dyer	Seaman
K.J. Phelps	Seaman
G.L. Waylett	Seaman
S.D. Bell	Seaman
P.S. Wilson	Motorman
I.P. Herbert	Motorman
K.A. Walker	Chief Cook
P.G. Molloy	2nd Cook
K. Weston	Senior Steward
J. Newall	Steward
D.W. Lee	Steward
C.P. Savage	Steward

Figure 2. JR298 shipboard scientific party.
From left to right, standing: C.-D. Hillenbrand, F.J. Hernández-Molina, J.E.T. Channell, C. Xuan, E.J. Gowland, J.C. Hancock, R.D. Larter, A. England, S.G. Paterson, M.O. Preston, S.D. Polfrey, A.G.C. Graham, L. Pérez, R. Pietsch, A.M. Piotrowski, T.A.R.M. Jordan.
From left to tight, kneeling: T.J. Williams, K.L. Gunn, P.E. Morgan, K.A. Hogan, J. Horrocks, I. Miller, C. Cook,

3. Timetable of Events

January 2015

23 R. Larter, S. Polfrey, A. England and three Exploration Electronic Ltd staff joined vessel. Mobilisation started in afternoon. Seismic streamer winch and coring container set in place on deck.

24 Mobilisation continued. Two seismic equipment containers unpacked. Cheek plates bolted onto seismic winch. Rest of scientific party joined vessel.

25 Mobilisation continued. Additional 900 m of hydrophone sections spooled onto seismic winch. Airgun umbilicals assembled and set in place along starboard side of aft deck.

26 Scientific equipment mobilisation completed. Streamer winch welded to steel plates that had been bolted to deck matrix. Seismic streamer depth controllers prepared. Piston corer cradle assembled on aft deck.

27 Port quarter Effer crane repaired and used to set fairlead ("doughnut") for seismic streamer in place on stern. Bunkering from road tankers started in afternoon.

28 Bunkering continued .

29 Bunkering completed.

30 RRS *James Clark Ross* departed from Muele Prat, Punta Arenas at 0900 local time (1200Z). Piston corer cradle mounted on starboard rail prior to departure. Passage eastwards along Strait of Magellan and east of Tierra del Fuego.

31 Passage through Le Maire Strait and into Drake Passage. Tested assembly of two sets of three piston corer barrels. Deployment procedures discussed and agreed for seismic equipment and giant box corer.

February 2015

1 Transit across Drake Passage continued. Four Argo floats deployed. Three XBT casts (two unsuccessful). Magnetometer deployed. EM122 and TOPAS pinging and logging started.

2 One Argo float deployed on last part of transit across Drake Passage. XBT cast before seismic equipment deployed for PEN-1 site survey. Seismic data acquisition started.

3 Seismic data acquisition for PEN-1 site survey completed.

4 CTD cast 001 and giant box core (GBC722) near PEN-1 site. Piston coring postponed due to deteriorating weather.

5 Sea glider recovered on transit to southern Bellingshausen Sea.

6 CTD cast 002, piston core (PC723) and giant box core (GBC724) at BELS-1 site. Seismic survey postponed due to icebergs on planned lines.

7 Transit to southwestern Bellingshausen Sea. Seismic equipment deployed for BELS-2C/BELS-3B site survey. Seismic data acquisition started.

8 XBT cast. Seismic data acquisition for BELS-2C/BELS-3B site survey completed.

9 CTD cast 003, giant box core (GBC725) and piston core (PC726) at BELS-2C site.

10 Multibeam echo sounding and TOPAS survey on lower, western part of Belgica Trough Mouth Fan in poor weather conditions. Later, seismic equipment deployed for BELS-1 site survey. Seismic data acquisition started.

11 Seismic data acquisition for BELS-1 site survey continued.

12 Seismic data acquisition for BELS-1 site survey completed.

13 Transit to southern Antarctic Peninsula continental rise. Piston core (PC727) at PEN-4B site on Drift 7.

14 Piston core (PC728) and giant box core (BC729) at PEN-3B site on Drift 6. Returned to PEN-4B site for CTD cast 004. In poor weather conditions, started multibeam echo sounding and TOPAS survey of Drift 8 area

15-16 Continued multibeam echo sounding and TOPAS survey of Drift 8 area in poor weather conditions.

17 Giant box core (GBC730) at PEN-4B site. Seismic equipment deployed for PEN-3B/PEN-4B/PEN-5C site survey. Seismic data acquisition started.

18 Seismic data acquisition for PEN-3B/PEN-4B/PEN-5C site survey continued. Five XBT casts along line BAS145-55.

19 Seismic data acquisition for PEN-3B/PEN-4B/PEN-5C site survey continued. Four XBT casts and one XCTD cast along line BAS145-58.

20 Seismic data acquisition for PEN-3B/PEN-4B/PEN-5C site survey completed. XBT cast near end of survey. Transit to PEN-2 site on Drift 5.

21 Giant box core (GBC731) and piston core (PC732) at PEN-2B site.

22 Seismic equipment deployed for PEN-2B site survey. Seismic data acquisition started. Three XCTD casts on line BAS145-61, two XBT and two XCTD casts on line BAS 145-62, two XBT casts and four XCTD casts on line BAS145-63.

23 Seismic data acquisition for PEN-2B site survey continued. Two XBT casts on line BAS145-64.

24 Seismic data acquisition for PEN-2B site survey continued. Two XBT casts on line BAS145-70.

25 Seismic data acquisition for PEN-2B site survey completed. XCTD cast near end of line BAS145-70. CTD cast 004 and giant box core (GBC733) at deep-water channel site to southwest of Drift 5. Piston core (PC734) and giant box core (GBC735) at site more distal than PEN-2B on crest of Drift 5.

26 Transit to PEN-1 site on Drift 4. Piston core (PC726) at PEN-1 site. Start transit to Rothera.

27 Piston corer cradle removed from starboard rail prior to arrival at Biscoe Wharf, Rothera at 1100 local time (1430 Z). Cast off at 2000 (2300 Z).

28 Remained close to Rothera overnight to shelter from weather. Started transit to Punta Arenas at 0500 (0800 Z).

March 2015

1 Transit across Drake Passage. TOPAS logging stopped at 1756 Z.

2 Transit across Drake Passage continued. EM122 logging stopped at 0450 Z.

3 Passage through Le Maire Strait and along east coast of Tierra del Fuego.

4 Pilot stepped aboard at 0637 local time (0937 Z). RRS *James Clark Ross* arrived at Muele Prat, Punta Arenas at 1315 local time (1615Z).

4. Introduction

Ship time for JR298 was allocated on the basis of a Site Survey Investigation grant from the NERC UK-IODP Programme (NE/J006548/1: Depositional patterns and records in sediment drifts off the Antarctic Peninsula and West Antarctica). The grant was awarded in 2011, and ship time on RRS *James Clark Ross* could have been made available in either the 2012-13 or 2013-14 Antarctic seasons. However, National Marine Facilities Sea Systems (NMFSS) were unable to provide the required seismic equipment or technical support in either of those seasons. In recent years NMFSS have had an agreement with the Spanish research council CSIC to borrow their multichannel seismic streamer for seismic cruises. After this cruise had been postponed for a second time it emerged that CSIC were unwilling to allow their streamer to be used in the Southern Ocean due to concern about the risks posed by ice. Furthermore, they were unwilling to allow it to be away from Spain for the length of time that would be required, which would have been a minimum of five months. In view of this situation, the UK-IODP Programme Manager, Mike Webb, agreed that the programme would fund commercial hire of seismic equipment and technical support for the 2014-15 season, and a contract was placed with Exploration Electronics Ltd.

Once the contract for seismic support had been placed, it emerged that NMFSS were also unable to provide piston coring equipment and associated technical support, which had been requested in the Shiptime and Marine Equipment Form submitted in 2011. A piston coring capability was essential to achieving the objectives of the cruise, and a way of providing this capability was to upgrade the NIOZ gravity coring system that had been purchased by two BAS science programmes in 2010. Quotes for the components required to upgrade the system were obtained and Mike Webb agreed to fund the upgrade from the UK-IODP programme budget. The upgraded coring system is entirely compatible with NIOZ piston coring system operated by NMFSS, and Jez Evans of NMFSS provided valuable advice on the components that needed to be purchased and additional components that needed to be manufactured. Jack Schilling of the Royal Netherlands Institute of Oceanography (NIOZ) was contracted to assist with commissioning of the upgraded system and with mobilisation for a trial on JRtri008 in September 2014. Unfortunately, it was only possible to deploy the corer with one barrel during the trial because the ship's aft crane was out of action at the time, so the piston coring system had not been tested thoroughly prior to the cruise.

Another major new piece of equipment that had not been tested before the cruise was the Ocean Instruments giant box corer. This had been bought by BAS in 2014 as a replacement for a box corer that had been purchased from an Antarctic Funding Initiative grant 11 years before and had served many different projects. Unfortunately, the new giant box corer was delivered too late to be tested during the JRtri008 cruise in September.

The main aim of the UK-IODP grant that was the basis for JR298 was to obtain site survey data to support International Ocean Discovery Program (IODP) proposal 732-Full2, "Sediment drifts off the Antarctic Peninsula and West Antarctica" (Channell, Larter, Hillenbrand et al.). This drilling proposal was approved by the IODP Science Planning Committee (SPC) in 2010 with a very high ranking, but has not yet been scheduled for drilling because the *JOIDES Resolution* has been operating in other parts of the world since that time. The proposed drilling sites contain continuous sections with high sedimentation rates (Barker and Camerlenghi, 2002) that have the potential to be dated using relative (geomagnetic) palaeointensity (RPI) and, at relatively shallow water-depth sites, oxygen isotope stratigraphy (Vautravers et al., 2013). Six proposed sites target expanded Pliocene-Quaternary sequences, with two sites targeting the pre-Pliocene record at locations characterized by relatively thin younger sediment cover. Establishing precise chronological control on continuous records from the proposed sites will allow a range of questions about the history and climatic sensitivity of the Antarctic Peninsula Ice Sheet and West Antarctic Ice Sheet to be addressed.

Although proposal 732-Full2 was highly ranked by the SPC (since superseded by the Science Evaluation Panel in the new IODP structure), six of the eight proposed sites still lacked crossing multichannel seismic profiles, which are usually considered essential for safety reasons. Furthermore, the existing seismic profile network is quite sparse (Larter, 2008). An interpretation of these sparse seismic data tied to Ocean Drilling Program Leg 178 sites on one of the larger drifts ("Drift 7") showed the potential to relate drift development to changing patterns of Antarctic bottom current flow, glacial history and climate (Uenzelmann-Neben, 2006). Additional data were needed to enable a thorough analysis of drift growth and how it reflects changing conditions.

Although palaeomagnetic analyses on cores from drift sites drilled during Leg 178 suggest that the sites are suitable for application of RPI dating (Guyodo et al., 2001), the lack of complete composite sections precludes full verification of the potential of this technique. New piston cores from drift sites, sampled using u-channels for palaeomagnetic analyses, would provide an opportunity to demonstrate the full potential of RPI dating over the last glacial cycle. Additionally, cores from the shallowest parts of the drifts could be used to test the inference from sparse existing sites that carbonate preservation improves with decreasing water depth.

In summary, our main objectives on JR298 were to:

1. Obtain crossing multichannel seismic profiles through each of the proposed sites where these were lacking.
2. Collect networks of seismic profiles over two of the larger drifts that will provide a basis for a thorough analysis of how the drifts developed and the relation of drift growth to changing patterns of bottom current flow, glacial history and climate.
3. Collect piston cores from the drifts to verify the potential of RPI for high-resolution dating of Quaternary glacial cycles in this environment.
4. Collect piston cores from the shallowest part of each drift to test the hypothesis that carbonate preservation improves with decreasing water depth in this region and to test whether RPI records from the cores can be consistently calibrated against oxygen isotope records.

The cruise also provided an opportunity to develop a number of ancillary collaborative projects that required no dedicated ship time. Two such projects were enabled by funding from the Collaborative Gearing Scheme, one was made possible by an Antarctic Science Bursary, another was supported by Cambridge University and one was arranged between two BAS science programmes, drawing on National Capability funding.

Achievements

There are now crossing multichannel seismic lines at all of the proposed drill sites.

New multichannel seismic lines, acoustic sub-bottom profiles and multibeam echo sounding data collected over drifts 5 and 7, integrated with existing data, will enable a thorough analysis of drift growth and how it reflects changing conditions.

New multichannel seismic lines, acoustic sub-bottom profiles and multibeam echo sounding data collected over the Belgica Trough Mouth Fan, integrated with existing data, will enable a detailed analysis of the structure and development of this fan.

New multichannel seismic lines and potential field data over the Bellingshausen Gravity Anomaly will provide an opportunity to investigate the origin of the unusual structure underlying it that tilted early Cenozoic sediments, making them accessible locally by drilling to relatively shallow sub-sea-floor depth.

Seven new piston cores from sediment drifts, with recovered core lengths ranging from 9.4 to 12.93 m, will allow the potential of RPI for high-resolution dating of Quaternary glacial cycles in this environment to be verified. The cores will also provide a test of the hypothesis that carbonate preservation improves with decreasing water depth in this region and a test of whether RPI records from the cores can be consistently calibrated against oxygen isotope records.

New geophysical data, sediment core material and oceanographic data collected on the cruise will also provide the basis for a range of ancillary collaborative projects in fields including palaeoceanography, contourite sedimentology, sediment provenance analysis, seismic oceanography and modelling of crustal structure.

Successful operation of the upgraded NIOZ coring system, with support from a BAS Antarctic Marine Engineering technician and the JCR crew, provides NERC and BAS with an enhanced equipment pool and additional options for providing equipment and technical support for future coring cruises.

The new BAS giant box corer was used successfully and the cores recovered with it were of high quality, confirming that it was a worthwhile investment.

At short notice the cruise provided support for physical oceanography projects by deploying six Argo floats and rescuing a malfunctioning sea glider.

Four current PhD students and two early career postdoctoral researchers who completed their PhDs within the past two years gained valuable training and experience through participating in the cruise and being involved in a wide range of shipboard scientific work.

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5. Activity Reports

5.1 Seismic Profiling

Kelly Hogan, Ali Graham and Rob Larter

10 days of seismic surveying were carried out over the sediment drifts on the continental rise west of the Antarctic Peninsula (three surveys) and Bellingshausen Sea (two surveys) during JR298. Overall, five seismic surveys in the area of the proposed drill sites on the continental rise and slope were acquired totalling 1960 line-km of multichannel seismic (MCS) profiles (Table 1; Figures 3-7). The surveys were designed to acquire high-resolution MCS profiles at right-angles to one another (or to existing seismic lines detailed in the IODP proposal) over the proposed drill sites, and to provide information on the architecture of the drift deposits, and their relationships to sedimentary units on the Western Antarctic continental slope and shelf.

Approximately 20 hours of acquisition at the first, most northerly survey area (around PEN-1) during the early part of the cruise was followed by transit to the most western and southern survey area (around BELS-2/3) because weather conditions and forecasts indicated that conditions would make survey work difficult at sites between the most northern and southern/western study areas. After surveying at BELS-2/3 was complete seismic surveys were carried out from west/south to north, i.e., in the area of BELS-1 followed by PEN-3/4/5, and finally at PEN-2. Owing to poor sea-ice and weather conditions during JR298 several surveys (surveys B and D) had to be reduced in size in order to obtain the necessary site survey profiles during periods of good weather and favourable sea-ice conditions.

Survey A: PEN-1 area (2225 on JD33 to 0000 on JD34)

The first seismic survey was acquired in the area of the proposed PEN-1 drill site (Fig. 3) with a full streamer length and recordings on all channels (2.4 km-long streamer; 192 channels). Line BAS145-39 was acquired in approximately a NNW-SSE orientation along the crest of Drift 4 and through the PEN-1 site. The line intersects several older seismic profiles including a line through the ODP site 1101, which drilled on the distal part of Drift 4. BAS145-39 extends up the continental slope and on to the continental shelf where it should image relationships between sedimentary units in Drift 4 and those on the continental margin. BAS145-40 was acquired parallel to the shelf break and across the mouth of Biscoe Trough, a glacially-eroded cross-shelf trough. BAS145-41 provides a second dip profile across the continental margin (shelf break-slope-rise) but in a location without a drift deposit. BAS145-42 was acquired parallel to the continental margin and crosses over the proposed PEN-1 site; it also intersects several older seismic profiles including Petrobras line A5000015 through PEN-1. In general, the quality of the MCS data during acquisition appeared to be good, although channel 190 persistently recorded noisy traces and bands of swell noise were apparent in the near-offset traces.

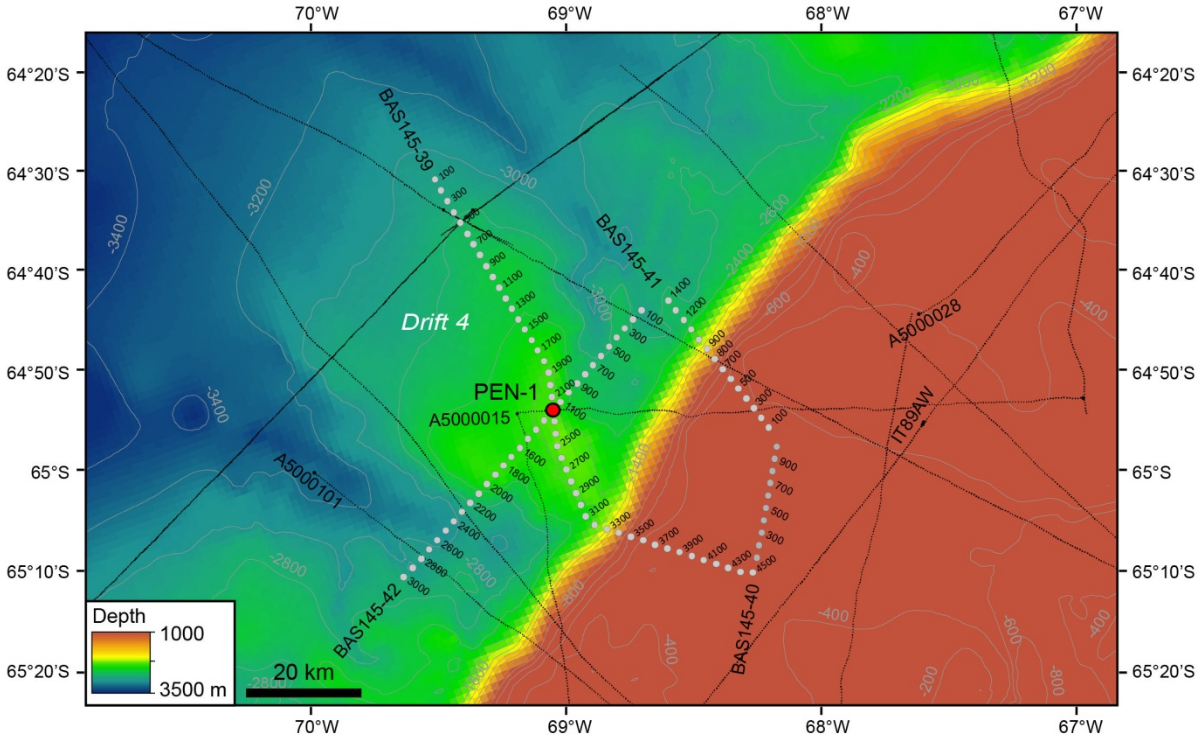


Figure 3. Seismic survey A in the PEN-1 area comprising lines BAS145-39 to BAS145-42. Time and date of acquisition for each seismic line is given in Table 1. Note that for Figures 3-7 the plotted shot locations depict the ship's position rather than the position of the seismic source during acquisition.

Preliminary observations: A brute stack of Line BAS145-40 on the continental shelf revealed what appear to be up to two semi-transparent to chaotic seismic units (tills?) beneath the seafloor in Biscoe Trough; one similar unit on the adjacent bank to the north at around 0.85 seconds TWTT appears to pinch out towards the trough in the south. A near-offset trace (Trace 5) from Line BAS145-42 over Drift 4 shows a package of relatively continuous stratified reflections from the seafloor down to the silica diagenesis zone around 4 seconds TWTT, and what looks to be a fault-bounded graben in the central part of the drift. In addition, oceanic basement was clearly imaged across the line around 6 seconds TWTT.

Survey B: BELS-2/3 area (1808 on JD38 to 0308 on JD39)

Survey 2 was acquired over the sediments in the area of the Bellingshausen Gravity Anomaly in order to collect seismic profiles over the proposed BELS-2C and BELS-3B drill sites. Due to large icebergs and smaller bergy bits (“growlers”) in the vicinity of the survey area only half of the streamer was deployed to reduce the risk to the streamer, i.e., 1.2 km-long streamer with 96 channels (Ch. 97-192) deployed. Following the noisy return observed in channel 190 during Survey A this channel was muted during Survey B. In total, the survey comprised five lines and 200-line km of MCS profiles. The extent of the seismic survey in the southern part of the area had to be reduced in order to avoid a band of sea-ice and icebergs south of around 69°50’ S.

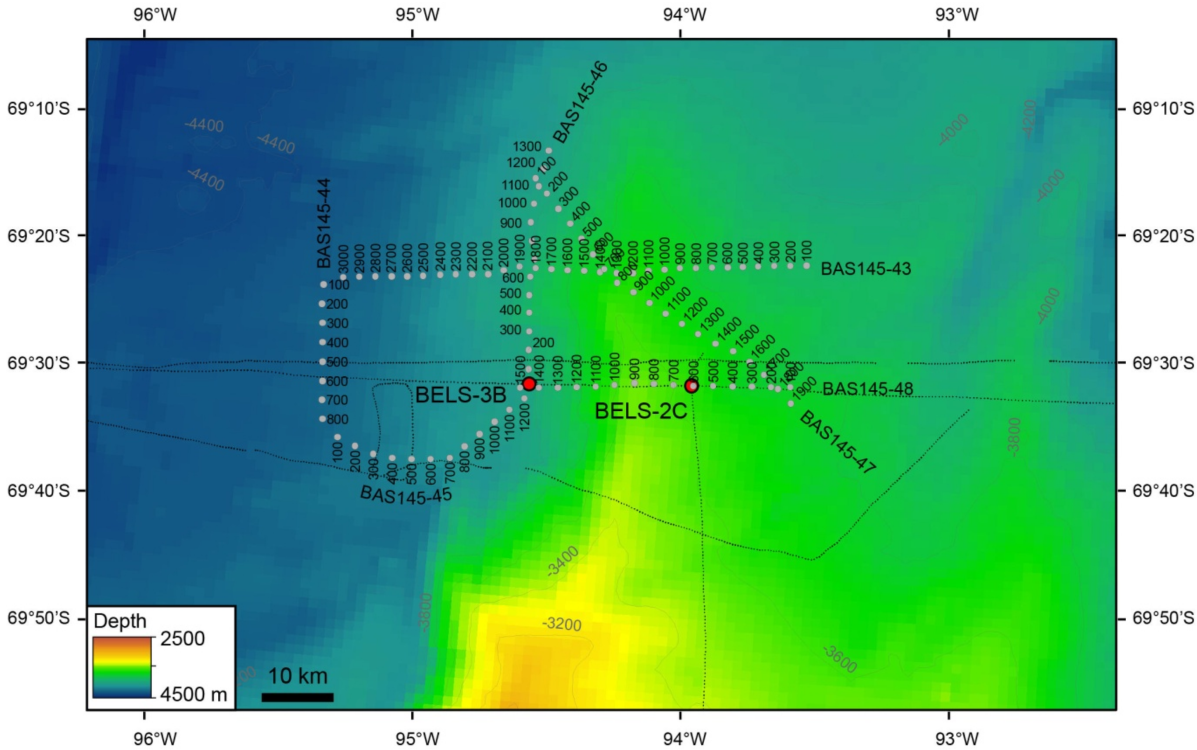


Figure 4. Seismic survey B in the BELS-2/BELS-3 area comprising lines BAS145-43 to BAS145-48 (see Table 1).

Figure 4 shows the location of the five profiles of Survey B. BAS145-43 and BAS145-48 represent two strike lines across the distal part of the sediment drift; BAS145-48 crosses over the proposed BELS-2C and -3B drill sites. BAS145-46 provides an intersecting dip line over the BELS-3B site on the western flank of the drift deposit. BAS145-44 and -45 provide N-S and approximately W-NE lines, respectively, to the west of the drift. These lines intersect with previous seismic profiles in the area allowing the new MCS lines to be correlated with seismic units identified from older profiles (e.g., AWI94043). During the collection of seismic line BAS145-47 it was noted that readings from the towed magnetometer were abnormal (large spikes from 18:05 on 08/02/15; shot 885 on line BAS145-47). When checked it was clear that the magnetometer had become tangled with the seismic streamer. After the end of line BAS145-47, around 100 m of the streamer was brought on deck to untangle the magnetometer from bird 1 on the streamer; the streamer was then redeployed for line BAS145-48. No degradation of the seismic traces was observed on the incoming data stream during acquisition of line BAS145-47 because of the magnetometer being wrapped around the streamer.

Preliminary observations: A brute stack of line BAS145-43 across the distal part of the sediment drift shows an approximately 2 seconds (TWTT) thick sedimentary sequence down to oceanic basement. The upper sediment package includes a band of high-amplitude reflections at its base, which is bottom-simulating and cuts across stratigraphic reflections, s is presumably part of the silica diagenesis zone.A basement high, which interrupts a mostly flat-lying basement reflection in the western part of the line, may have a compressional origin (cf. Gohl et al., 1996; Cunningham et al., 2002, 2003). At the sea floor, sediment waves are imaged on the eastern flank of the drift. Line BAS145-45, which crosses the drift in a more proximal location, shows the same oceanic basement high sub-cropping to within ~0.12 seconds TWTT of the seafloor. Several units with chaotic internal character and variable thicknesses are also imaged in the shallow part of the sediment pile; these can probably be interpreted as debris-flow units.

Survey C: BELS-1 area (0107 on JD42 to 2227 on JD43)

Four MCS profiles totalling about 367 line-km were acquired over Depocentre B of Scheuer et al. (2006a, b), which corresponds to the the distal part of the Belgica trough-mouth fan (TMF; Figure 5; Dowdeswell et al., 2008). The proposed BELS-1 drill site is on a slightly elevated part of the sea-floor beneath which the uppermost package of reflections has a drift-like character. As in Survey 2, only half of the streamer length was deployed because of icebergs and bergy bits in the vicinity of the survey area at the start of the survey. Channels 189 and 190 were both muted because traces from channel 189 became increasingly noisy during the last line of Survey 2. During the survey the weather varied from slightly “choppy” to “choppy” with a significant roll during the last line of the survey (sea state 5-6, wind 26 knots from shot 1350 on line BAS145-51). In order to reduce the low frequency noise observed in the incoming data a digital 5 Hz low-cut filter was applied to the traces prior to recording (NOTE: a 5 Hz filter was applied to the raw SEG-D data of all lines acquired from

BAS145-49 onwards).

MCS profiles BAS145-49 and -51 are strike lines across the lower and distal parts of the Belgica TMF, respectively (BAS145-49 bearing 080˚; BAS145-51 bearing 260˚). Line BAS145-50 was acquired along dip on TMF, perpendicular to the margin in deeper water east of BELS-1 but. It intersects AWI line 20010001 from which Depocentre B was identified, and from which the BELS-1 proposed drill site was selected. Line BAS145-52 is nearly 170 km long, and it runs approximately N-S up the Belgica TMF crossing both line AWI20010001 and the BELS-1 drill site. The southern end of this line also crosses line BAS923-S27, a two-channel line collected on cruise JR04.

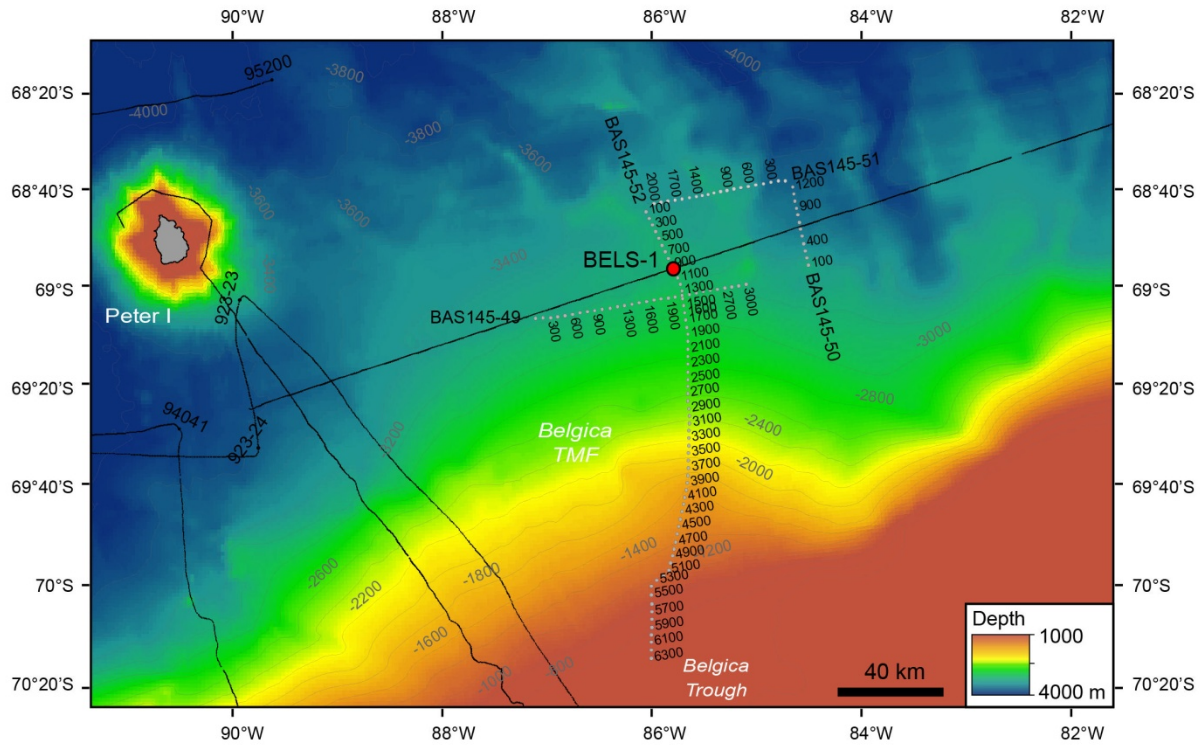


Figure 5. Seismic survey C in the BELS-1 area comprising lines BAS145-49 to BAS145-52 (see Table 1). Belgica TMF is Belgica trough-mouth fan.

Preliminary observations: A brute stack of line BAS145-51 across the distal part of Belgica TMF images two sediment packages above oceanic basement, which occurs at around 2 seconds TWTT below sea floor. The upper package includes low to medium amplitude, continuous reflections with drift-like characteristics; the lower package contains high to medium amplitude reflections that are more discontinuous. Within the upper sediment package there is evidence for larger-scale deformation of the sediments including faulting, and a sub-package of reflections that may represent an early drift deposit phase. To either side of the crest of the drift-like unit there is evidence of large-scale debris flow deposits at the sea floor.

Survey D: PEN-3/4/5 area (2013 on JD48 to 1738 on JD52)

The survey over the PEN-3/4/5 area consists of eight MCS profiles (BAS145-53 to BAS1245-60) totalling 569 line-km of seismic data. As there were no icebergs or bergy bits in the survey area the full streamer length was again deployed for this survey (i.e., 2.4 km-long streamer) and the streamer section with the non-functioning channels 189 and 190 was replaced. Due to time constraints the survey carried out was reduced in size compared to what has originally been planned. Noisy data on the last two lines of the survey can be attributed to poor weather conditions which caused a pitching motion of the vessel that affected the nearest channels on the streamer.

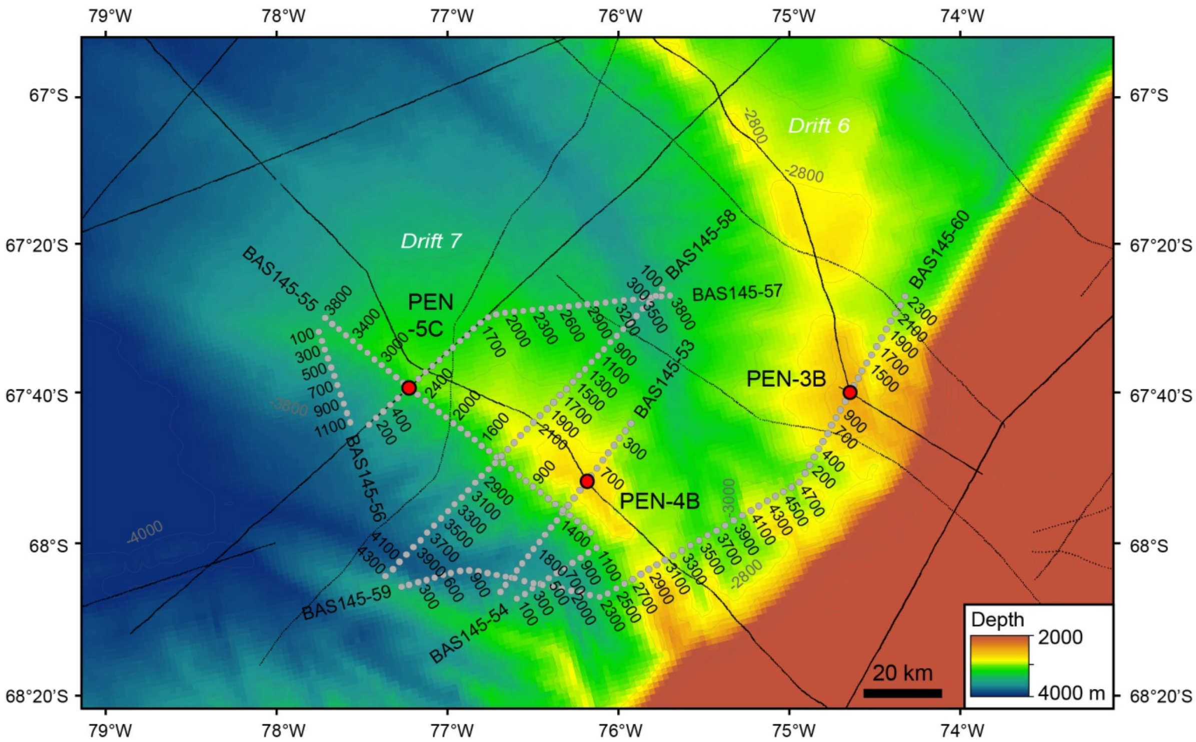


Figure 6. Seismic survey D in the area of PEN-3B, -4B and -5C proposed drill sites on drifts 6 and 7. The survey comprises lines BAS145-53 to BAS145-60 (see Table 1).

MCS line BAS145-55 was acquired along the southwest-facing slope of Drift 7 and along with BAS145-57 it provides new high-resolution seismic data over the PEN-5C site (Figure 6). Lines BAS145-53, -57, -58, and -59 cross Drift 7 in a strike direction (i.e., parallel to the continental margin); BAS145-53 intersects the proposed PEN-4B drill site. The final line of this survey, BAS145-60, runs parallel to the continental margin over drift6, and provides an intersecting MCS profile over the PEN-3B site (crossing an existing Italian line). On lines

BAS145-59 and -60 the streamer was lowered (from 4.5 m to 5 m tow depth) to try to reduce the effect of large swells and the resulting ship motion on the incoming data.

Preliminary observations: A brute stack of line BAS145-57, which runs approximately E-W on the distal part of Drift 7 and crosses the PEN-5C proposed drill site, shows at least 2 seconds TWTT of sediments above oceanic basement. The sediment package comprises mostly continuous reflections but with varying amplitudes; the silica diagenesis zone occurs around 500 ms beneath the seafloor. At the proposed PEN-5C site the upper part of the sediment package appears to form part of a large rotated block, the base of which occurs at 4.9 seconds TWTT. Beneath this, reflections are flat-lying and continuous. At the eastern end of the line (shots 3400-3700) the seismic profile crosses Alexander Channel which appears to contain up to 300 ms of infill.

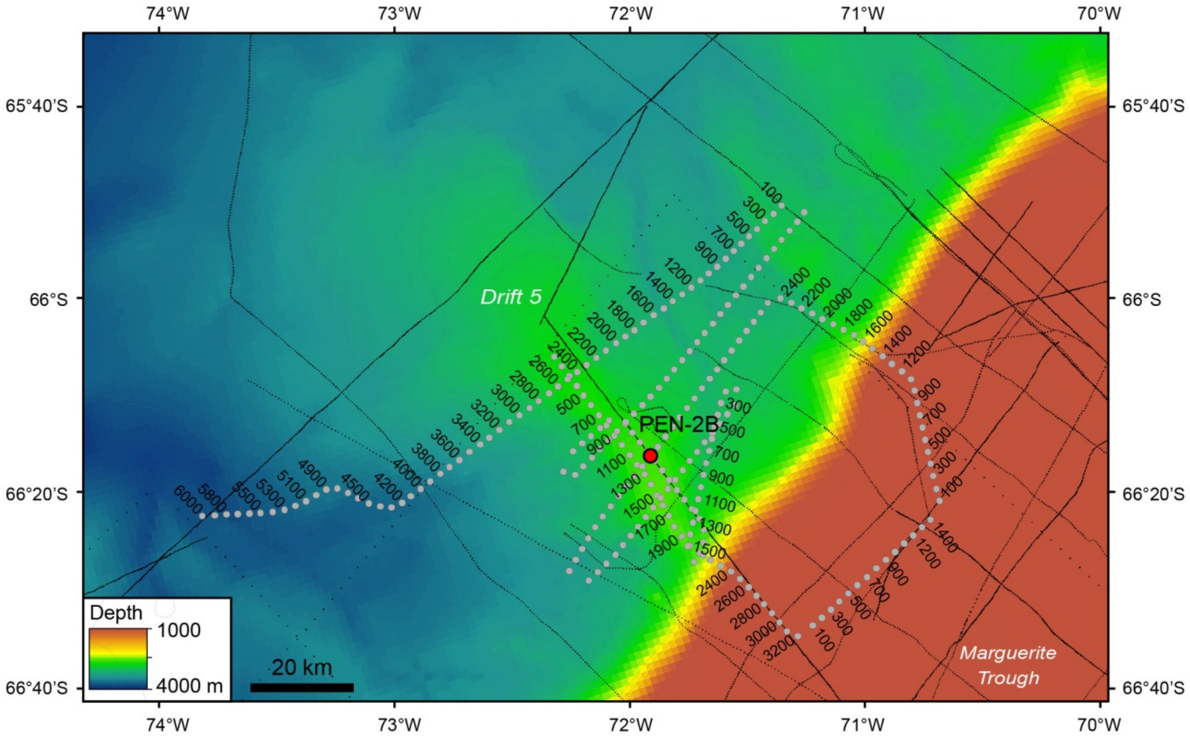
Survey E: PEN-2 area (05:56 on JD 053 to 04:41 on JD56)

A total of 578 line-km of MCS profiles were collected on a survey over Drift 5 and the adjacent continental shelf at the seaward end of Marguerite Trough, a prominent cross-shelf trough that was occupied by a large ice stream during the Last Glacial Maximum. The survey consists of ten seismic profiles (BAS145-61 to BAS145-70) shot with a full streamer length and good operation of all channels (Ch. 1-192).

Seismic line BAS145-61 was shot along the crest of Drift 5 in a NW-SE orientation; it extended on to the continental shelf in the western part of outer Marguerite Trough (Figure 7). Line BAS145-62 was acquired in a strike direction across outer Marguerite Trough and line -63 crosses over a sedimentary body on the outermost shelf. Line BAS145-63 was acquired across the continental margin extending from the eastern part of Marguerite Trough; this line provides a profile across this glaciated continental margin that does not cross a prominent sediment drift and so should be of interest when compared directly with Line 145-61 over Drift 5. Line BAS145-64 was acquired parallel to the continental margin and crosses the proposed PEN-2B drill site; BAS145-67 intersects -64 at the PEN-2B site. Additional lines on the survey were acquired to obtain sub-seafloor images of sediments in deeper, inter-drift locations.

Preliminary observations: Because Seismic Survey E occurred towards the end of the cruise very few of the MCS lines were studied on board. A brute stack of part of line BAS145-63 (shots 180 to 900) in the outer part of Marguerite Trough shows that the sedimentary body (grounding-zone wedge?) consists of chaotic reflections and a well-defined base.

Interestingly, there also appear to be sub-parallel reflections sub-cropping on the shelf that may represent older sedimentary bodies related to past glacial extent in the trough.



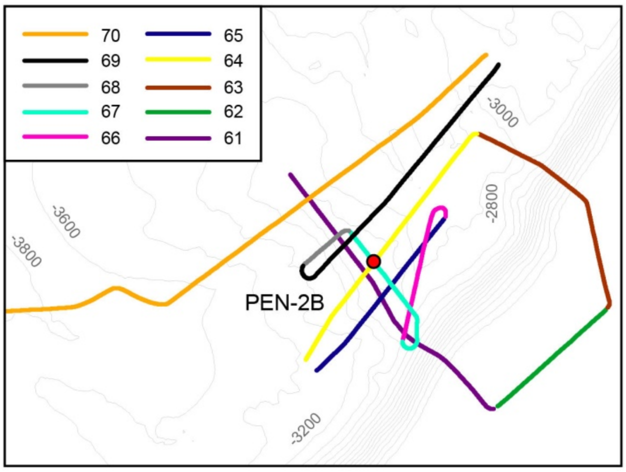


Figure 7. Seismic survey E in the area of PEN-2B proposed drill site on Drift 5. The survey comprises lines BAS145-61 to BAS145-70 (see Table 1). Inset shows the location of the lines by number.

Table 1. Seismic line start and end times and positions.

Line (BAS145-)	Start				End				Length (km)
	JD	Time (UTC)	Latitude	Longitude	JD	Time (UTC)	Latitude	Longitude	
39	**33**	**22:25**	**64° 29.9' S**	**69° 32.1' W**	**34**	**10:55**	**65° 10.2' S**	**68° 16.2' W**	**95.7**
40	**34**	**10:55**	**65° 10.2' S**	**68° 16.2' W**	**34**	**14:01**	**64° 56.9' S**	**68° 10.7' W**	**25.0**
41	**34**	**14:01**	**64° 56.9' S**	**68° 10.7' W**	**34**	**18:04**	**64° 42.5' S**	**68° 37.2' W**	**33.9**
42	**34**	**18:25**	**64° 43.1' S**	**68° 40.3' W**	**35**	**00:00**	**65° 01.6' S**	**69° 18.7' W**	**45.7**

43	**38**	**18:08**	**69° 22.3’ S**	**93° 28.1’ W**	**39**	**02:28**	**69° 23.3’ S**	**95° 15.1’ W**	**69.9**
44	**39**	**02:32**	**69° 23.3’ S**	**95° 16.0’ W**	**39**	**05:18**	**69° 34.9’ S**	**95° 19. 9’ W**	**24.2**
45	**39**	**05:18**	**69° 34.9’ S**	**95° 19. 9’ W**	**39**	**09:31**	**69° 32.1’ S**	**94° 33.7’ W**	**36.2**
46	**39**	**09:32**	**69° 32.0’ S**	**94° 33.7’ W**	**39**	**13:59**	**69° 12.7’ S**	**94° 29.0’ W**	**35.7**
47	**39**	**15:08**	**69° 14.4’ S**	**94° 34.6’ W**	**39**	**21:36**	**69° 33.7’ S**	**93° 34.0’ W**	**35.9**
48	**39**	**22:23**	**69° 32.0’ S**	**93° 31.3’ W**	**40**	**03:27**	**69° 32.1’ S**	**94° 36.5’ W**	**43.6**
49	**42**	**01:07**	**69° 06.9’ S**	**87° 10.4’ W**	**42**	**14:04**	**68° 57.3’ S**	**84° 30.3’ W**	**107.7**
50	**42**	**14:05**	**68° 57.3’ S**	**84° 30.1’ W**	**42**	**18:15**	**68° 39.0’ S**	**84° 39.5’ W**	**34.2**
51	**42**	**18:17**	**68° 38.9’ S**	**84° 39.5’ W**	**43**	**01:15**	**68° 43.4’ S**	**86° 01.7’ W**	**55.9**
52	**43**	**01:18**	**68° 43.5’ S**	**86° 02.2’ W**	**43**	**22:27**	**70° 15.1’ S**	**86° 00.0’ W**	**169.6**
53	**48**	**20:13**	**67° 43.2’ S**	**75° 53.3’ W**	**49**	**03:00**	**68° 06.7’ S**	**76° 41.8’ W**	**57.9**
54	**49**	**03:33**	**68° 08.0’ S**	**76° 38.2’ W**	**49**	**06:49**	**67° 59.8’ S**	**76° 06.6’ W**	**28.4**
55	**49**	**06:55**	**67° 59.4’ S**	**76° 07.1’ W**	**49**	**17:28**	**67° 30.1’ S**	**77° 42.7’ W**	**89.5**
56	**49**	**17:55**	**67° 30.8’ S**	**77° 46.1’ W**	**49**	**21:07**	**67° 44.8’ S**	**77° 33.1’ W**	**28.3**
57	**49**	**21:26**	**67° 45.2’ S**	**77° 29.9’ W**	**50**	**08:09**	**67° 27.0’ S**	**75° 39.7’ W**	**91.8**
58	**50**	**09:05**	**67° 25.2’ S**	**75° 42.1’ W**	**50**	**21.03**	**68° 04.5’ S**	**77° 21.7’ W**	**104.5**
59	**50**	**22:04**	**68° 06.3’ S**	**77° 19.0’ W**	**51**	**11:11**	**67° 51.9’ S**	**74° 55.9’ W**	**113.7**
60	**51**	**11:11**	**67° 51.9’ S**	**74° 55.8’ W**	**51**	**17:38**	**67° 27.0’ S**	**74° 19.0’ W**	**54.6**
61	**53**	**05:56**	**66° 05.2’ S**	**72° 20.9’ W**	**53**	**14:49**	**66° 34.8’ S**	**71° 17.4’ W**	**74.9**
62	**53**	**14:57**	**66° 34.5’ S**	**71° 15.7’ W**	**53**	**19:01**	**66° 22.4’ S**	**70° 41.9’ W**	**34.6**
63	**53**	**19:06**	**66° 22.0’ S**	**70° 41.1’ W**	**54**	**01:48**	**66° 00.0’ S**	**71° 21.6’ W**	**56.4**
64	**54**	**01:51**	**65° 60.0’ S**	**71° 22.1’ W**	**54**	**09:45**	**66° 28.6’ S**	**72° 16.0’ W**	**67.9**
65	**54**	**10:21**	**66° 30.0’ S**	**72° 12.5’ W**	**54**	**15:59**	**66° 10.8’ S**	**72° 32.7’ W**	**47.3**
66	**54**	**16:03**	**66° 10.5’ S**	**71° 32.1’ W**	**54**	**20:21**	**66° 26.0’ S**	**71° 45.4’ W**	**36.1**
67	**54**	**20:25**	**66° 26.4’ S**	**71° 45.5’ W**	**55**	**00:44**	**66° 12.5’ S**	**72° 02.0’ W**	**36.7**
68	**55**	**00:47**	**66° 12.3’ S**	**72° 02.4’ W**	**55**	**02:26**	**66° 16.6’ S**	**72° 16.4’ W**	**13.5**
69	**55**	**02:29**	**66° 16.8’ S**	**72° 16.9’ W**	**55**	**11:06**	**65° 51.2’ S**	**71° 15.5’ W**	**72.3**
70	**55**	**11:46**	**65° 49.8’ S**	**71° 19.3’ W**	**56**	**04:41**	**66° 22.5’ S**	**73° 52.1’ W**	**137.9**

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Scheuer, C., Gohl, K. and Eagles, G., 2006b. Gridded isopach maps from the South Pacific and their use in interpreting the sedimentation history of the West Antarctic continental margin. *Geochemistry, Geophysics, Geosystems,* 7, Q11015, doi:10.1029/2006GC001315.

5.2 Onboard seismic processing (with GLOBE Claritas)

Ali Graham

This section provides a brief overview of the processing carried out for newly-acquired multi-channel seismic (MCS) reflection data on board cruise JR298. A background to the processing personnel and their responsibilities is provided firstly, followed by an overview of the software used, some initial details of the processing steps and work-at-sea, and a record of issues encountered. Finally, a post-cruise seismic processing workflow is presented which will be implemented upon return to the UK.

5.2.1. Background and responsibilities

The initial processing of multi-channel seismic reflection data for the UK-IODP site survey investigation was tasked to A. Graham (University of Exeter), who is funded to undertake work on the project over the next 24 months (October 2014 to October 2016). With support from PI Larter and Project Partners, the data will be processed and presented to IODP as site survey information ahead of proposed drilling on the crests and flanks of the drift sites. Subsequent analysis and interpretation responsibilities will be divided up between the project team once processing of the data has been completed.

On board, A. Graham took on the main role of processing the new MCS data, with discussion and advice from RDL, KAH, JH-M, and RP. Kathy Gunn (University of

Cambridge) took charge of processing water-column data for seismic oceanography, which is discussed in section 5.3 of this cruise report.

5.2.2. Software and pre-cruise training

In preparation for JR298, early in 2014, project Co-I Graham acquired a single-user license for the seismic processing software package GLOBE Claritas; its chief purpose, to be used as an alternative to ProMax in the manipulation and processing of seismic reflection datasets acquired on JR298. This processing package had been recommended by colleagues processing large MCS datasets, and was chosen based on its affordability and versatility (supported on both Windows and Linux platforms). Graham and PI Larter attended an 'Introduction to Marine Processing with Claritas' training course at Amsterdam-PG in June 2014 to gain experience of processing using the software. GLOBE Claritas was installed on a University of Exeter laptop ahead of the cruise, running through Cygwin-X (32-bit).

5.2.3. Marine Processing onboard with Claritas: work-at-sea

Objectives and summary of tasks

The objective of 2D seismic processing in any marine environment is to form an image of the subsurface in which only the primary reflections from the scattered wavefield are maintained, whilst other noise or unwanted energy is removed or attenuated. A full processing flow to achieve that purpose will be implemented post-cruise, and is outline further in section 5.2.7. However, for work on JR298, the achievable processing objectives were set at: (1) being able to read and image the newly-acquired data, and (2) to begin some of the steps towards processing those data, ideally producing brute stacks (rough first-pass stacked data) for a selection of the lines to allow for initial appraisal and discussion.

The main onboard seismic processing tasks thus comprised of:

1. Reading in data, and converting to useable formats (from SEG-D to SEG-Y and subsequently to a more usable Claritas internal format; .hdf5)
2. Imaging and providing QC of the new data, understanding trace headers and shot information.
3. Producing initial near-trace plots of the seismic lines.
4. Re-familiarisation with Claritas software and the various modules for MCS processing.
5. Establishing an initial processing flow to reach brute stack stage.

6. Producing some brute stacks and plots for a number of lines of interest.
7. Carrying out initial tests of processing steps to be applied later (trace editing, picking of velocity function, filter tests for noise removal)

Commentary of work-at-sea

The first week at sea was spent re-familiarising with Claritas software, having only used the package for one week during the summer of 2014 and for a number of days immediately prior to joining the ship. Several days were spent using existing SEG-Y data from previous BAS seismic surveys to test some of the modules, and to begin designing some useable processing flows for later application. Useful and successful tests of the geometry, seg-y analyser, trace editing and plotting tools were undertaken.

Once MCS acquisition began, Claritas was used to begin work on the new profiles. An initial challenge encountered was handling the data itself; individual lines often amounted to >20 GB in size (individual shots at ~7MB each). Because Claritas has a number of functions that require an internal data format to be used (*.HDF5 format), considerable disk space was needed to convert SEG-D data to SEG-Y and subsequently into workable HDF5 files. A work-around for lack of primary disk space on local machines was to write larger files to the ship's '*legwork*' drive, and to read data directly from remote network locations. Regardless of network or local data access, seismic processing steps were often heavily time-consuming and required stringent disk management in order to work effectively. Processing was therefore slower all-round than first anticipated.

The first MCS lines were acquired early on in the cruise in the PEN-1 working area (e.g. BAS145-39) which allowed for some initial testing and revising of work flows. To assess data quality, SEG-D data were read in sequentially and converted to SEG-Y and subsequently into HDF5 file format. Near-trace plots were then produced as an initial data QC (normally on Channel 5, and with a number of 'quick and dirty' shot processing steps, as described below, already applied). Subsequent steps were then established for the pre-stack processing of shots: these comprised (i) application of simple in-line geometry so that shots could be sorted to CDP, (ii) true amplitude recovery, and (iii) noise attenuation.

Pre-stack shot processing: A simple in-line marine geometry was set-up for each seismic line based on the source and receiver configurations during acquisition (Figure 8). Two main configurations were used, one appropriate for a 192 channel full-streamer, the other for a 96 channel half-streamer. In addition, streamer depth varied occasionally along line, because of weather conditions, and this will need to be taken into account in the set-up of a full geometry. Another parameter that will vary for each seismic line is shot spacing – here a nominal 25 m was used to define shot intervals, but more accurate spacings will be needed for final processing. The geometry was applied using the MGEOM module in the pre-stack shot processing flow.

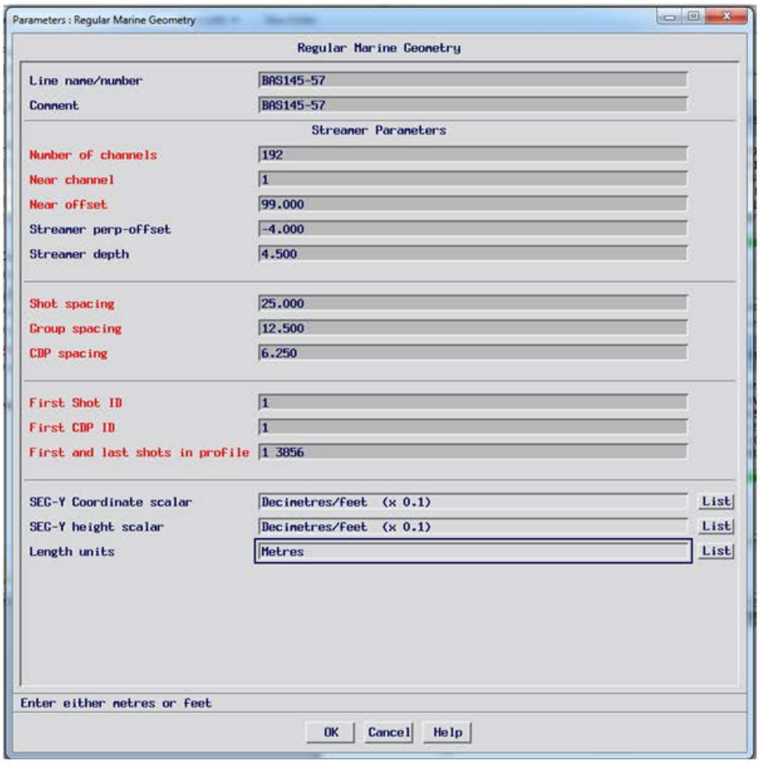


Figure 8: Screenshot example of the 'Marine' tool used to define simple in-line geometry for marine seismic data.

For all lines worked on aboard, shots were first processed with a bandpass (BP) filter to cut out high and low frequency noise. The cuts for the filter were established based on interactive frequency analysis of the raw data, using both the ‘frequency analysis histogram’ tool and ‘FK spectrum’ tool as well as ‘on-the-fly’ processing options in the Claritas SV/XVIEW module. Typical parameters settled on for the BP filter were:

Low stop: 5 Low pass: 100 High pass: 16 High stop: 150 (Hz)

Within the same flow, filtered data were subsequently passed into the SPHDIV module (spherical divergence). Spherical divergence compensates for the attenuation in seismic wave amplitude due to the geometrical spreading of the wavefront through the various velocity layers of the subsurface, and to loss of energy through dissipation. Attenuation is removed by multiplying the samples of the traces by a vector of scalars (power of the time, power of the velocity, a power of the offset, and a fourth exponential term). A time-velocity function also needed to be defined as part of the SPHDIV processing step. Velocity models for SPHDIV were initialised based on user-specified V(t) pairs which were used to produce a linear velocity structure. Values were based initially on Hamilton's (1979) velocity depth relationships for deep sea environments which equate to ~1.5 km s^{-1} at the sea floor, ~1.9 km s^{-1} at 1 km below the sea floor, and ~2.7 km s^{-1} between 1-2 km below sea bed. An *.nmo file was produced approximating these velocities and used in the SPHDIV module.

Another part of True Amplitude Recovery uses the SCALE function in Claritas to apply scaling functions to the seismic data. This option was not commonly used, and was largely removed in the processing of later lines, because the result of some initial attempts (applying 6 dB/sec of gain from 0 to 6 seconds in the upper part of the line) led to over-gaining in parts of the record near to the sea floor (e.g. plot of BAS145-42). However, a revised and more appropriate function which applies 1 dB of gain/sec from the sea floor down appears to lead to more promising results and will be tested further post-cruise.

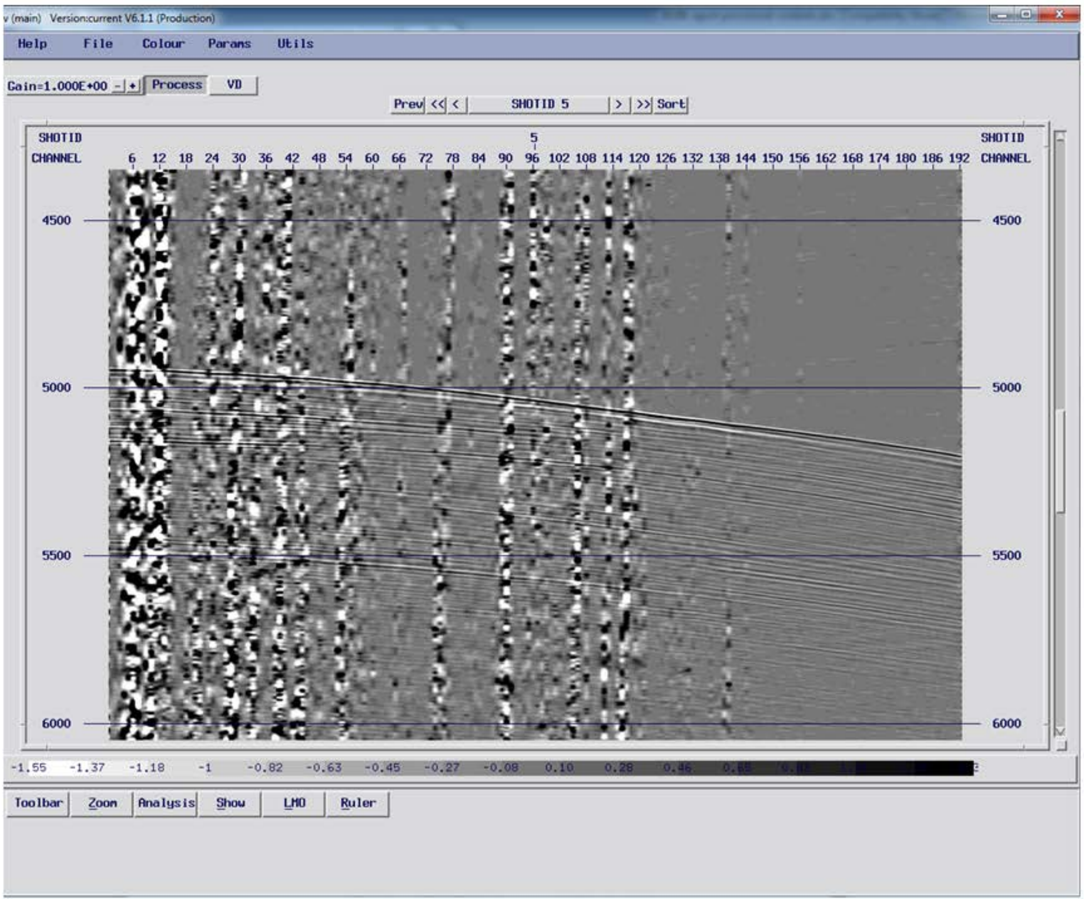


Figure 9. Shot #5 from BAS145-57 showing prominent vertical noise in the data (BP filter applied); near-offset channels appear particularly affected.

For several lines, the trace editing features of Claritas were also experimented with pre-stack in an attempt to remove vertical noise (Figure 9) that was still evident in the brute stack (e.g. BAS145-43). The AREAL module was used to output peak RMS amplitudes for the pre-stack MCS line, and the ‘areal’ tool subsequently used for interactive selection of anomalous amplitudes that might represent bad traces in the data. These selections could then be implemented through the TREDIT module as part of a number of iterative runs of the pre-stack processing flow. The tool can also be used to remove a percentage of the amplitudes at either end of the data range (e.g. all traces can be flagged with amplitudes above a user-defined dB limit). For line BAS145-43 this proved useful for removing some obvious bad traces although was not successful in removing the majority of the vertical noise observed.

Through the above steps, the shots were processed and written out to a new file: typically named *job2.job, for continuation.

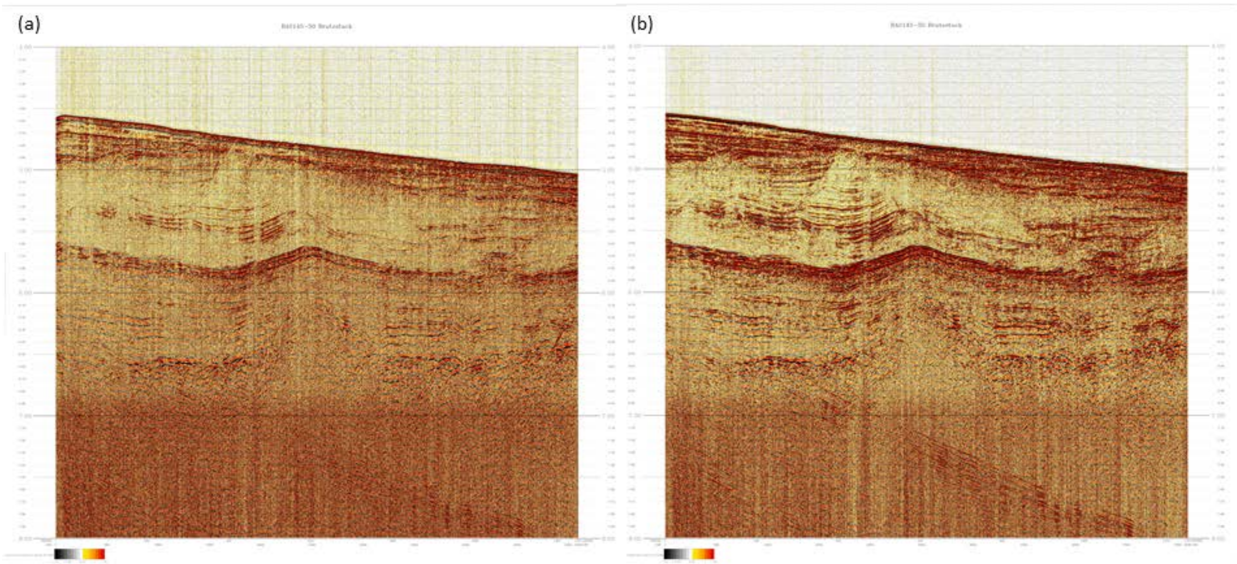


Figure 10. Comparison of brute stacks produced using different stacking velocities. (a) Image of multi-channel seismic line BAS145-51 stacked with basic linear velocity model; (b) image of the same line, stacked using RMS velocities picked from a single CDP position (CDP 100).

Stacking: For stacking, the pre-stack processed data were read into a new flow which sorted shots to CDP, applied an NMO correction, and then stacked the dataset. Stacked data were written out as a ‘brute stack’. For stacking itself, interval velocities defined above were converted to RMS stacking velocities using the ‘Vrms to Vint’ tool in Claritas with the ‘InvDix’ algorithm selected. Although this initial velocity model wasn’t always appropriate for the section in question, semblance analysis could be used after brute stack to manually pick stacking velocities from CDP gathers (within the 'isovels' tool). Even with a single V(t) profile, application of a new picked velocity function was shown to improve significantly upon the first-pass stacking result (e.g. BAS145-50; Figure 10). For several lines (e.g. BAS145-57), more detailed velocity picking has begun, which promises to improve the processed output even further (Figure 11).

The above flows were run and re-run through various iterations and parameter tests for 10 of the 31 MCS lines acquired on-board. Brute stacks were made for 8 of the lines in total.

5.2.4. Typical processing flow onboard for each seismic line worked on:

Job name	**Description**
0_segd_to_segy	Read in a list of SEG-D data files shot-by-shot and write out to a single SEG-Y file for the entire line. Typically stored to legwork and removed later.
1_segy_to_hdf	Convert the SEG-Y file to a single or a number of individual .hdf5 files, for further processing in Claritas. Typically named according to shots (e.g. BAS145-43_raw_1-800.hdf5) N.B. Claritas could only handle individual data files <~7 GB in size. A work-around for this was to chunk the data into shot groupings (e.g. 1-800,801-1250), use a LISTFILE and read in data to a flow sequentially. XEDT can be used to manipulate text files, strip blank lines, and carriage returns (non-printing digits).
1b_hdf_channels	For lines where only a 1200m streamer was deployed, a further conversion was carried out to isolate channels 97-192 and then renumber the channels in the trace header to 1-96 (using the module SETHEADER, and with the input as CHANNEL=CHANNEL-96). This was necessary in order to achieve a correct geometry later on (the MGEOM module expects either 1 or 96 to be the near channel if 96 channels are specified). At the end of this step, we'd expect to have a set of files ready for shot processing.
2_neartraceplot	If desired, a near trace plot could be viewed in XVIEW or plotted using RASTER and PLOTLABEL to check the data.

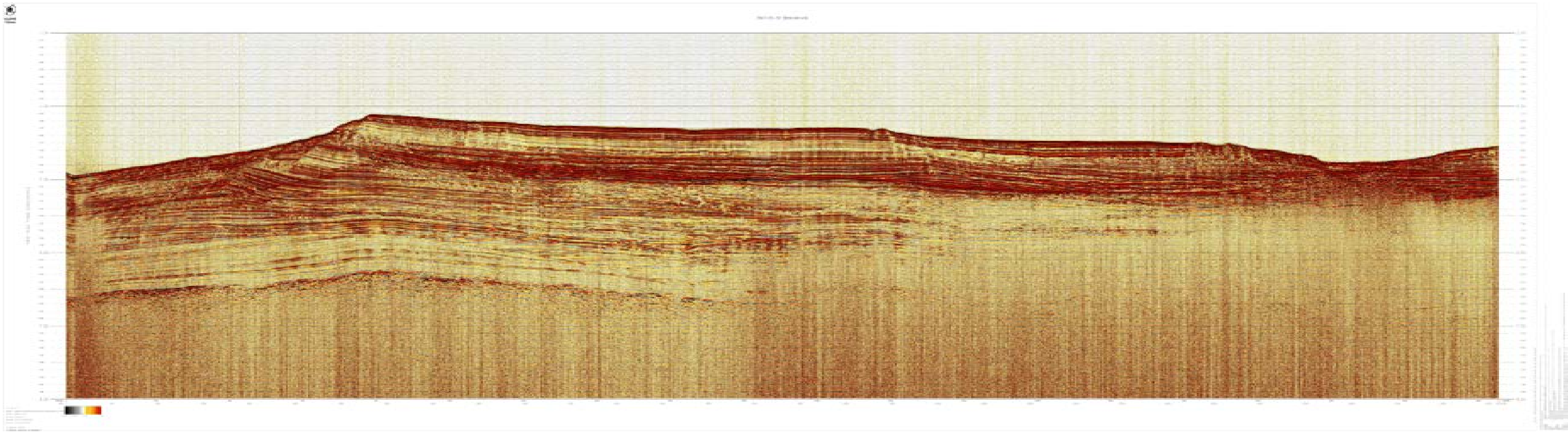


Figure 11. BAS145-57 Brute stack. The left portion of the line is constrained by detailed velocity picks while the right hand half (from approximately centre) is constrained by a basic linear velocity model.

3_TARa/b/c_shotsn-n	Applied an initial shot processing flow to each set of the raw shot files, labelled as a,b,c etc. Each module in the flow was supported by a number of QC steps in XVIEW prior to running the job (e.g. frequency histogram analysis, checking for noisy traces, filter processing tests). Once parameters were set, the flow then applied the following: True Amplitude Recovery: Spherical Divergence with SPHDIV using user-defined V(t) pairs; Linear scaling if required using SCALE – typically 1dB/sec. Bandpass Filter: typical corner frequencies 5-16-100-150 Hz Output Peak amplitudes to *.tre file for later trace editing in AREAL
4_brutestack	Sort to CDP. Trace balance (BALANCE module) if required (often skipped here and applied in the 'bruteplot' job instead) and write out to .hdf5
5_bruteplot	Read in the stacked data and plot out using RASTER and PLOTLABEL with a trace balance applied (BALANCE, similar to normalization). Use 'tiffrtl' function within the RASTER module to convert output to *.tiff.

For each line, various iterations of the above were carried out, using revised *.nmo (picked stacking velocities), with/out a picked topmute, with/out SCALE, application and revision of AREAL trace edits, and testing of a variety of different filters.

5.2.5. Summary table of processing carried out onboard:

Processing of new MCS data on-board JR298 focused on 10 of the 31 MCS lines acquired.

		MCS processing on JR298										
Line No.	line-km	SEG-D to HDF5	Near-trace plot	MGEOM applie	TAR flow	AREAL picks	1st Brutestack	Plot available	Velocity picks	2nd Brutestack	Plot available	Other
39	95.7	X	X									
40	25	X	X	X	X		X	X				FK filter tests for noise removal
41	33.9											
42	45.7	X	X	X	X		X	X				NMO file used inappropriate
43	69.9	X	X	X	X	X	X	X	Xpartial	X	X	tests on mutes, 5 plots available
44	24.2	X	X									
45	36.2	X	X	X	X	X	X	X				AREAL trace editing tests
46	35.7											
47	35.9											
48	43.6											
49	107.7											
50	34.2	X	X	X	X	X	X	X	Xpartial	X	X	velocity model testing; 3 plots available
51	55.9	X	X	X	X		X	X				
52	169.6											
53	57.9											
54	28.4											
55	89.5											
56	28.3											
57	91.8	X	X	X	X	X	X	X	Xpartial	X	X	vel picks every 500cdps; 3 plots
58	104.5											
59	113.7											
60	54.6											
61	74.9											
62	34.6											
63	56.4	X	X	X	X		X	X				Shots over grounding zone wedge only
64	67.9											
65	47.3											
66	36.1											
67	36.7											
68	13.5											
69	72.3											
70	137.9											

Table 2. Summary table outlining the processing steps carried out onboard (X = Yes).

5.2.6. Evaluation and issues encountered:

- Overall, Claritas performed excellently in terms of data input, handling, editing and processing. The quality and format of graphical outputs from the package (e.g paper plots and TIFFs) far exceed those of SU and ProMAX. The data, even in short streamer configuration with half the channels, are superb. Profiles have high resolution, achieved good penetration, and image the upper second of data, in particular, in unprecedented detail (Figure 12).

- Claritas running in Cygwin-32 cannot handle seismic data files in excess of a certain size, in the region of ~7GB (SEISREAD gives a segmentation fault). A solution to circumvent the issue is to chunk the data, using a LISTFILE to read in several individual sub-sets of the data.
- Channels needed to be renumbered in the trace headers when the seismic streamer was deployed in a shorter configuration (e.g. with channels 97-192 active on a 1200-m stretch of the cable). Otherwise, it was not possible to create an accurate geometry in Claritas. Changes to the trace headers can be easily achieved using SETHEADER in a flow.
- Vertical (swell?) noise in some of the shots (e.g. Line BAS145-43) remains prevalent in some of the stacked outputs (seen in traces in Figure 9). Analysis in FK space within XVIEW showed that the noise does not have a preferred wavelength and is present through relatively high frequencies. A high-pass filter at 35Hz removes a lot of the noise but also starts cutting into the data. For some lines, a filter to remove vertical environmental noise may have to be devised for future implementation. The DUSWELL module may be a useful tool to test in this regard. Better velocity picks may also improve the coherency in the stack and improve signal-noise ratio.
- Navigation data are held within an extended header in the SEG-D data. This information can be dumped out as a text file via the READSEGD module; for each line, textfiles were written out to a folder called 'navlogs' on the onboard NAS drive which replicate the information stored in the header. The header only gives the ship's GPS receiver location so adjustment to give accurate shot positions may be necessary later (a full geometry setup in Claritas may do this automatically, through the use of a 'streamer' file that provides details of the streamer and GPS configuration on the vessel – AG to investigate this further).
- Claritas sometimes experiences memory segmentation faults if a *.nmo velocity model has been copied and pasted from one project into another (for example, for use in the SPHDIV module). In cases where this occurred, editing, renaming and saving the file in xedt (opened directly from the SPHDIV module 'Edit' function) solved the problem.
- The processing on-board was slow; I would have liked more of the lines processed to 'brute stack' stage by the end of cruise. However, the onboard processing has been successful in establishing some clear flows that can produce some clearly excellent

results. We have gained further familiarity with the Claritas software package, and with the new data itself, which means post-cruise processing can start immediately.

5.2.7. Outline of planned full processing flow for BAS145 multi-channel seismic reflection profiles

1. Reformat data and convert to useable file formats, edit trace headers (e.g. CHANNEL numbers) if needed.
2. Archive copy of raw SEG-Y for each line
3. Set up basic in-line geometry in MGEOM and initialise a velocity model for NMO correction
4. Edit out bad data (bad channels etc.)
5. Remove any refractions or direct arrivals by muting
6. Amplitude recovery, correcting for signal amplitude losses from spreading (spherical divergence) and transmission (linear scaling)
7. Remove any swell noise and other environmental noise using filters (Bandpass, Butterworth)
8. Autocorrelation and deconvolution to eliminate reverberations
9. Assign basic geometry to calculate CDP and OFFSET; sort data by Common Mid-points (CDPs)
10. Apply trace edits if already picked (AREAL – step 13)
11. Write out as *job2.job for continuation of processing
12. Produce brute stack and conduct mid-flow QC – check shots, the near offset and fold
13. AREAL QC and apply trace editing, iteratively with step 10
14. Pick a velocity field for NMO correction every ~200-500 CDPs
15. Apply pre-stack imaging such as dip-moveout or pre-stack migration
16. Second, more accurate velocity analysis with picks every ~50 CDPs
17. NMO correction (optionally, apply a far-offset mute)
18. Stack the data within each CDP
19. Second QC and comparison of stacks
20. Residual or full migration depending on pre-stack imaging applied.
21. Final random noise attenuation/coherency filtering
22. Final filtering
23. Pick top mute if desired

24. Assign real navigation and sort geometry; produce UKOOA file, calculate shot positions in relation to CDPs, and produce shotpoint map
25. Scaling and output – Write to SEG-Y with full header and navigation
26. Produce large-format plots in digital and printed format

Estimate of 4 days for processing each line x 31 lines = approximately 25 working weeks

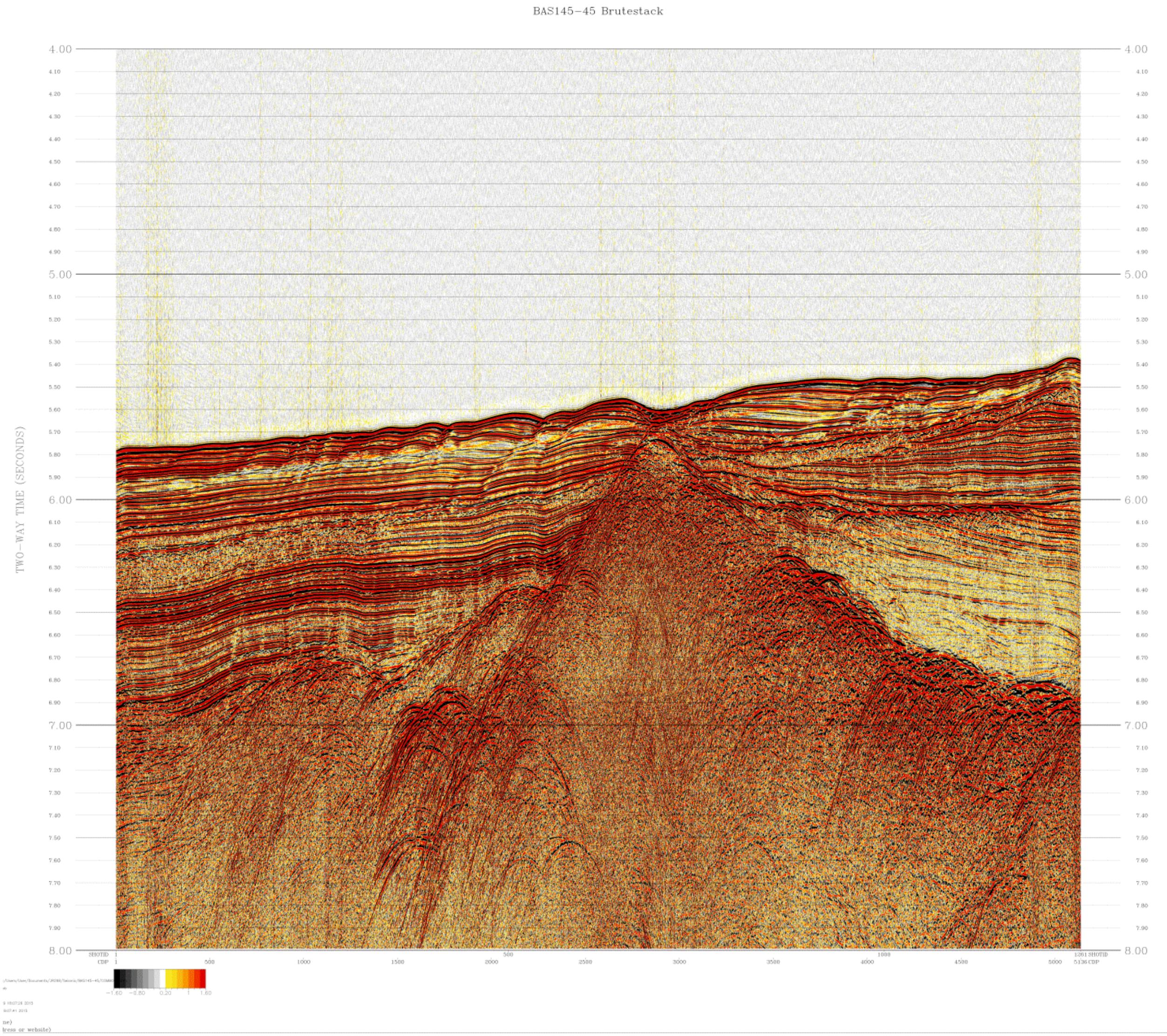


Figure 12. BAS145-45 brute stack, illustrating exceptional detail and resolution of new MCS data.

5.3 Onboard seismic processing for seismic oceanography (with Seismic Unix)

Kathryn Gunn

Several of the incoming seismic lines were processed onboard using Seismic Unix. The objective was to investigate potential structure in the water column using traditional methods of processing seismic reflection data.

The processing flow is summarised as follows:

- Convert each SEG-D shot file to an Seismic Unix (.su) file.
- Divide the line into sections of 200-600 shots (due to computational limitations).
- Apply a low-cut and high-cut filter to remove long period swell noise and higher frequency wave breaking.
- Apply a basic geometry assuming that the streamer is straight and the distance between shots is constant.
- Remove the direct wave using a median filter. This step was only applied to a few of the lines as in some cases the filter did not create a significant improvement.
- Sort into common midpoint gathers.
- Semblance analysis was used to pick the velocity function for each gather and then used to stack the data.

5.3.1 Preliminary results

The preliminary processing described above identified distinct structure in the water column. At all locations, in the upper 0.5-1.0s, strong reflections were observed (e.g. Figure 13). These reflections indicated layering, for example the interface between AASW and WW, eddies and internal waves. In other locations, deeper reflections were also identified. It is possible that these reflections relate to the boundary between UCDW and LCDW and even the boundary between LCDW and the basal counter current flowing westward.

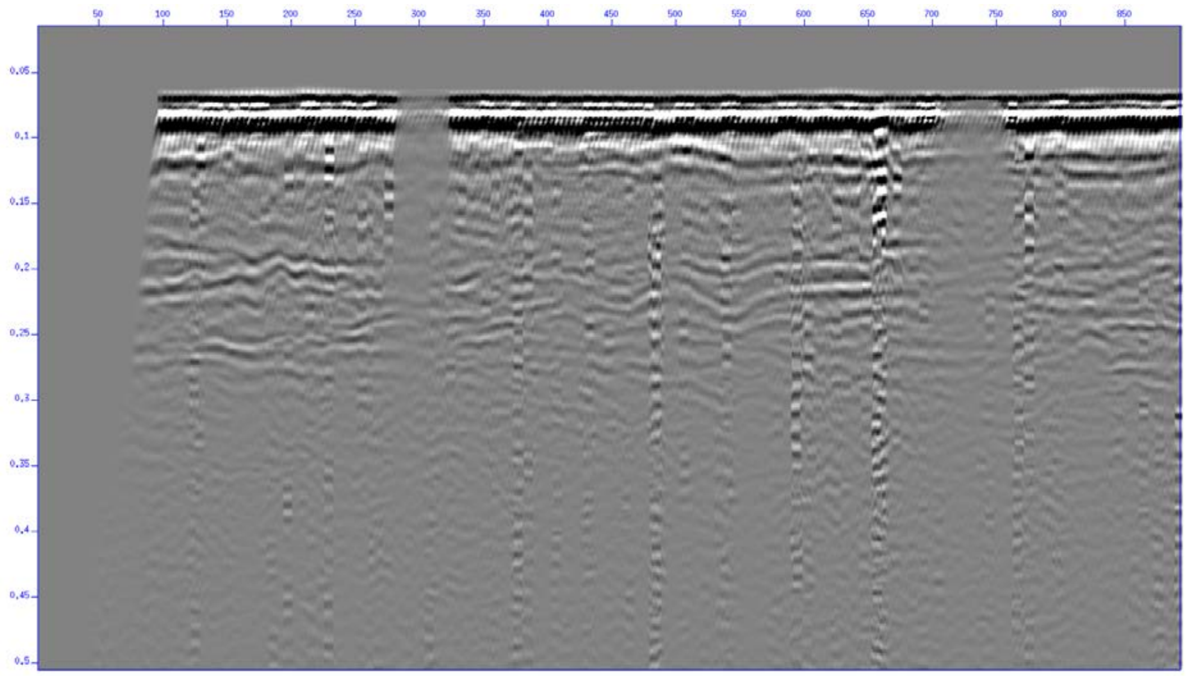


Figure 13. Upper 0.5s TWTT of a line collected in the BELS-2C and 3B area. This section is roughly 5km in length. Strong reflections are visible at just over 0.1 and 0.2s.

In some cases a strong correlation was found between the identifiable interfaces in the EK60 and seismic data. Figure 14 shows a section of seismic line coincident with the EK60 image shown in Figure xx.

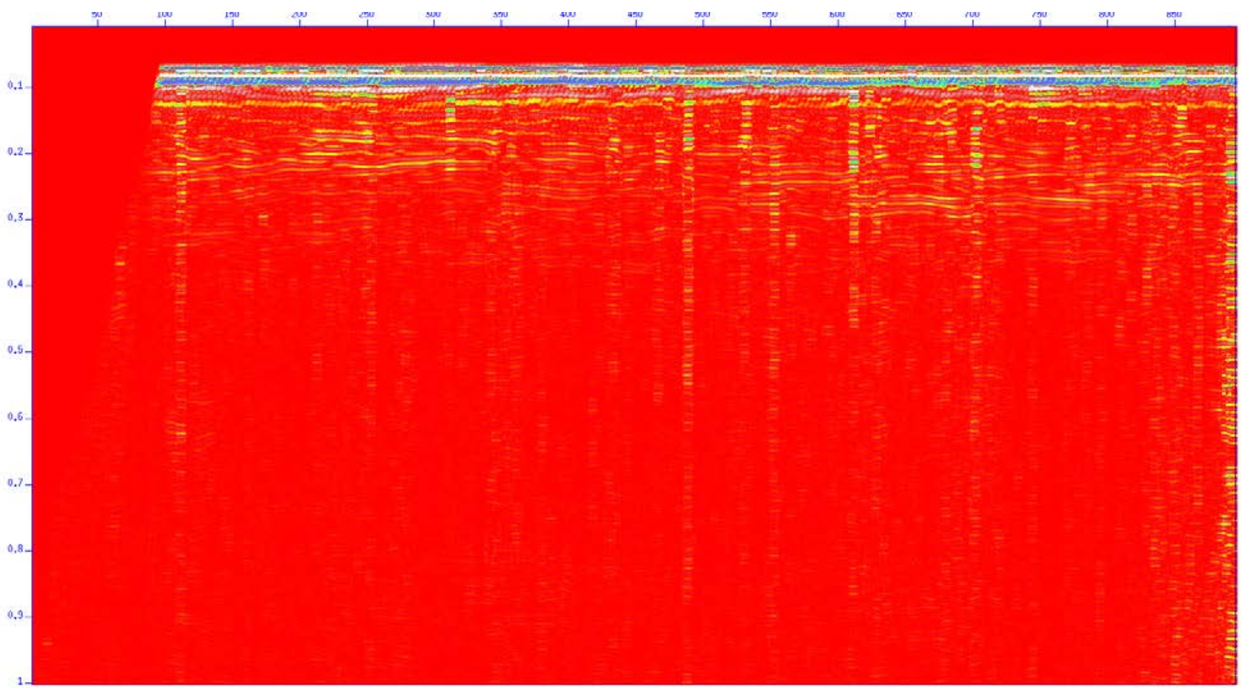


Figure 14. A snapshot of the upper 1s (TWTT) of a processed seismic line coincident with EK60 data. The colour scheme has been changed to highlight features of interest. Strong reflectors at 0.1, 0.2 and 0.25s TWTT, assuming the speed of sound is 1480m/s, correlate to depths of 74, 148 and 185m

respectively. These depths could represent the interfaces between, within and at the base of the Antarctic Surface Water and Winter Water Layer, and they correlate with possible interfaces imaged in the EK60 echosounder data.

5.4 TOPAS and swath bathymetry surveys

Elanor Gowland

Objectives

The TOPAS and EM122 instruments were run continually whilst the vessel was in motion (outside of Exclusive Economic Zones) to:

1. Ensure coverage of geophysical data to support the concurrently run seismic surveys (see section 5.1)
2. Provide real-time data to aid selection of coring sites
3. To increase the coverage and quality of existing holdings to support other science projects.

Areas of work

Data were collected for 5 specific seismic survey areas and opportunistically on transit to, from and between survey and coring locations. The seismic surveys focussed on a number of sediment drifts located on the continental rise to the west of the Antarctic Peninsula and West Antarctica (Bellingshausen Sea). For detailed information about the drift sites see section 5.1

EM122 survey details are given in Table 3. There were a number of breaks in the TOPAS and multibeam acquisition between the timeframes listed due to the ship being stationary for scientific deployments, the stop in Rothera or due to bad weather. It should also be noted that EM122 water column data was only collected for a sub-set of the bathymetry data (see Table 3).

Survey name	Name of survey area	Start time (Jday / Time)	End time	No. of lines	Water Column Data (WCD) lines
jr298_a	Transit from edge of Argentine EEZ to PEN-1 site	032 / 12:41:00	033 / 16:09:52	30	0003 - 0029
jr298_b	Seismic Survey A - Central Antarctic Peninsula Pacific Margin Survey [PEN-1]	033 / 17:26:42	035 / 16:33:36	42	full survey
jr298_c	Transit from PEN-1 to Southern Bellingshausen Sea	035 / 16:35:30	038 / 08:51:25	53	0015 - 0018, 0036 - 0042
jr298_d	Seismic Survey C - Southern Bellingshausen Sea [BELS-2C and BELS-3B]	038 / 08:55:57	040 / 23:13:54	53	0031 - 0048
jr298_e	Seismic Survey B - Belgica Trough Mouth Fan [BELS-1]	040 / 23:16:13	043 / 22:38:10	79	not recorded
jr298_f	Transit BELS-1 to PEN-4B	043 / 22:43:43	048 / 17:05:29	100	not recorded
jr298_g	Seismic Survey D - Southern Antarctic Peninsula Pacific Margin [PEN-3B, -4B, -5C]	048 / 17:08:48	052 / 10:00:43	90	not recorded
jr298_h	Seismic Survey E - Central Antarctic Peninsula Pacific Margin Survey [PEN-2B]	053 / 00:53:42	056 / 09:23:42	83	0009 - 0011, 0069 - 0082
jr298_i	Transits for core sites Drift 5 & PEN-1, Rothera and towards Punta Arenas	056 / 16:04:58	061 / 04:49:08	79	full survey

Table 3. Detailed list of EM122 surveys associated with seismic surveys and transits. Times are GMT.

Work at sea

5.4.1 TOPAS

Bottom and sub-bottom reflection patterns obtained by TOPAS characterize the uppermost sediments in terms of their acoustic properties in the immediate sub-surface (below the sea floor). This can be used to study depositional environmental patterns and their variation in space and time. Data were logged in TOPAS RAW and SEGY format and an automatic processing of TOPAS data has been applied. Please refer to the typical sonar parameters listed in Appendix 6.

5.4.2 EM122 Overview of equipment

The JCR's hull-mounted Kongsberg Simrad EM122 multibeam echo sounder was used near-continuously for the duration of the cruise. The EM122 system emits a fan-shaped array with multi-ping capability and FM chirps. In typical ocean depths a sounding spacing of finer than 50 m is possible, and has an accuracy of up to 0.2% of depth. The nominal sonar frequency is 12 kHz with 432 soundings per ping (or 864 sounding in dual ping mode). It is possible to achieve a swath width of up to 6 times water depth (for a flat seafloor), although uncertainties increase towards the edges of such a wide swath and the system is more typically operated with beam angles that result in a swath width of 3 to 4 times water depth. Further detailed information about the equipment performance can be found in section 7.2, and the typical settings are listed in Appendix 6.

Import of Sound Velocity Profiles

Beam raypaths and sea floor depths were calculated in near-real-time using sound velocity profiles (SVP's) derived from Expendable Bathythermographs (XBTs), Expendable CTDs (XCTDs) or CTDs deployed during this cruise. It was noted that the initial XBT cast's SVP did not auto-populate the folder on the EM122 computer as expected, this was corrected by ICT onboard and onward transfer of XBT and XCTD data worked fine as did the transfer of CTD sound velocity data to the same directory. It should be noted that some .asvp files are stored within the same 'raw' folder as the multibeam survey they were applied to. Historically this has not happened, so it may be a result of the upgrade at the summer refit in 2014.

SVP	Source	Date/time applied (GMT)	Latitude (degrees decimal)	Longitude (degrees decimal)	Notes
jr276_13_thinned.asvp		01/02/2015 12:35	-59.49957	-66.83143	stored in leg folder \20110408\
T5_00003_thinned.asvp	XBT	01/02/2015 19:20	-69.2212	-94.4885	First sucessful XBT deployment of cruise
JR298_002_thinned.asvp	CTD	06/02/2015 17:34	-68.94285	-85.79026	Used profile from CTD collected on station BELS-1
T5_00005.thinned.asvp	XBT	08/02/2015 13:52	-69.2212	-94.4885	
JR298_003_thinned.asvp	CTD	09/02/2015 20:03	-69.53168	-93.9159	
JR298_002_thinned.asvp	CTD	12/02/2015 22:42	-70.2689	-85.99448	Returned to BELS-1 site, so reapplied SVP for area
JR298_004_thinned.asvp	CTD	14/02/2015 21:19	-67.87638	-76.18821	Used profile from CTD004.
T5_00015_thinned.asvp	XBT	21/02/2015 01:39	-66.39	-73.26528	Updated SVP using recent XBT profile
jr276_13_thinned.asvp		01/03/2013 02:55	-65.06332	-68.7842	stored in leg folder \20110408\

Table 4. Sound velocity profiles (SVP's) used for EM122 during cruise JR298.

Data processing

In total, approximately 7900 line-kilometres of swath bathymetric data were collected. TOPAS data were collected simultaneously. The process of ping-editing the multibeam data to remove anomalous depths was begun / carried out whilst onboard, using the MB-system on Linux, by a number of the cruise participants and further details can be found in the Data Processing section below. It should be noted that the interference from other acoustic instruments (in particular the TOPAS) and the poor weather on certain headings made a significant proportion of the data very noisy and therefore the manual processing was very time consuming, so it was not able to be completed during the cruise.

Raw data were automatically written to the data drive (D:/sisdata/raw/’survey name’) on the EM122 acquisition machine and then a cron job running every 10 minutes copied the data to the path:

/data/cruise/jcr/current/em122/raw/’survey name’

where current is a symbolic link to the leg id 20150123 (the date the SCS logging system was initialised for cruise - YYYYMMDD).

Data were processed with MB System v5.4.2099 installed on the Linux virtual server JRLC (full server name is jrlc.jcr.nerc-bas.ac.uk) following the same general procedures detailed in the JR93, JR134, JR168 and JR259 cruise reports. ICT set up a general Linux user “jr298” specifically for this cruise to enable any cruise participants to be able to help process the multibeam data. Training on bathymetric processing was provided by Elanor Gowland, Kelly Hogan and Ali Graham.

Cleaning the data

Data cleaning was required to correct for 1) parabolas due to interference with the TOPAS system and 2) spikes, especially at wider angles.

All of the data cleaning was done manually using the mbedit graphical interface. This allows the user to manually flag data in either a ping-by-ping view or as a waterfall view where n number of pings can be viewed together. Detailed editing was done using the ping-by-ping view for each hour file followed by a quick look using the waterfall and alongtrack view to check for any erroneous depth values missed.

Preliminary results: Multibeam coverage maps and TOPAS profiles

The figures below show the coverage for each of the surveys, and any items of specific interest. For more information about the specific surveys see the seismic profiling section (5.1).

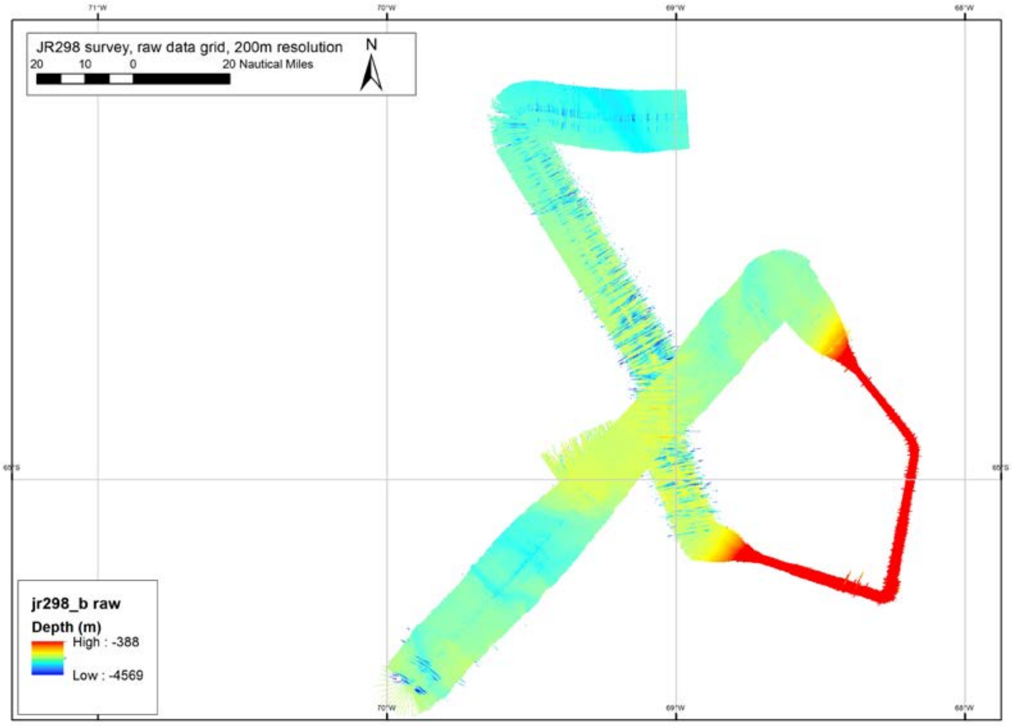


Figure 15. Seismic survey A - central Antarctic Peninsula Pacific Margin [PEN-1].

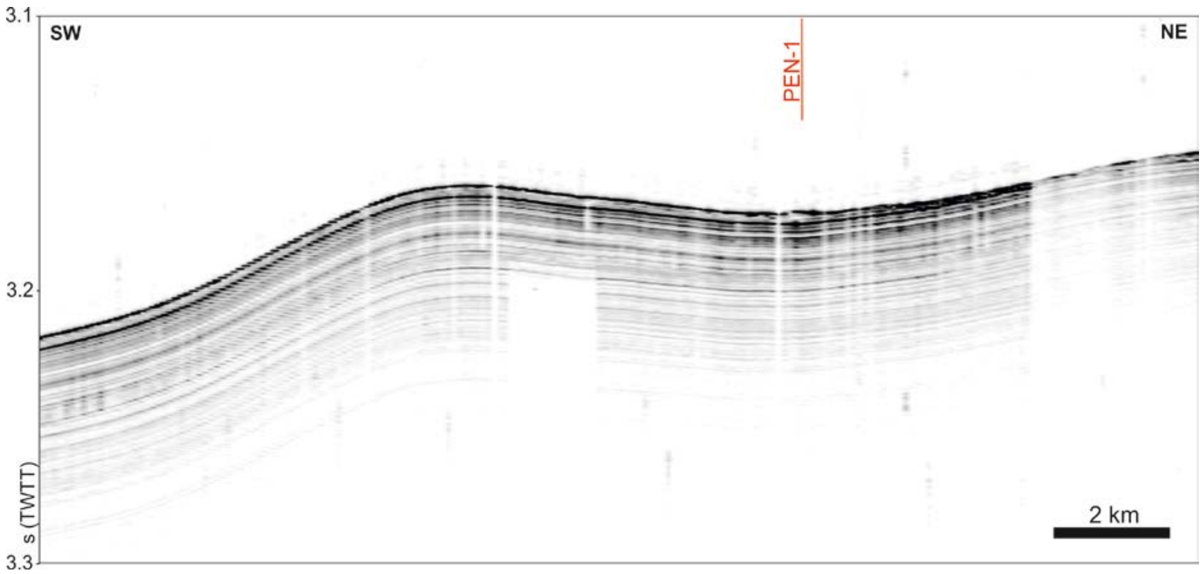


Figure 16. TOPAS profile across proposed PEN-1 drill site.

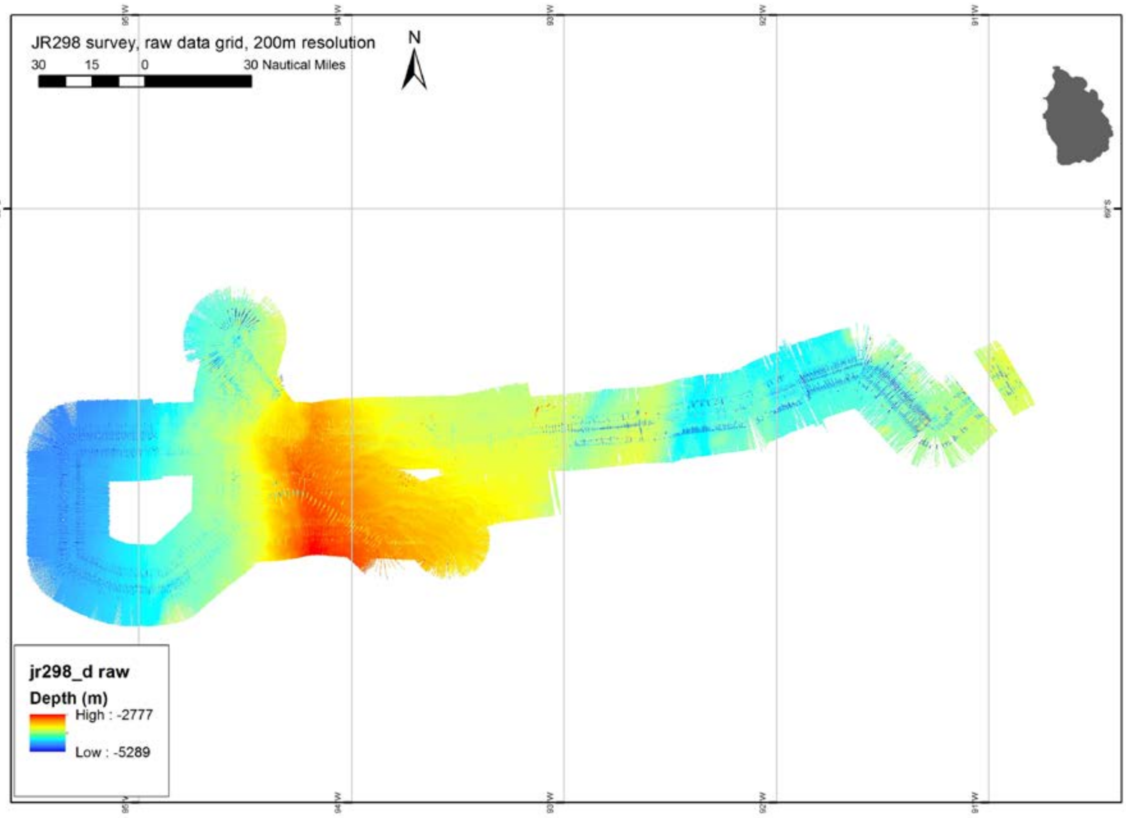


Figure 17. Seismic survey B - southern Bellingshausen Sea [BELS-2C and BELS-3B].

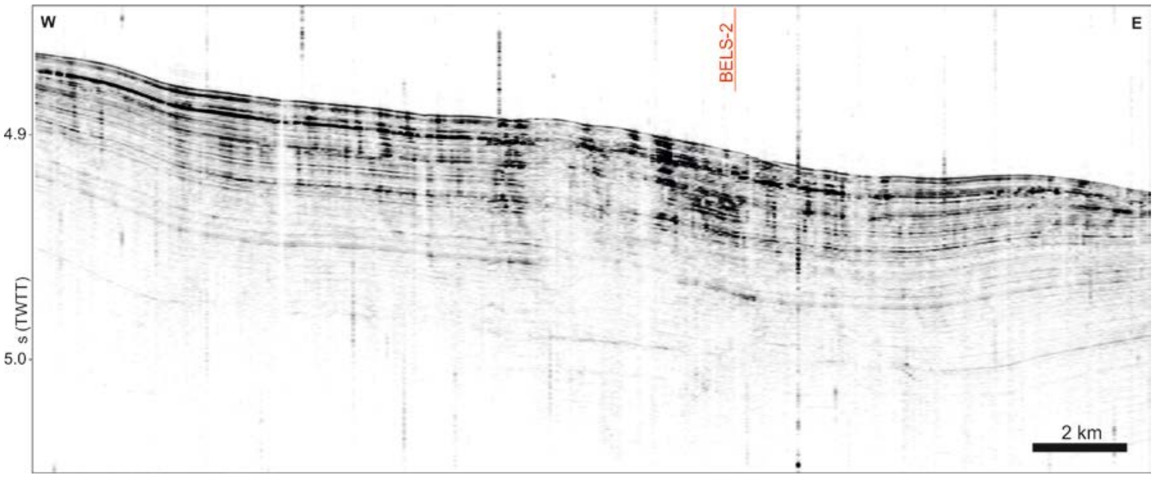


Figure 18. TOPAS profile across proposed BELS-2C drill site.

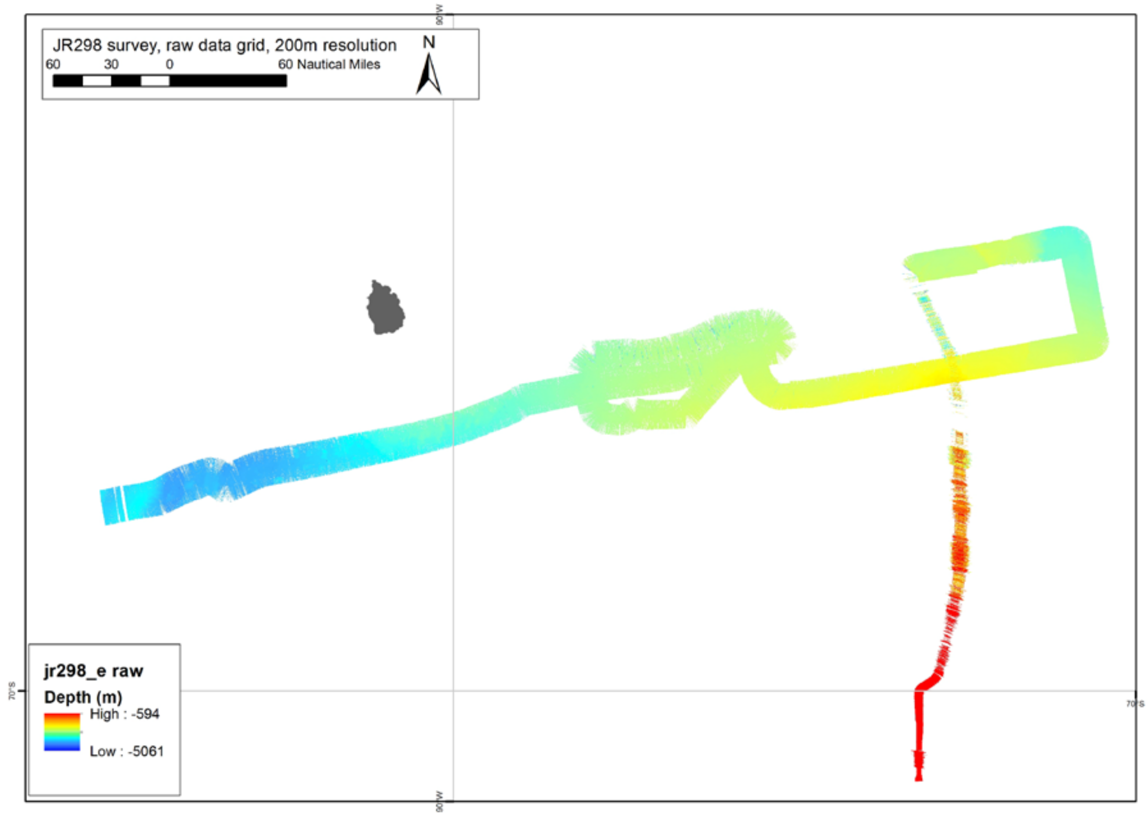


Figure 19. Seismic survey C - Belgica Trough Mouth Fan [BELS-1]. Data collected on the approach to the survey area are also shown. Seismic data were only acquired on tracks shown on the eastern part of the map.

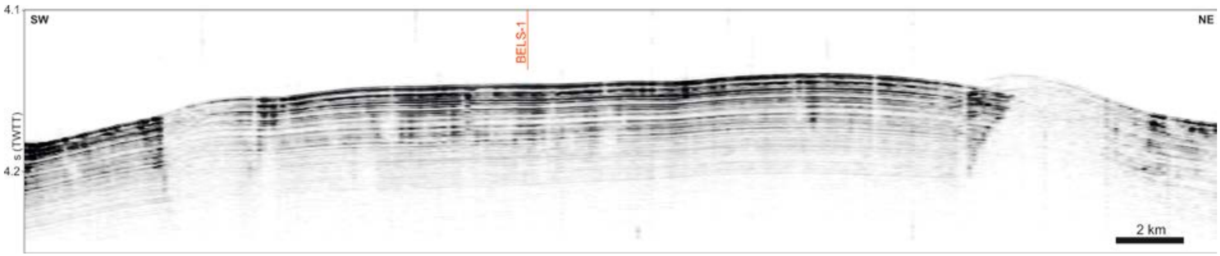


Figure 20. TOPAS profile across proposed BELS-1 drill site.

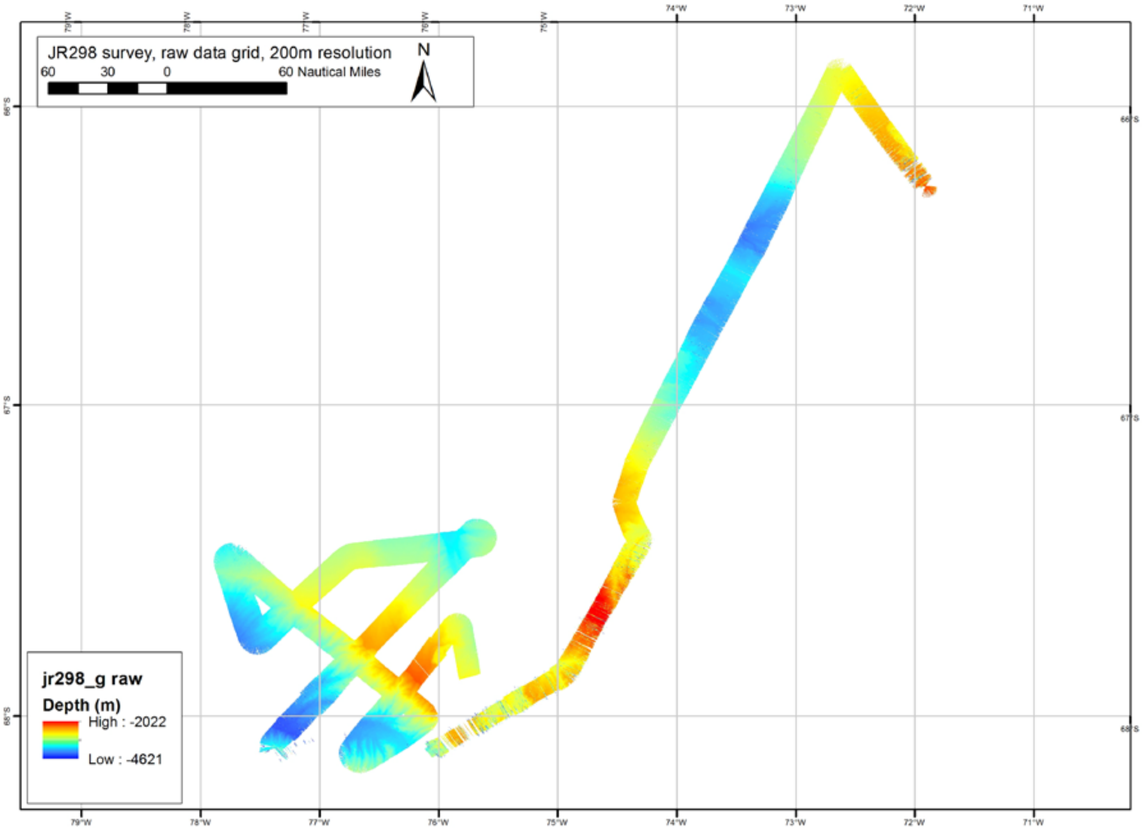


Figure 21. Seismic survey D - southern Antarctic Peninsula Pacific Margin [PEN-3B, -4B, -5C].

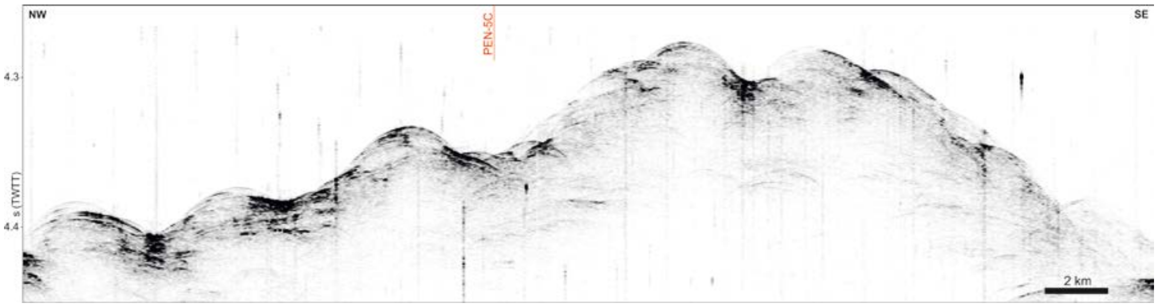


Figure 22. TOPAS profile across proposed PEN-5C drill site.

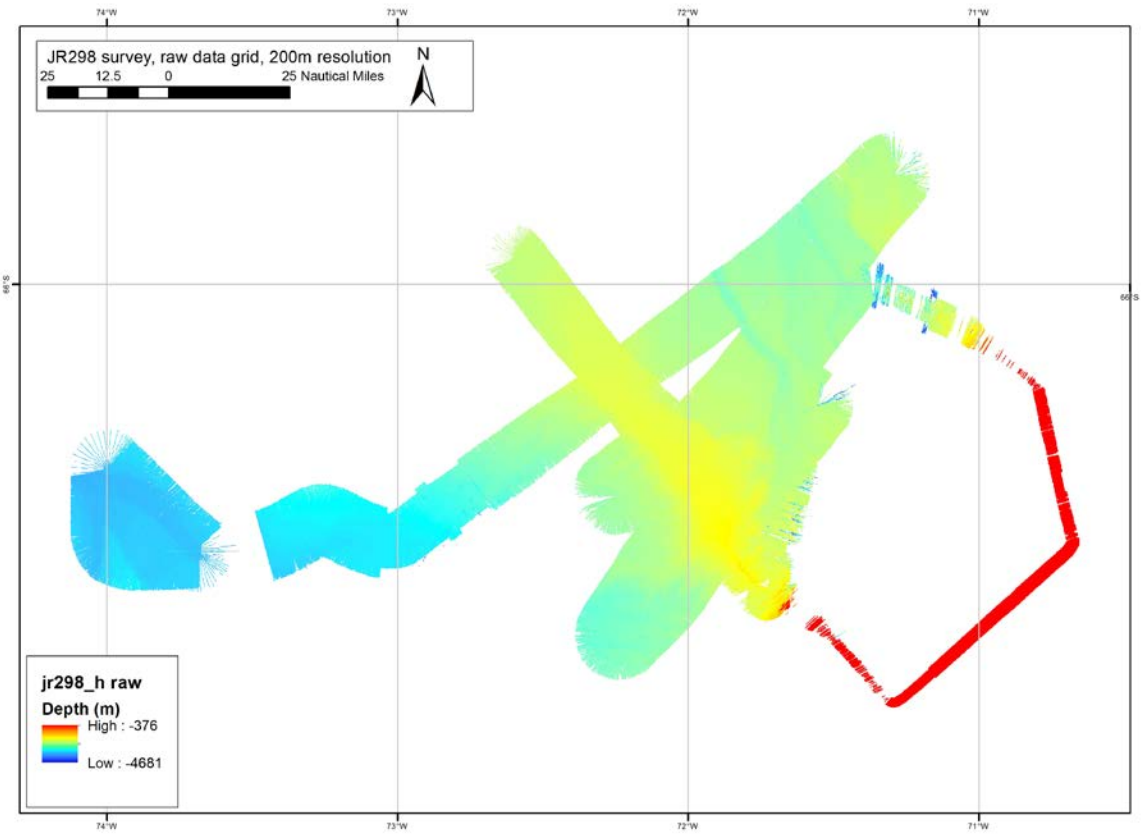


Figure 23. Seismic survey E - central Antarctic Peninsula Pacific Margin [PEN-2B].

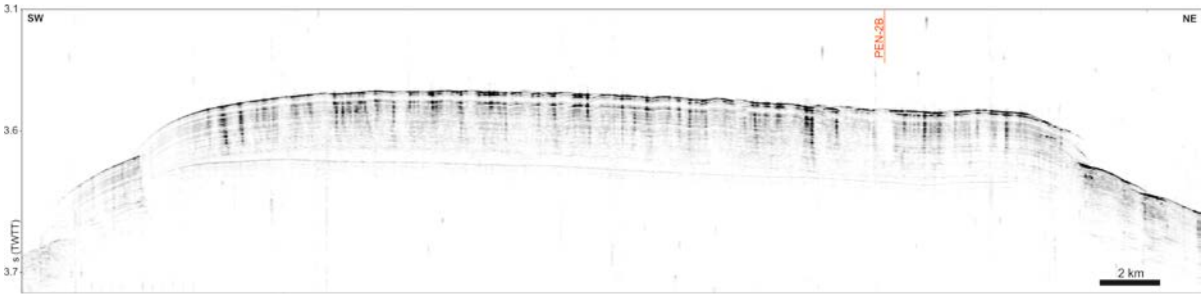


Figure 24. TOPAS profile across proposed PEN-2B drill site.

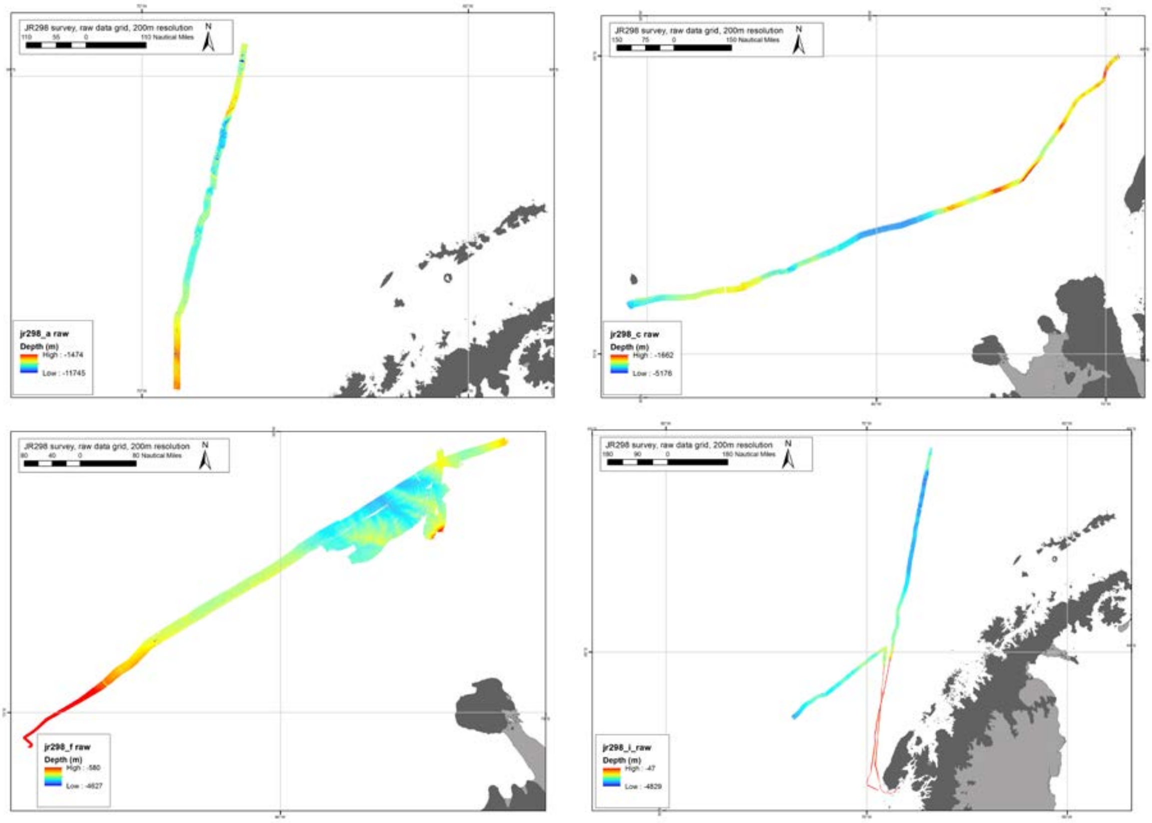


Figure 25. Opportunistic / transit lines (EM122 surveys jr298_a, _c, _f, _i).

5.4.3 TOPAS data Kingdom Suite project

Lara Perez

A Kingdom Suite project has been created to visualize and interpret the TOPAS profiles. The used coordinated system group is World Projections Mercator WGS 1984 and the XY units meters. The import of the files has been done through a variable start times and length traces in order to adjust the delay changes. The visualization of the TOPAS .segy files is correct using the 'Enveloped' filter as seismic attributes and a 'Band pass' filter on frequency with the next values: Low cut: 1200 Hz; Low pass: 1700 Hz; High pass: 4800 Hz; High cut: 5200 Hz. The used filter length in seconds is 0.2 and 0 phase angle degrees.

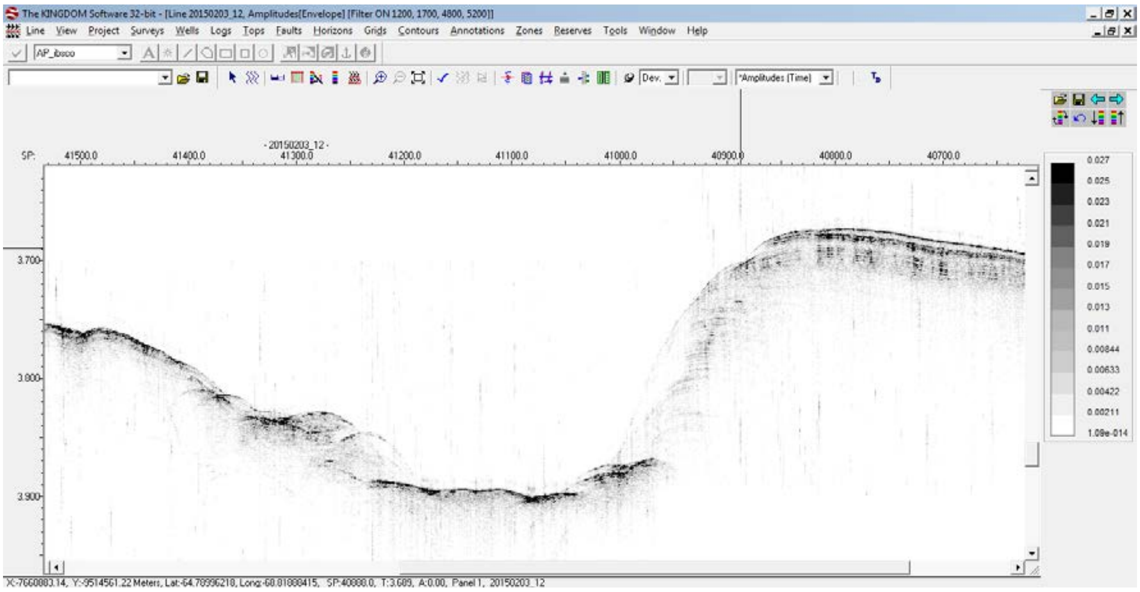


Figure 26. Example of visualization of one of the TOPAS lines in Kingdom Suite.

References

TOPAS PS18 Parametric Sub-bottom Profiler, Operator manual, Rev. J. 18/03/2011.

EM122 Multibeam Echosounder, Product Description, Rev. D, 02/07/2007.

5.5 Potential field measurements

Tom Jordan

5.5.1 Objectives

The objectives of the potential field geophysical measurements on JR298 were:

i. To acquire new higher-resolution magnetic and gravity data coincident with seismic data over the sediment drifts targeted by the JR298 cruse providing information about the underlying geological structures.

ii. To acquire new opportunistic magnetic and gravity data along transits to and from survey areas.

5.5.2 Gravity system

5.5.2.1 Summary

- 5166 km of good quality ship borne gravity data were collected between 1st February and 1st March along the western margin of the Antarctic Peninsula (Figure 27). Processing and detailed time line is below.

- The gravity system failed on the 15th February, most likely due to a problem with the meter power supply unit. Replacement of system control module and power supply module allowed continued data collection from the 17th February.
- Suggestions for the future: 1/ Instability of the system on initial installation may have been an indication that failure was likely, and should be fully investigated. 2/ The breaker switch to the torque motors should always be in the off position when the platform is clamped in its frame. 3/ The range of movement of the platform within the frame is too large in even a moderate sea state, and additional constraint of the platform would be preferred (e.g. downward shock cords).
- Notes on operation: System was simple to operate once set up. Display of long and cross access accelerations on SCS screen in the UIC allowed monitoring of the system and prompt response to problems.

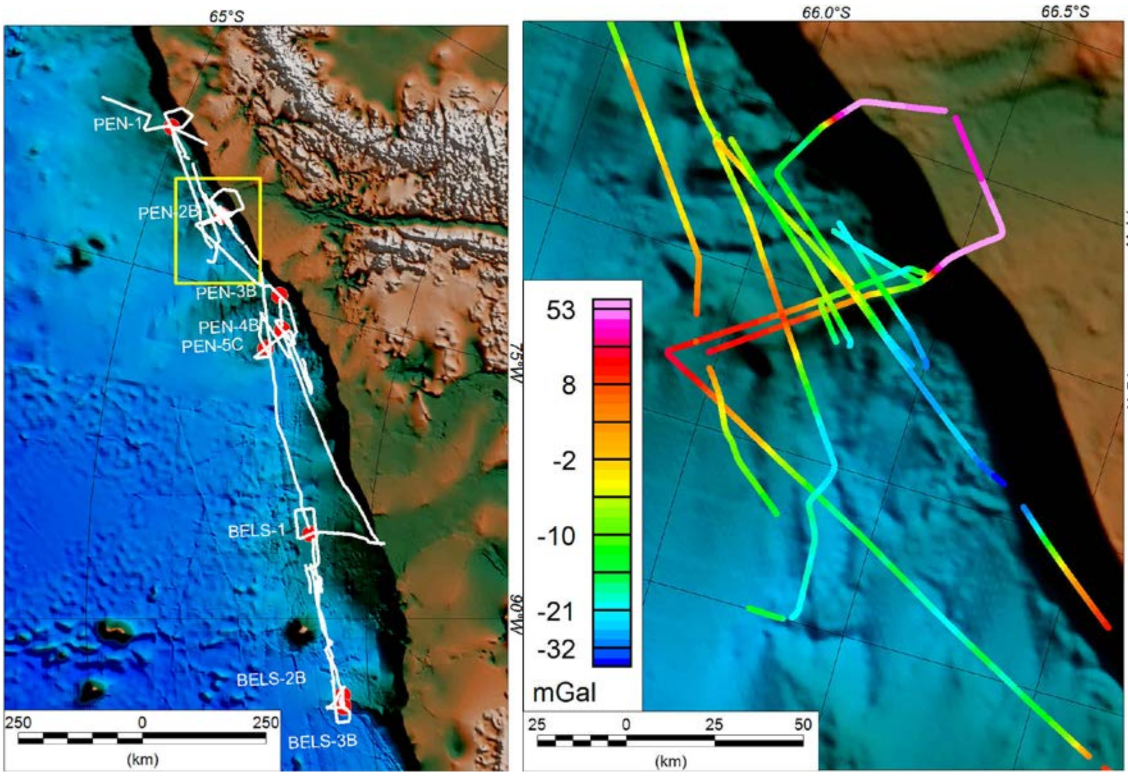


Figure 27. Summary gravity survey maps. a) Regional compilation of new gravity data west of the Antarctic Peninsula (white lines). Yellow box locates (b). b) Example of QC gravity data over Drift 5, on which proposed drill site PEN-2 is located.

5.5.3 Magnetic system

5.5.3.1 Summary

- 3005 km of good quality magnetic data was collected between 1st and 13th February, coincident with seismic lines over the PEN-1, and BELS-1 and BELS-2C/3B proposed drill sites, and along the intervening transit lines (Figure 28). Processing and detailed time line is below.

- The magnetic system failed on the 13th February due to a fault in the tow cable, which was deemed irreparable on the ship.
- Suggestions for the future include: 1/ Periodic servicing of the magnetic system (e.g. every 5 seasons where it is used). 2/ Investigate the possibility of carrying spares for the magnetic system.
- Notes on operation: Although simply deployed by hand, when working with seismic gear recovery and redeployment is required on every turn, which requires assistance from the crew.

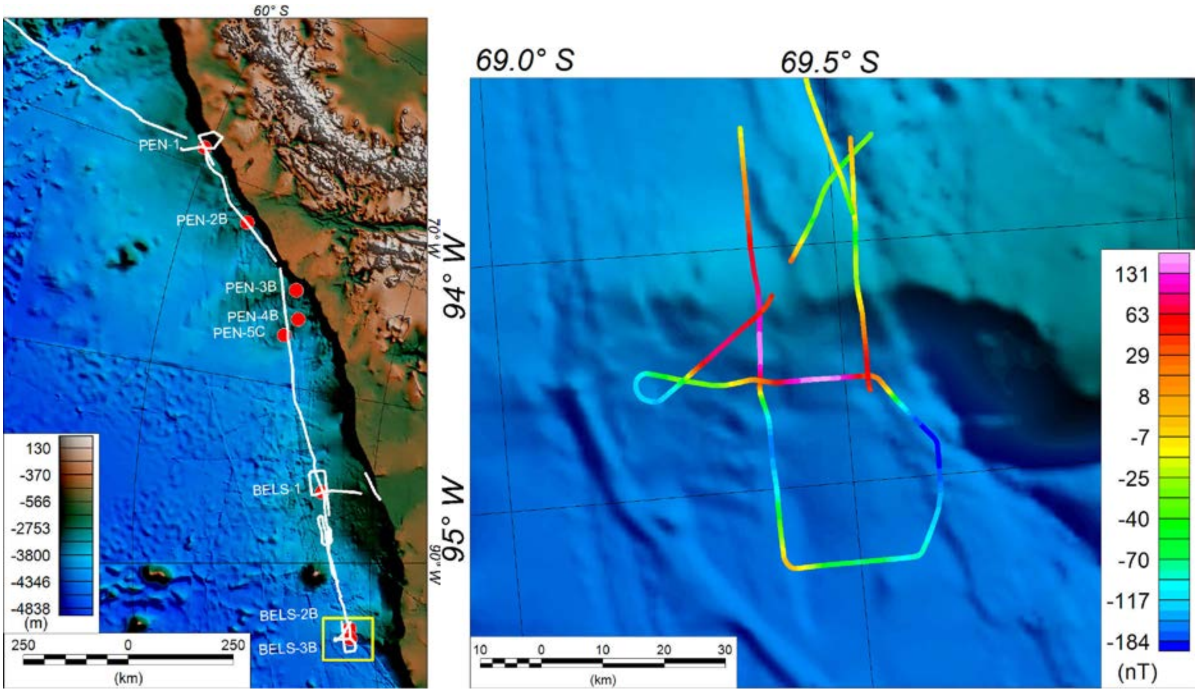


Figure 28. Summary magnetic survey maps. a) Magnetic data coverage (white line) overlain on BEDMAP2 topography. Yellow box locates (b). b) Example of magnetic data over the sediment drift in the southern Bellingshausen Sea on which proposed drill sites BELS-2C and BELS-3b are located. Note offset of peak magnetic anomaly from peak topography.

5.6 Coring and core sampling

Claus-Dieter Hillenbrand, James E. T. Channell, Carys P. Cook, Jennifer Horrocks, Alexander M. Piotrowski, Scott Polfrey, Thomas J. Williams, Chuang Xuan

5.6.1 Objectives

The overarching objective of coring operations on cruise JR298 was the recovery of Late Quaternary sedimentary sequences directly at and in the vicinity of deep-sea drilling sites of the International Ocean Discovery Program (IODP) proposal 732-FULL2 *Sediment drifts off the Antarctic Peninsula and West Antarctica*. The specific objectives of the piston coring programme were:

I) To evaluate whether the recovered sedimentary sequences contain continuously sufficient calcareous foraminifera tests for dating the cores by stable oxygen isotope ($\delta^{18}O$) stratigraphy

II) To investigate whether the glaciomarine, mainly terrigenous sediments from the West Antarctic drifts are suitable to establish age models for the cores by measuring their relative geomagnetic palaeointensity (RPI)

III) To extract information from the cores that allows for reconstructing palaeoenvironmental conditions on the West Antarctic continental margin during the glacial-interglacial cycles of the Late Quaternary. Changes in the extent and dynamics of the Antarctic Peninsula Ice Sheet and the West Antarctic Ice Sheet as well as the climatic and oceanographic conditions of the high-latitude Southern Ocean will be reconstructed by carrying out post-cruise multi-proxy investigations, with associated projects focussing on studying the abundance and geochemical provenance of ice-rafted debris (IRD) and past changes in biological productivity and deep- and bottom-water mass circulation.

The objectives of box coring on cruise JR298 were:

I) To retrieve undisturbed seafloor surface sediment samples from the piston core sites

II) To provide seawater samples from the ocean-seafloor interface, pore water samples and seabed surface sediment samples to study (i) the concentration and down-core distribution of nutrient proxies, such as the stable carbon ($\delta^{13}C$) composition of pore water and benthic foraminifera tests, and of water mass tracers, such as the neodymium isotopic composition of bottom water and iron-manganese coatings of sedimentary particles, and (ii) to obtain reference data for the modern distribution and sources of IRD along the West Antarctic continental margin.

5.6.2 Work at sea

Long sedimentary sequences were recovered using the BAS piston corer (PC, NIOZ-type; Figure 29) while surface sediment samples were collected with the new BAS-owned giant box corer (GBC, model BX-650 manufactured by Ocean Instruments Inc., San Diego, U.S.A.; Figure 30). The piston coring involved deployments of PCs consisting of three barrels with a combined length of 16.2 m (*note: because of the ca. 0.4 m long piston the maximum core length that can be recovered with such an assembly of barrels is only 15.8 m*) and a liner diameter of 110 mm as well as a trigger corer (TC; gravity corer type) with a length of 0.75 m and a liner diameter of 63 mm. The PC was deployed at or in the close vicinity of six IODP 732-FULL2 drill sites targeting Pliocene to Quaternary sequences and at one nearby location (Appendix 2). The IODP 732-FULL2 sites had been selected on the basis of pre-existing seismic profiles, and the other PC site is located in the vicinity of BAS piston core site PC107. During cruise JR298 TOPAS acoustic sub-bottom profiles (see section 5.4) were evaluated when arriving at a core site to ascertain that the sub-seafloor sediments were suitable for the 16.2 m-long PC deployments. In addition, a GBC with box dimensions of 0.5 x 0.5 x 0.6 m was recovered from all PC sites and one additional location (Appendix 2).

Site PEN-1, crest of Drift 4 (in the vicinity of BAS core site PC466), western Antarctic Peninsula continental rise: Giant box core GBC722 with a recovery of 0.37 m collected brownish diatom-bearing gravelly sandy mud with manganese-coated dropstones and various benthic organisms, including calcareous foraminifera, on its top (Figure 31). This unit is underlain by terrigeous brown-olive mud, whose diatom content decreases down-core. The piston corer PC736 recovered from the same site later during the cruise recovered a 10.26 m long sedimentary sequence.

Site BELS-1, distal part of Belgica Trough Mouth Fan, southern Bellingshausen Sea: Core PC723 recovered an 11.09 m long sequence consisting mainly of laminated to stratified terrigenous mud and sandy mud with thin laminae and layers of silty to sandy material. In addition, two down-core horizons of mottled (probably bioturbated) diatom- and foraminifera-bearing sandy mud are observed. GBC724 from the same site retrieved 0.43 m of sediment. Its surface is characterised by brownish foraminifera-bearing diatomaceous sandy mud with a few manganese-coated dropstones, while the unit below consists of terrigenous mud.

Site BELS-2C, near crest of mound, southern Bellingshausen Sea: Box core GBC725 recovered a 0.45 m long sequence consisting of a thin brownish foraminifera-bearing diatomaceous sandy mud with manganese-coated dropstones at its top and olive terrigenous mud underlying this surface unit. The 12.00 m long core PC726 collected from the same site retrieved predominantly laminated to stratified terrigenous mud bearing a few sandy mud horizons and layers. These mud units bracket a mottled foraminiferal mud horizon which is underlain by a laminated diatom-bearing mud horizon.

Site PEN-4B, Drift 7, western Antarctic Peninsula continental rise: The seabed surface sediments retrieved in giant box core GBC729 collected from this location consist of brownish, diatomaceous gravel-bearing sandy mud with manganese-coated and bryozoan encrusted dropstones, abundant calcareous and agglutinated foraminifera and tube worms. These sediments are underlain by a sequence of predominantly terrigenous olive to dark grey mud and sandy mud, which are occasionally intercalated with muddy sand layers recovered in the 12.17 m long piston core PC728 from the same site. The two glued basal liners in core PC728 became separated during the liner extraction from the barrels after recovery resulting in slight disturbance of the sediments between ca. 7.32 and 7.43 m core depth.

Site PEN-3B, Drift 6 (near BAS core site PC467), western Antarctic Peninsula continental rise: Piston core PC727 recovered a 9.90 m long sequence consisting mainly of terrigenous mud and, to a lesser extent, sandy mud. Near the seafloor surface and further down-core these sediments alternate with thin units of diatom- and foraminifera-bearing mud and sandy mud, respectively. Recovery at site PC727 was obviously restricted by a cobble that got trapped in the core catcher during corer penetration into the seabed. Giant box core GBC730 collected from the same site retrieved brownish gravel-bearing diatomaceous sandy mud with calcareous foraminifera and dropstones coated by only a very thin layer of manganese at its top. These deposits are underlain by predominantly terrigenous olive mud.

Site PEN-2B, crest of Drift 5 and site on distal part of Drift 5 (SE' of BAS core location PC107), western Antarctic Peninsula continental rise: Seafloor surface sediments in the 0.32 m long giant box core GBC731 deployed at the PEN-2B site consist of brownish gravel-bearing sandy mud with manganese-coated dropstones and calcareous foraminifera on its top, which is underlain by a terrigenous olive sandy mud. The piston core PC732 collected from the same location retrieved a 9.40 m long sedimentary sequence consisting of a thin layer of diatomaceous sandy mud at its top and a thick sequence of terrigenous mud intercalated with sandy mud horizons and thin sand layers below. The greyish mud and sandy mud at the core base is relatively stiff. Giant box core GBC735 was deployed on the more distal crest part of Drift 5, to the SE of BAS core PC107, and recovered 0.35 m of sediment consisting of brownish diatom- and gravel-bearing sandy mud with a few manganese-coated dropstones at its top, underlain by terrigenous olive mud. Piston core PC734 collected from this location retrieved a 12.93 m long sedimentary sequence consisting predominantly of terrigenous mud, with intervals of diatom-bearing sandy mud and foraminiferal mud and ooze.

Deep-water channel between Drifts 5 and 6, western Antarctic Peninsula continental rise: This location was targeted by giant box corer GBC733 (Appendix 2), which retrieved 0.20-0.30 m of sediment with a disturbed uneven surface consisting of brown and olive diatom-bearing to diatomaceous mud. The mud is underlain by dark grey, well sorted medium-sized sand that obviously hindered pristine sediment recovery, especially the recovery of an undisturbed seabed surface. An USBL beacon was attached to the coring wire at ca. 15 m above the giant box corer in order to test whether it landed in the channel. However, the USBL positioning did not work below 2400 m water depth during both veering and hauling due to unknown reasons. Eastward offset from the mid-ship's gantry increased with water depth and reached 84 m and 97 metres during veering and hauling, respectively, at 2000 m water depth.

After draining and sampling the excessive water from the GBC the recovered sediments were described and photographed, and the recovery was measured. Then the following samples were routinely taken:

- two surface sediment samples 0-1 centimetres below seafloor (cmbsf)
- three sub-cores (Ø 110 mm) labelled 'A', 'B' and 'C' to be cut onboard into 1 cm slices for geochemical analyses of the pore water and the sediments
- one sub-core (Ø 63 at some sites and Ø 110 mm at others) labelled 'D' for palaeomagnetic investigations
- one sub-core (Ø 110 mm) labelled 'E' to be split and sampled onboard for various sedimentological, micropaleontological, geochemical, mineralogical and palaeomagnetic investigations
- one sub-core (Ø 63 mm) labelled 'F' for archiving.

At several of the GBC sites additional samples (large dropstones, sieved IRD, calcareous microfossils) were taken.

All cores recovered with the PC (except PC736) were cut into 1.5 m long sections, closed with end caps and tape, and then labelled. Magnetic susceptibility was measured on each section (see section 5.7) before it was split into an archive and a working half with a router, photographed, sampled (work half only) and described (archive half only). The sampling procedures were as follows: First, a 1.5 m long u-channel sub-core for palaeomagnetic analyses was obtained from the working half of each section before 1 cm-thick sediment slices for various sedimentological, micropaleontological, geochemical and mineralogical studies were taken at varying depth intervals depending on the visually observed changes in core lithology and sedimentary structures. In addition, several 1 cm-thick slices were taken from each PC core for provenance analyses on IRD. The core description comprised a visual record of sediment lithology, composition, structure, texture and coring disturbance, aided by the microscopic investigation of smear slides. No attempt was made to open and sample the TC cores because their small diameter prevented their splitting with the equipment available onboard. The sub-cores 'E' from the GBCs were split, sampled and described in the same way as the PC core sections (except that discrete samples with plastic cubes rather than u-channels were taken for the post-cruise palaeomagnetic analyses).

Figure 29. Piston corer (PC) with 16.2 m barrel length after recovery on cruise JR298 (photo: R.D. Larter)

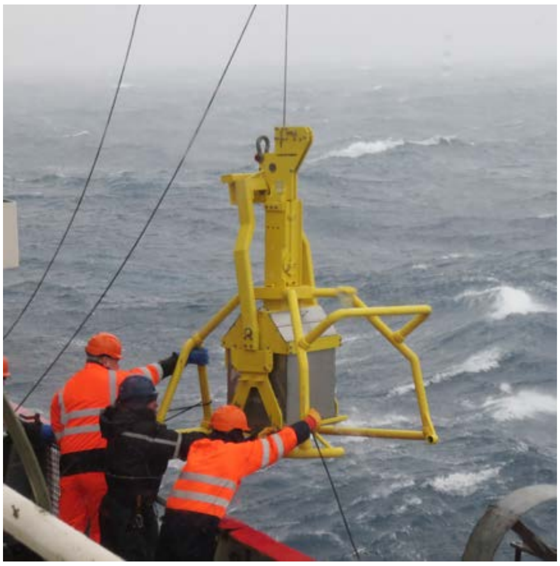


Figure 30. Giant box corer (GBC) during recovery on cruise JR298 (photo: F.J. Hernández-Molina)

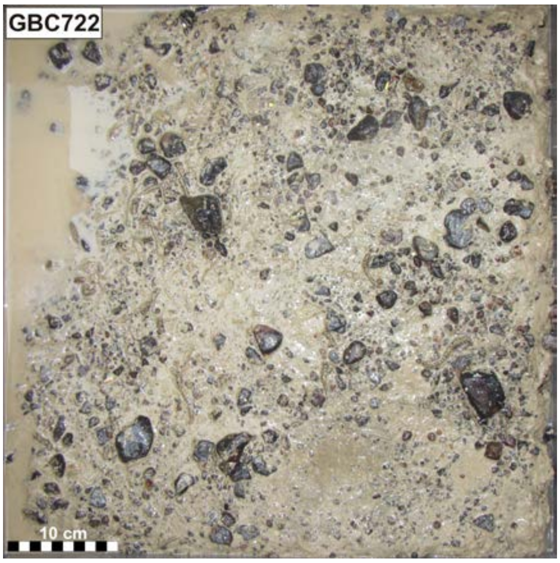


Figure 31. Surface of giant box core (GBC) recovered at station GBC722 (photo: C.-D. Hillenbrand)

5.7 Magnetic susceptibility measurements on core sections

Chuang Xuan and James E.T. Channell

Aboard ship, all recovered piston core (PC) sections were measured for magnetic susceptibility using a 120-mm diameter Bartington loop sensor (MS2C) connected to a BartingtonMS3 susceptibility meter. The measurement is controlled using the Bartsoft software (version 4.2.1.1). The sections were measured at 2.5 cm intervals with a 15-cm leader and trailer interval. The background null readings were acquired before and after the measurement of each core section, with the core section at least 30 cm away from the loop sensor.

The measurement of 150-cm long core sections, with outer diameter of 110 mm and inner diameter 99.4 mm, was carried out using a track system assembled shipboard using nine wooden supports, four on one side and five on the other side of the loop sensor, and wooden 2-cm diameter beads strung from the supports (Figure 32). Note that some core sections, particularly top-core sections, were less than 150 cm in length. The supports and beads were shipped from BAS. The supports were connected by two 3x3x155 cm wooden posts (found shipboard) that were tied with string to each individual support and also made fast to the bench using eyelets anchored in the bench recesses (Figure 32).The system was proven to be robust and practical, with high levels of repeatability for core sections that were measured more than once (Figure 33A). The ~30 kg core sections were rolled manually on the wooden bead supports to each measurement position. A distance scale, using self-adhesive measurement tape, provided accurate determinations of sample position as the core sections were positioned for each measurement. For each measurement position, one person controlled the sample position while another triggered the measurement through the Bartsoft software.

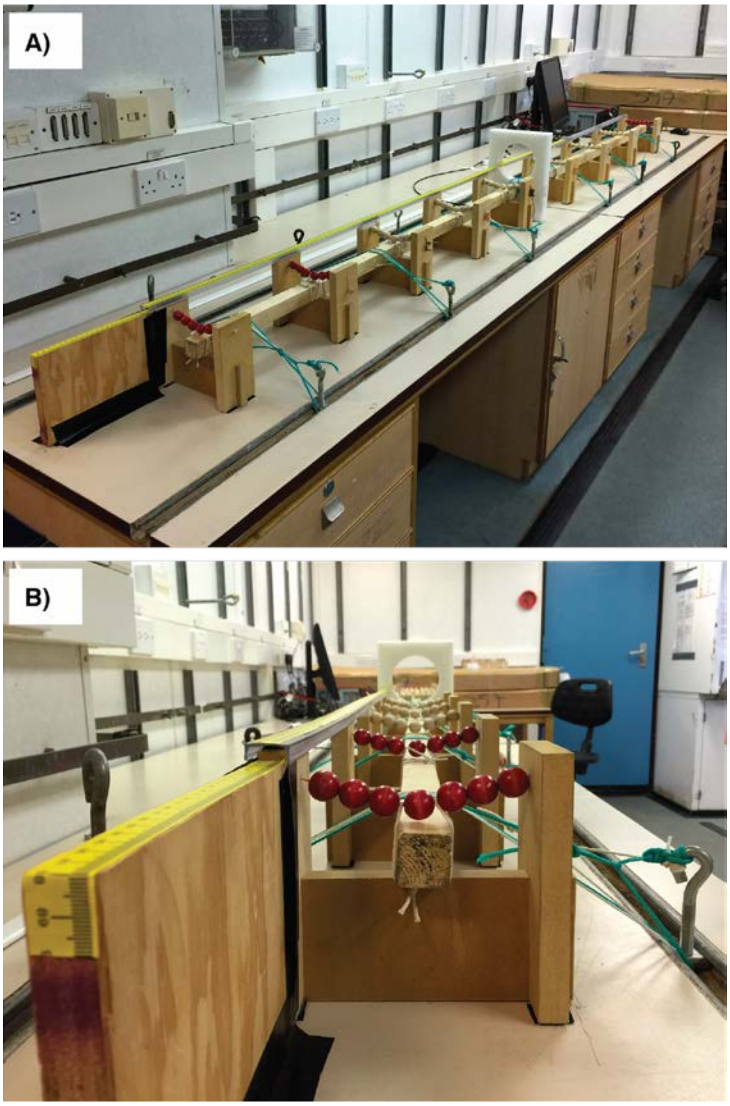


Figure 32. Magnetic susceptibility track built during JR298. A) General view; and B) view along measurement track.

The Bartsoft software records the raw magnetic susceptibility measurement as well as a corrected susceptibility compensating for drift and volume of the sample, although it is not clear if the response function of the loop sensor was accurately measured to determine the effective sample volume. For most purposes, the relative volume susceptibility is all that is required so the lack of precise calibration is not a serious issue. We did, however, measure the response function of the loop sensor as part of the process of determining the useful measurement interval. The response function of the loop sensor was measured by attaching a

~1-cm long piece of metal wire to adhesive tape and placing the tape on the end of an empty core liner such that the wire was at the centre of the loop sensor during response function measurement. Susceptibility measurements were collected at 1-cm intervals while moving the liner over a 40-cm long interval. The width of the response function (Figure 33B) at half-height is ~7 cm. The first and last three sample measurements, within the top and basal 7.5 cm of core sections, were therefore subjected to the edge effect and masked in the final data files.

The volume magnetic susceptibility values for the core sections recovered during JR298 were in the range of 0.5-14 x 10^{-3} SI, about three orders of magnitude above the noise level of the instrument (mean: -6 x 10^{-6} SI, standard deviation: 4 x 10^{-6} SI) determined by letting the susceptibility meter run in continuous acquisition mode (without a sample close to the loop) for ~5 minutes (Figure 33C).

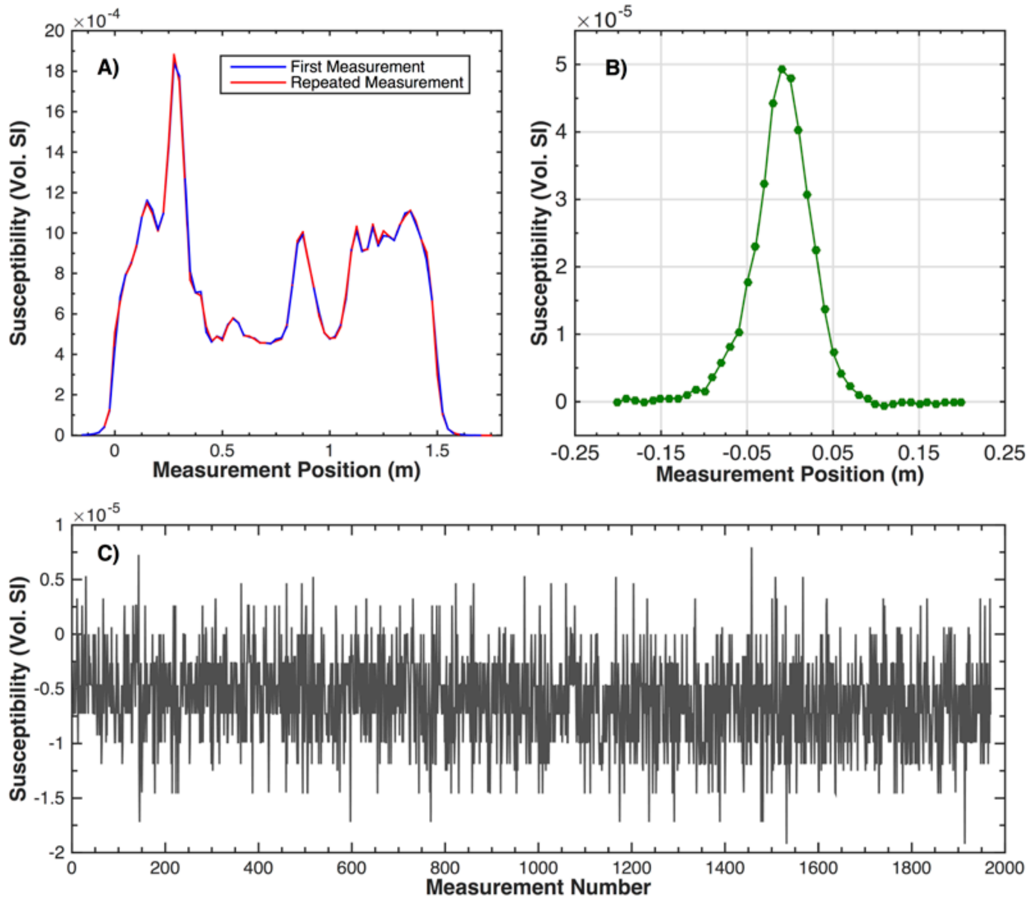


Figure 33. A) Repeated measurement of an individual core section using the susceptibility track; B) measured response function of the 120-mm diameter Bartington MS2C susceptibility loop sensor; and C) background noise measurement collected continuously over an ~5-minute time period.

5.8 CTD casts and water sampling

Rob Larter

The CTD was deployed at five core stations (Appendix 3) to

I) Obtain sound velocity profiles for input to the EM122 multibeam echo sounding system.

II) Collect water samples for geochemical analyses, and oceanographic data to characterise the physical properties of the sampled water masses (for Collaborative Gearing Scheme project *Tracing and reconstructing the neodymium and carbon isotopic composition of circum-Antarctic waters*).

III) To characterise the physical property variations in the water column that may be imaged by appropriate processing of the multichannel seismic reflection data collected during the cruise (for University of Cambridge PhD project on seismic imaging of oceanographic structures and processes in the Southern Ocean).

In addition to the standard conductivity, temperature and pressure sensors, data were also recorded from a fluorometer, an oxygen sensor, a photosynthetically active radiation (PAR) sensor, a transmissometer and an altimeter. An internally-recording lowered acoustic Doppler current profiler (LADCP; Teledyne RDI Workhorse 300kHz) was also operated during each cast, and the data it collected were downloaded after the CTD had been recovered.

At each station the CTD package was lowered to within 10 m of the sea bed by monitoring the altimeter.

5.9 Seismic and acoustic investigations of the water column

Kathryn Gunn and Javier Hernández-Molina

Seismic Oceanography is a new field of geophysics that uses existing marine seismic methods to determine the structure and dynamics of the water column. It has been shown that seismic oceanography can map seismic reflectors with a lateral and vertical resolution of less than 10m (Holbrook et al., 2003), whilst also increasing the coverage achieved by traditional physical oceanographic measurements. On board processing, described in section 5.3, of water column multichannel seismic data was achieved for several of the seismic lines collected during the cruise.

The Simrad EK60 scientific echo sounder system is designed for fishery and biomass research in the water column (Figure 34). Based on the operational frequencies this system allows the differentiation of interfaces between water masses with different densities (*pycnoclines*). During the JR298 cruise, EK60 data were recorded from the entire water column with the main purpose of identifying possible pycnoclines in the study areas, and eventually interaction of water masses with the seafloor. EK60 data were recorded between 7th February (Julian day 38) and 2nd March (Julian day 61) most of the time that the ship was underway.

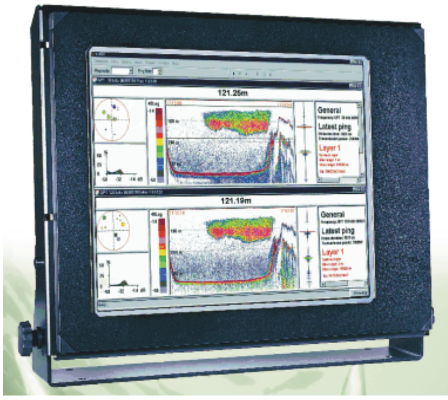
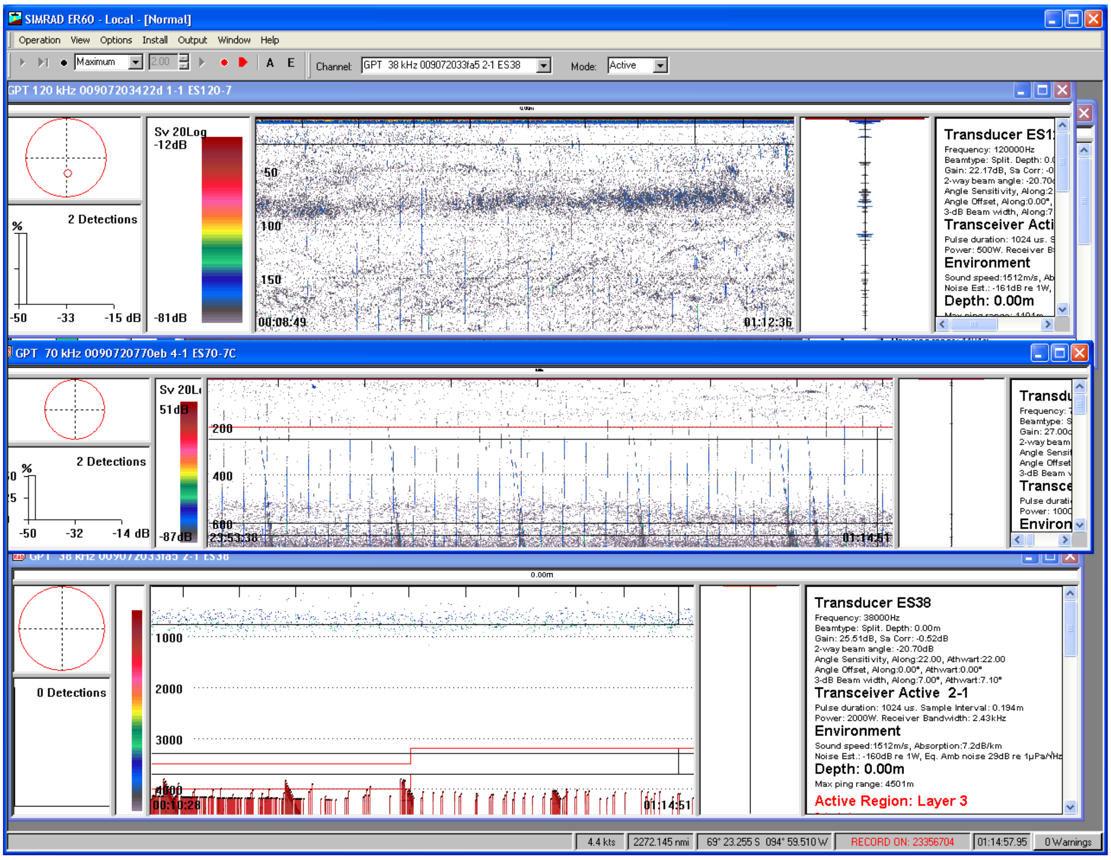


Figure 34. EK60 scientific echo sounder display.

During cruise JR298 the EK60 echo sounder was operating with frequencies at 38, 70, 120 and 200 kHz (Table 5). Higher frequencies were useful for determining the internal structure of the Superficial Antarctic Water (SAW); the interface of SAW with the Winter Water (WW), and the interfaces of the WW with the Upper Circumpolar Deep Water (UCDW). The lowest 38 kHz frequency has detected a backscatter signal in the upper part of the UCDW (Figure 36). It may be useful to correlate these acoustic data with the seismic investigations of the water column.

Figure 35 (overleaf). Example of data acquired during cruise JR298 with EK60 echo sounder frequencies 120 kHz (top) 70 kHz (middle) and 38 kHz (bottom). In the upper panel it is possible to identify an echo from plankton as well as some reflections from the internal structure of the Superficial Antarctic Water (SAW) between about 50 and 170 m water depth. With the 70 kHz frequency is possible to determine a reflection about 500 - 600 water depth, which could be the boundary between the Winter Water (WW) and the Upper Circumpolar Deep Water (UCDW). At the bottom with the 38 kHz frequency a widespread backscatter signal is determined in the upper part of the UCDW.



References

Holbrook, W. S., Páramo, P., Pearse, S. and Schmitt, R.W. 2003. Thermohlaine fine structure in an oceanographic front from seismic reflection profiling, *Science*, 301, 821-824.

6. List of Scientific Equipment Used

6.1 Seismic equipment

Hamworthy seismic air compressors

Following equipment provided by Exploration Electronics Ltd:

2 x Generator-Injector airguns used in harmonic mode (75 in^3 generator, 75 in^3 injector)

Sercel Seal hydrophone streamer with 2400 m-long active sections (192 x 12.5 m groups)

17 x DigiBIRD streamer depth controllers

Sercel 408XL digital data recording system

Quad Source Controller airgun controller

6.2 Echo sounders

Kongsberg Simrad EM122 multibeam echo sounder

Kongsberg Simrad TOPAS PS018 sub-bottom profiler

Kongsberg Simrad EA600 (Bridge navigational echo sounder)

Kongsberg Simrad EK60 echo sounder

Kongsberg Simrad K-sync sonar synchronisation unit

6.3 Oceanographic instruments

Sea-Bird Conductivity-Temperature-Depth (CTD) system with 24-bottle rosette, also including oxygen sensor, fluorometer, transmissometer, PAR sensor and altimeter

RDI Ocean Surveyor 75 kHz Acoustic Doppler Current Profiler

Teledyne RDI Workhorse 300 kHz Lowered Acoustic Doppler Current Profiler

BAS Oceanlogger, including thermosalinograph, fluorometer, uncontaminated seawater intake thermometer, air temperature thermometer, anemometer, barometer, humidity sensor, PAR sensor and TIR sensor

6.4 Winches and wire monitoring

30-tonne traction winch, ship’s coring wire and CLAM wire monitoring system

10-tonne traction winch, ship’s hydrographic wire and CLAM wire monitoring system

6.5 Coring equipment

NIOZ piston coring system

Ocean Instruments Inc. BX-650 giant box corer (500 mm square box)

6.6 Potential Field Equipment

LaCoste & Romberg shipborne gravity meter (No. S83) mounted within a Micro-g LaCoste Air-Sea System II control platform

SeaSpy towed Overhauser magnetometer

6.7 Navigation

Seatex Seapath 320+ (input to EM122 and TOPAS)

Furuno GP-32 GPS receiver

Ashtech GG24 GPS+GLONASS receiver

Ashtech GDU-5 3D GPS receiver

TSS300 heave, roll and pitch sensor

Chernikeeff Aquaprobe Mk5 electromagnetic speed log

Sperry Doppler speed log

Gyro

Sonardyne ultra-short baseline (USBL) acoustic navigation system

6.8 Data Logging

NOAA Scientific Computer System (SCS) system

7. Equipment performance

7.1 Multichannel seismic equipment

Rob Larter and Kelly Hogan

7.1.1 Seismic survey operations

Collection of multichannel seismic reflection data around the proposed scientific drilling sites was one of the main aims of the cruise, and the one for which the largest amount of time was allocated. Seismic equipment and technical support were provided by Exploration Electronics Ltd through a contract funded by the NERC UK-IODP Programme.

A total of 1960 line-km of data were collected (Table 1). This was a smaller amount of data than originally envisaged as a result of bad weather conditions preventing work on a larger number of days than anticipated and a high concentration of icebergs, growlers and brash ice making part of the westernmost planned survey too high risk. The plans for surveys carried out during the latter part of the cruise were revised to ensure that critical lines across each proposed drill site were collected, although the overall extent and line density of one of the penultimate survey was reduced compared to the original plan.

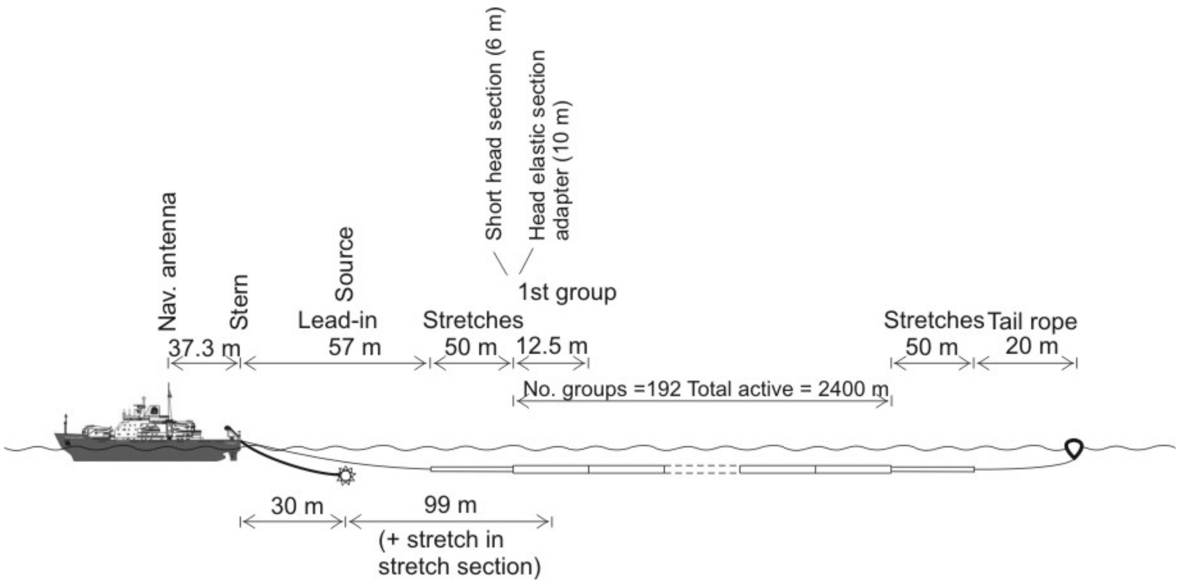


Figure 36. Schematic diagram of multichannel seismic acquisition geometry during JR298. N.B. On two surveys only half of the active length of the streamer was deployed.

7.1.2 System configuration

Two GI guns firing in 'harmonic mode' (generator and injector volumes each 75 in³) were used as the seismic source. The guns were suspended from a beam that was towed from the starboard quarter (i.e. about 9 m starboard from the centre line) such that the centre of the beam was at a distance of 30 m from the stern of the ship (Figure 36). The beam was suspended beneath a pair of A6 buoys so that the guns themselves were towed at a depth of about 4 m (except for the first deployment, when they were towed at 3 m depth). Seismic signals were detected using a 192-channel Sercel Seal streamer with a channel spacing of 12.5 m, and thus an active length of 2400 m. It was towed from a position offset 4 m to port from the centre line (i.e. to port of the stern gantry) with the front of the first active section at a distance of 123 m from the stern of the ship (Figure 36). For the two southernmost surveys, only half of the active streamer length was used, with the near channel (channel 97) of this half of the streamer deployed to the same distance behind the vessel as the first channel was for survey on which the full streamer was used. On most lines the streamer depth controllers were set to maintain the active sections at a depth of 4.5 m. Exceptions were the first part of line BAS145-39, which started with a nominal towing depth of 3 m, and some data recorded in poor conditions, when the nominal towing depth was increased to 5 m.

For each line, data were recorded in SEG-D format with a sample interval of 1 ms and a record length of 8 s. The Sercel 408XL recording system included an analogue 3Hz low cut filter. However, examination of data from the first two surveys showed that they still contained a significant amount of lower frequency swell noise, so a digital 5 Hz low cut filter was applied during recoding of subsequent lines (lines BAS145-53 and following). The airgun firing cycle time was 10 s on most lines, but was increased to 12 s on most lines in the westernmost survey area to the prevent sea-floor multiple reflection from previous shots contaminating water column seismic data during the deeper water parts of this survey. A cycle time of 12 s was also used for the following survey, over the Belgica Trough Mouth Fan (proposed BELS-1 site area) before it was changed back to 10 s for subsequent surveys. On all surveys, the airguns were synchronised to fire 30 ms after the start of recording of each shot.

7.1.3 Problems encountered

During the first streamer deployment the sleeve pulled away from a weight in one of the active sections, resulting in a small leak of isopar-M. Almost all the leaking fluid was captured. The 150 m-long streamer section was replaced by a spare section. Another small leak resulting from a split in a sleeve was found during a subsequent streamer recovery, but in that case a temporary repair was carried out, avoiding the need to replace the section.

During the first survey the firing times of one of the airguns started to show more variation than usual, although they remained within the normal tolerance limit. After the survey this airgun was serviced and the problem did not recur.

After the streamer had been deployed for the survey on the Belgica Trough Mouth Fan (proposed BELS-1 site area), it was noticed that channels 189 and 190 were very noisy. These channels were muted for that survey and the last active section in the streamer was replaced by a spare section during recovery.

After the airguns had been recovered at the end of the survey on the Belgica Trough Mouth Fan, several strands of the towing strop were observed to have parted, probably through rubbing on the starboard rail (Figure 37). The Bosun made a new short strop to replace the damaged section and the towing point on the rail was extended with additional shackles and padded (Figure 38). At the end of the final survey the recovery wire from the new deck winch (Gilson replacement) failed and thus the airgun umbilical had to be hauled in by hand. A small amount of slack had been left in the wire so that the towing strain was taken on the starboard quarter. A loop of slack wire had probably been damaged by coming into close contact with the airguns while they were firing.

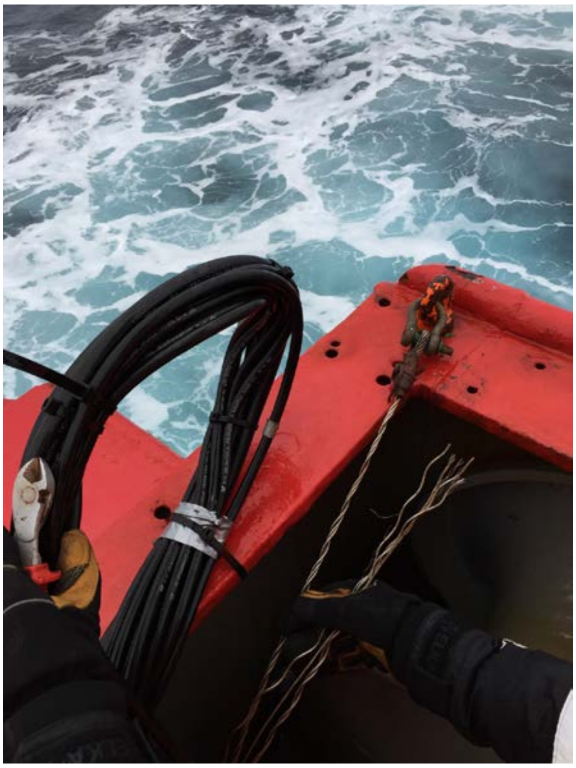


Figure 37. Damaged towing strop.

Figure 38. Repaired strop and modified towing arrangement.

7.2 EM122 multibeam echo sounder

Elanor Gowland, Ricarda Pietsch and Kelly Hogan

Logging of EM122 data was initiated at 1216Z on Julian day 032, after clearing the Argentine Economic Exclusion Zone limit, 200 nautical miles for their coast. The system was operated at virtually all times when the vessel was in motion, until logging was stopped at 0450Z on Julian day 061.

7.2.1 Setup and Standard settings

The EM122 Built In Self Tests (BIST) were carried out on initial start up around 1130Z on 1st February 2015. All tests were passed and the output saved to the em122/common/bist folder with the filename 'BIST_test_JR298_01022015'. This can be found in the data section of the cruise leg '20130123' of the JCR records.

For the majority of the cruise, the EM122 was only synchronized with the EA600 and not with the TOPAS. On the occasions the TOPAS and EM122 were synchronised (in relatively shallow water areas) the 2 echo sounders were placed in different active groups in the K-sync.

The width of the swath was set to a level appropriate for the water depth and weather conditions. Under favourable conditions, beam angles were set as wide as 68º, but were reduced if the outer beams became discordant or noisy, or if the EM122 had problems fixing the bottom. Minimum and maximum depths were set as appropriate for the regional bathymetry. Occasionally, the maximum depth was fixed near to the actual water depth in an attempt to stop the EM122 from picking spurious multiple seafloor reflectors.

The ping mode was mostly set to VERY DEEP (off shelf) to avoid the EM122 picking up the TOPAS signal. However, it should be noted that there was a significant amount of acoustic interference, particularly on certain headings, from both other instruments and the weather (waves on beam causing bubbles under the hull preventing transmission / receiving of acoustic signal).

Sound velocity profiles, derived from XBT / XCTD casts and CTD deployments during this cruise, were changed as necessary to be appropriate for the water structure of the survey area (see Table 4 in section 5.4). After the upgrade to the multibeam system during the summer refit of 2014 it is now possible to use the "FM" mode, and this was activated almost continuously during the cruise, with the exception of instances when there were poor returns / interference and settings were amended to try and restore data collection.

7.2.2 Problems encountered

Software Crashes

On a number of occasions during the cruise the SIS software crashed and had to be manually restarted which caused a gap in data acquisition (see Table 5). Often no error message would appear and the program would just stop responding, and try to close. No specific trigger for these failures was discernible, but as most occurred when changing the graphical display or background image it is likely that the high memory demand required to run and display the gridded data is the underlying cause of most failures. To minimize these types of crashes we kept the grid resolution coarse and tried to avoid displaying too much data at once, i.e. start a new survey in each study area and only display one or two surveys at a time. It is recommended this is further investigated and details sent to Kongsberg to try and avoid this during future cruises.

Synchronisation

Initially only the EM122 and EA600 were run together through the K-sync synchronisation unit and TOPAS was mostly run on an internal trigger, manually changing the TOPAS ping rate to be appropriate for water depth but also trying to avoid interference.

However, upon reaching the continental shelf we tried to use the K-sync to trigger TOPAS, EM122 and EA600 together; a number of the user configuration settings were tried but did not work correctly. Later in the cruise (also on the shelf) triggering TOPAS (in addition to the EM122 and EA600) through the K-sync was re-attempted, this time successfully, but only after a period of trial and error. The K-sync seemed most successful in triggering TOPAS, EM122 and EA600 together when using the configuration “Swath+Topas <1000m” which has TOPAS in a separate trigger group to the EA600 and EM122.

Problems were also encountered when crossing steep slopes because both systems lost track of the sea floor and interference occurred. This problem was solved using different configurations for shallower water using the K-sync.

Table 5. Problems encountered with the EM122 during the cruise.

ID	Problem	When did it occur (UTC time, date, JD)	What was the fix/what did not work/any additional information	Logged by
1	SIS crash	08:18:43 04/02/2015 (JD 035)	Restart SIS program; no option but to restart SIS program; no apparent trigger.	KAH
2	SIS Geog. display and Helmsman stopped showing gridded data.	16:33:09 04/02/2015 (JD 035)	Tried creating a new survey – did not fix the problem. Restarted SIS – problem solved. Note that both of these options require operator to stop logging and pinging of the EM122. Cause unknown.	KAH/TJ
3	SIS Crash	11:25:52 05/02/2015 (JD 036)	Restarted SIS program; no apparent trigger.	TJW
4	SIS Crash	16:50:04 05/02/2015 (JD 036)	Restarted SIS program; no apparent trigger, although I was re-sizing windows in the display at the time.	
5	SIS crash	01:06:00 07/02/2015	Adding a background image and system crashed. Would not close, so EM122 workstation restarted. On restart received error “Could not load U:\asvp\by-leg\20150123\JR298_002_thinned_salinity_3500.asvp Using old abs. Coeffs (542)”. This error kept appearing until I reloaded the svp (JR298_002_thinned). Reloaded survey and background – OK in SIS but Helm would not display them. SIS OK by 0115. Logging to line 0042 and jr298_c. Restarted Helmsman again, and this was OK and displaying by 0132 – but not the latest pings. NB: SIS displaying error that the grid engine contained too many points – check GridEngine Parameters when starting a new survey.	EG
6	SIS not displaying grids followed by crash	09:08:00 – 09:24:00 07/02/15 (JD 038)	Grids not displaying on SIS/Helmsman and no depth information (realtime depths) on Helmsman in new survey jr298_d. Stopped logging and pinging to check grid parameters and full SIS crash. Clicked “close program” but would not close or restart; had to kill process in Task Manager. Restarted SIS and Helmsman display but grids still not being	KAH

			shown, despite new survey grid parameters being lower resolution (64x64 cells; 100 m cell size). SIS message reads: "GridEngine returned a grid (jr298_c) with more cells (26688886) than allowed (2000000). (904)". Will try to investigate GridEngine/grid files for solution.	
7	SIS not displaying background grids/SIS crash	From 17:00:00 07/02/2015 (JD 038)	SIS and Helmsman not displaying grids. In "Survey Administration" we could see that the grid cell size was far too small (the default?) at c. 2 m. Stopped logging and pinging and performed "clean" restart of SIS/Helmsman to try to fix this problem. Went to New Survey to try to reset gridding parameters; continued with jr298_d survey but checked grid parameters were set as at start of survey e.g. 64x64 cells; 100 m cell size) – they were. Restarted pinging/logging but when jr298_c survey added SIS crashed. Restarted with jr298_d – DO NOT reload jr298_c as grids in that survey cause SIS to crash.	TJ/KAH/EG
8	New survey not displaying in SIS or Helm	2315 – 2345 09/02/2015	New survey (jr298_e) was created, but was not displaying correctly on EM122 and was not displaying at all on Helmsman. Tried restarting Helm a few times, ended up having to restart SIS to resolve.	AG/EG
9	SIS crash	21:12:008 13/02/2015	Crash out Multibeam.	
10	SIS crash	22:19:00 17/02/2015	SIS crash whilst zooming out in Geographical view.	
11	No GPS signal to equipement	02:28:01 25/02/2015	No GPS steam to any equipment, therefore Multibeam stopped pinging. System administrator restarted GPS system.	RP/AL
12	SIS crash	16:00:00 25/02/2015 (JD 056)	Created survey jr298_i. SIS crash when zooming on Geographical display. Fine after restart, but only survey jr298_i and 1 background image.	EG

7.3 TOPAS sub-bottom profiler

Kelly Hogan, Ali Graham, Rob Larter, Elanor Gowland and Javier Hernández-Molina

Logging of sub-bottom profiler data began at 1514 UTC on Julian day 032, and the system was operated near-continuously during the cruise until 1208 UTC on Julian day 058 when the JCR was approaching Rothera. TOPAS was re-started at 1014 UTC on Julian day 059 and was run until a location in the Drake Passage, 200 nautical miles from the coast at the edge of Argentina's exclusive economic zone. Pinging and logging of TOPAS sub-bottom profiles was stopped for the final time at 1756 UTC on Julian day 060.

7.3.1 Standard settings

Typical parameter settings on the control workstation for both deep water (continental slope and rise) and shallow water (continental shelf) logging are listed in Appendix 6. In deep water settings the TOPAS trigger was purposely operated with an internal trigger (i.e., TOPAS was not synchronised with other echo sounders on board) in order to output more frequent pings. At these times, care was taken to select a ping interval that was not an integer factor of the ping cycle of the EM122 multibeam echo sounder; this is known to cause interference to both the incoming EM122 and TOPAS data. In shallow water depths (less than about 1000 m) TOPAS was operated in a synchronised mode with an external trigger from the K-Sync unit. The TOPAS system was operated with a chirp source and matched filter throughout the cruise. Manual adjustments to the bottom tracker tool on TOPAS were made fairly often to help track the sea floor when interference from the EM122 occurred. A time-variable gain (TVG) and small adjustments to the receiver gain were made during acquisition to improve imaging of the seafloor on the screen display.

7.3.2 Problems encountered

In general, the TOPAS sub-bottom profiler performed well during JR298. Reflections were clearly imaged up to 100 ms (about 75 m assuming a sound velocity of 1500 m/s through the sediments) below the sea floor over the sediment drifts where fine-grained sediments with high water contents occur. Several minor operational problems were encountered during the cruise:

1. Between approximately 1212 and 1315 UTC on JD 048 the paper roll on the analogue printer (EPC9800) needed to be replaced. Upon changing paper roll TOPAS did not start plotting to the printer again. Restarting the TOPAS software, rebooting TOPAS machine, and checking the printer port settings in Printer Configuration in TOPAS 1.7.0 software (need to log in as Root) did not solve the problem. The eventual solution was to set the printer on Internal trigger and to stop pinging TOPAS. When pinging was restarted the plotter started to print again. It should be noted that the TOPAS machine did not restart automatically when "Turn off computer" then "Restart" was pressed and a manual restart of the TOPAS machine in the cabinet had to be performed at ~1240 JD 048.
2. During the first survey on the continental shelf (JD 034) attempts to get TOPAS to trigger externally through the K-Sync unit using the pre-existing configuration settings

on K-Sync were unsuccessful. During following surveys on the shelf synchronisation of the TOPAS echo sounder was achieved using a shallow water configuration on the K-Sync unit. This involved setting TOPAS to External trigger and switching TOPAS to trigger on the K-Sync unit but, importantly, in a different group to the EM122. Setting TOPAS and the EM122 to trigger within the same group A shallow-water configuration file for K-Sync (where the TOPAS and the EM122 are synchronised) was saved as “JR298_shallow <500m” on the K-Sync system.

7.4 EA600 echo sounder

The Kongsberg EA600 12 kHz echo sounder, the control console for which is located on the Bridge, was used for navigational purposes. Depths recorded by the system were all calculated using a constant assumed acoustic velocity of 1500 ms^{-1} and were logged on the NOAA SCS logging system. For most of the cruise the EA600 was triggered by the K-sync, synchronized with the EM122, and operated in ‘passive’ mode, with the EA600 calculating its depth from the EM122’s first return.

7.5 EK60 echo sounder

Javier Hernández-Molina and Kathryn Gunn

The EK60 is an echo sounder with split beam transducers, which allows target detection and the size distribution in a specific volume. The echo sounder on board the RRS *James Clark Ross* uses transducers with operational frequencies at 38, 70, 120 and 200 kHz; a general purpose transceiver (GPT) and a processor unit (computer), with the acquisition and processing software, located on the UIC room (Figure 39).

During cruise JR298 the EK60 echo sounder was operating with frequencies at 38, 70, 120 and 200 kHz (Table 6).

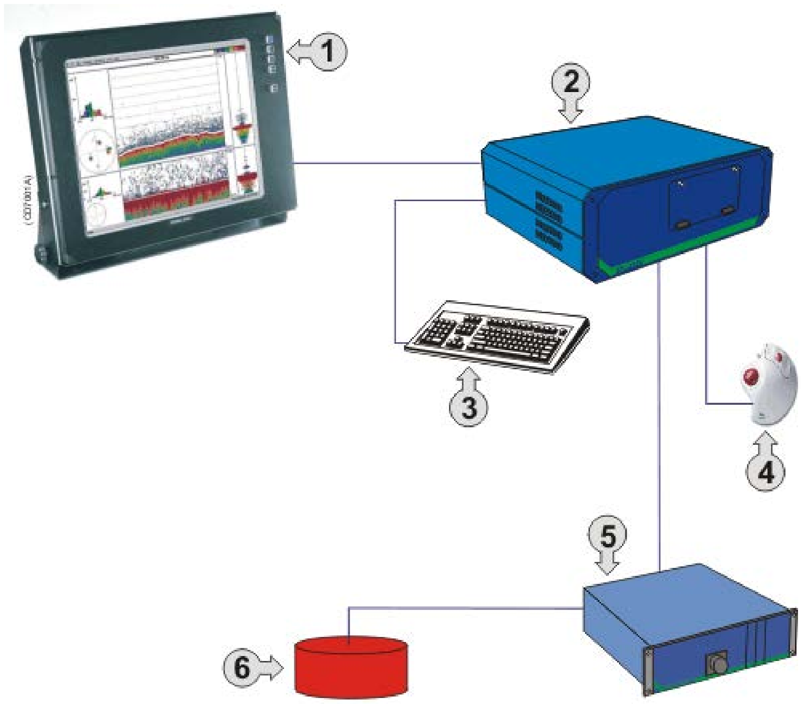


Figure 39. EK60 basic system diagram: 1) Colour LCD display; 2) Processor unit (computer); 3) Keyboard; 4) Mouse or pointing device; 5) General purpose transceiver (GPT); 6) transducer.

Acquisition parameters of EK60 during the JR298 cruise				
	Transducer ES38	**Transducer ES70-7C**	**Transducer ES120-7**	**Transducer ES200**
Frequency:	38000 Hz	70000 Hz	120000 Hz	200000 Hz
Beam type:	Split. Depthb0.00m	Split. Depthb0.00m	Split. Depthb0.00m	Split. Depthb0.00m
Gain:	25.51dB. Sa Con: -0.52dB -20.70dB	27.00dB. Sa Con: 0.00dB -21.00dB	22.1700dB. Sa Con: -0.42dB -20.70dB	23.61dB. Sa Con: -0.22dB -19.60dB
2-way beam angle:	*Along*: 22; *Athwart:* 22	*Along*: 23; *Athwart:* 23	*Along*: 21; *Athwart:* 21	*Along*: 23; *Athwart:* 23
Angle Sensitivity, Angle offset;	*Along*: 0.00°; *Athwart:* 0.00°	*Along*: 0.00°; *Athwart:* 0.00°	*Along*: 0.00°; *Athwart:* 0.00°	*Along*: 0.00°; *Athwart:* 0.00°
3dB Beam Width	*Along*: 7°; *Athwart:* 7.10°	*Along*: 7°; *Athwart:* 7.00°	*Along*: 7°; *Athwart:* 7.10°	*Along*: 8°; *Athwart:* 7.90°
	Transceiver Active 3-1			
Pulse duration:	1024µs	1024µs	1024µs	1024µs
Sample interval:	0.194m	0.194m	0.194m	0.194m
Power:	2000W	1000W	500W	300W
Receiver Bandwidth	2.43KHz	2.86KHz	3.03KHz	3.09KHz
	Environment			
Sound speed:	1512m/s	1512m/s	1512m/s	1512m/s
Absorption:	7.2dB/km	19.8dB/km	39.1dB/km	60.7dB/km

Table 6. Acquisition characteristics of the EK60 echo sounder during cruise JR298.

7.6 Acoustic Doppler current profiler (ADCP)

Kathryn Gunn

The ADCP on the JCR is a hull-mounted 75kHz RDI Ocean Surveyor. The ADCP uses a phased array transducer that produces all four beams from a single aperture at a specific angle. The transducer on the JCR is aligned at 60.08° relative to the centre line at 6.3m depth.

7.6.1 Command File

The command file is a text file that sends a series of commands to configure parameters within the ADCP. There are several possible combinations of commands; the file used on the JR298 enhances water column data acquisition and is found on the ADCP machine at *C:\ADCP\Command files\SetModes\JR 800m WaterTrack 16mBins NotThruSSU*. As there were no scientists on board with ADCP experience, no changes were made to the command file and set up guidance.

The *JR 800m WaterTrack 16mBins NotThruSSU* command file configures the system to narrowband water tracking mode with a maximum bottom depth search of 800 m. 100 8 m bins were applied to the data, with an 8m blanking distance. The radial ambiguity velocity applied was 390 cm/s.

7.6.2 Outputs

The ADCP produces several output types, the most important of which are .N1R and .ENR which are the NMEA telegram + ADCP time stamp ASCII file and Beam co-ordinate single ping data binary file, respectively. .ENX files can be read with matlab and processed accordingly.

7.6.3 Calibration

The data were not calibrated with bottom tracking mode because this requires a single ping to reach the sea floor i.e. sea floor has to be less than 800 m depth. The majority of the cruise was spent in deep water where this was not possible. It was assumed that recent calibrations were sufficient.

7.6.4 Data and preliminary results

The ADCP was running continually from Julian day 32 until Julian day 061 and only stopped when the LADCP was lowered with the CTD casts. The instrument was restarted before leaving each CTD station. The outputs of interest begin from JR298005_YYYYYY.ZZZ (i.e. JR298001-JR298004 are test files). Each output file is 10 MB in size. No onboard processing was applied to the data due to a lack of experience and software.

7.6.5 Interference

Several sonar instruments were run simultaneously throughout the cruise; ADCP, EM122, EA600, EK60 and TOPAS. The main priority was to collect high quality TOPAS data and therefore TOPAS was left free-running for the majority of the cruise. The EM122 and EA600 were synchronised using the K-sync system throughout the cruise, and in shallow water areas TOPAS was synchronised (i.e. triggered by being put in a separate K-sync group) with both of them to minimize interference. In deep water, however, TOPAS was not synchronised as this would have required an unacceptably long ping cycle. No synchronization was applied to the ADCP or EK60 as it was not believed they would affect TOPAS, i.e. the ADCP was also free running. It is unlikely that the EM122 will interfere with the ADCP due to the narrow bandwidth of the EM122 transmission. Therefore any potential interference present in the data is most likely caused by TOPAS. The level of interference will become apparent when processing is applied onshore.

7.7 Gravity meter installation and on-board processing

Tom Jordan

7.7.1 Installation and operation

Gravity data was collected using a LaCoste & Romberg shipborne gravity meter (No. S83) mounted within a Micro-g LaCoste Air-Sea System II control platform. The gravity system was supplied by National Marine Facilities Sea Systems (NMFSS) Southampton, and was installed in the JCR ‘gravity room’ which lies at the approximate centre of motion of the ship (Figure 40). Raw gravity data were collected at 1 Hz, and were logged in ASCII format to both a dedicated laptop and the JCR SCS. The platform control system was provided with real time positional data from the Furuno ship-borne GPS system, as the required GPRMC string was already set up (SCS variable furuno-rmc) (Table 7). These data allowed calculation of an initial estimate of the Eotvos correction, and were logged together with the raw gravity data.

An additional "environmental" file with meter coefficients, meter internal temperature and pressure was also recorded at a 10-second sample interval. Graphs showing long and cross axis accelerations were set up on the SCS display screen in the UIC room. This allowed the health of the gravity system to be monitored in real time by the geophysical watch keeper.

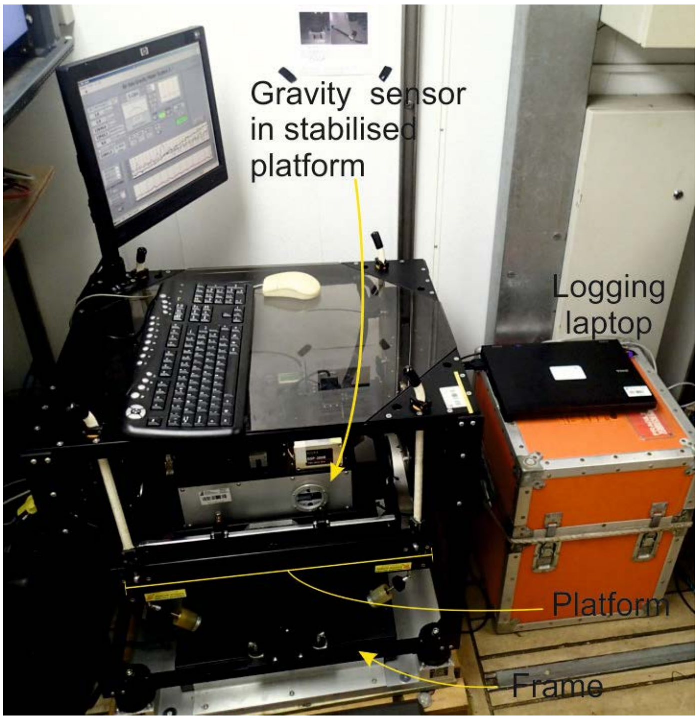


Figure 40. Gravity system and associated logging laptop installed in JCR gravity room.

Table 7. Example and format for GPRMC GPS NEMA string taken in by gravity system.

Example string	
$GPRMC,140017,A,6616.3332,S,07154.5232,W,0.1,220.6,210215,22,E*51	
String parts	
AAAAAA,BBBBBB,C,DDDD.DDDD,E,FFFFF.FFFF,G,H.H,III.I,JJJJJJ,KK,LLLL	
Code	**Description**
AAAAAA	Name string
BBBBBB	Time: Hour Min Second (HHMMSS)
C	Status (A=good)
DDDD.DDDD	Latitude: degrees and minuets (DDMM.MMMM)
E	North or south (N or S)
FFFFF.FFFF	Longitude: degrees and minuets (DDDMM.MMMM)
G	East or west (E or W)
H.H	Speed over ground
III.I	Heading
JJJJJJ	Date: day month year (DDMMYY)
KK	Magnetic variance
LLLL	Extra ascii code not used by meter.

7.7.2 Onboard quality control and data processing

QC processing of the gravity data was carried out using Geosoft™ geophysical data visualisation software. Raw ASCII gravity data were imported and merged with positional data from the Seatex ship-borne navigation system. Relative gravity values (Gravity(mGal)) were re-calculated from the raw gravity data as follows:

Gravity(mGal)=(((Beam(k-1)-Beam(k))*BEAM_coef+ST+CC)*M_coef

Where

Beam = beam position in millivolts.

BEAM_coef calculated during system calibration and recorded in the environment file.

ST = spring tension value.

CC= Cross coupling correction, initially calculated from the raw data and coefficients recorded in the environment file as (see note below for revised formula): VE_Coef*VE+VCC_Coef*VCC+AX_Coef*AX+AL_Coef*AL+AX2_Coef*AX2

M_Coef converts meter units to mGal and for meter S83 is 0. 9967

Relative gravity values were corrected to absolute level based on a pre-cruise still reading and tie to the absolute gravity tie point at Punta Arenas Harbour Administration Building (ISCN no. 51230N) as follows:

Absolute grav (mGal) = Gravity (mGal)- 12668.66+ 981320.61

The free air gravity anomaly (FAA) was calculated as:

FAA = Absolute grav (mGal) – Latitude correction + Recalculated Eotvos correction

QC Free air gravity anomaly was created by filtering FAA with a 2500 point Butterworth filter, which equates to a spatial wavelength of 5.7 km at the speed the seismic data was collected at, and ~17 km for passage between survey areas. Anomalies were manually masked to remove data associated with abrupt turns and coring stations where the ship was stationary. The processed, filtered and masked data were compared with the Sandwell and Smith satellite derived gravity grid as a final sanity check (Figure 41).

When processing the gravity data it became apparent that unusual anomalies were present which correlated with periods of more extreme weather. Tests showed that the filtered cross coupling value (derived from measurement of horizontal acceleration of the meter) correlated with the suspect processed anomalies (Figure 42). Further analysis showed that specifically the AX value was strongly anti-correlated with the problematic anomalies. Inverting the coefficient for the AX cross coupling factor appears to solve the problem.

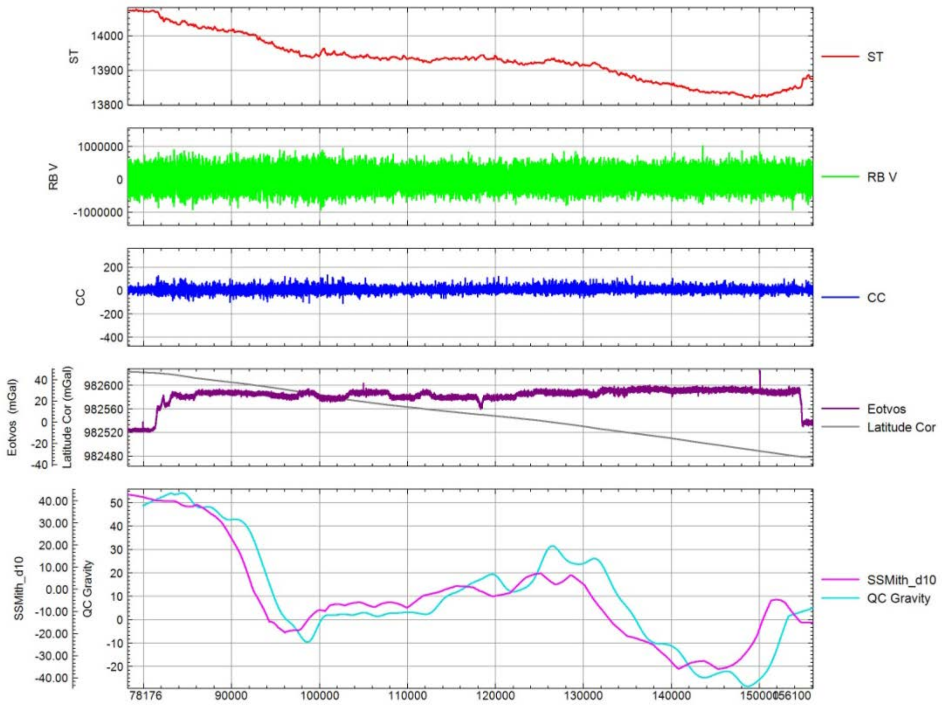


Figure 41. Example raw and QC-processed gravity data for one day. Top three panels show raw output from gravity meter. Panel four shows the latitude and Eotvos corrections applied. Lower panel shows QC gravity (blue) and Sandwell and Smith satellite gravity (pink).

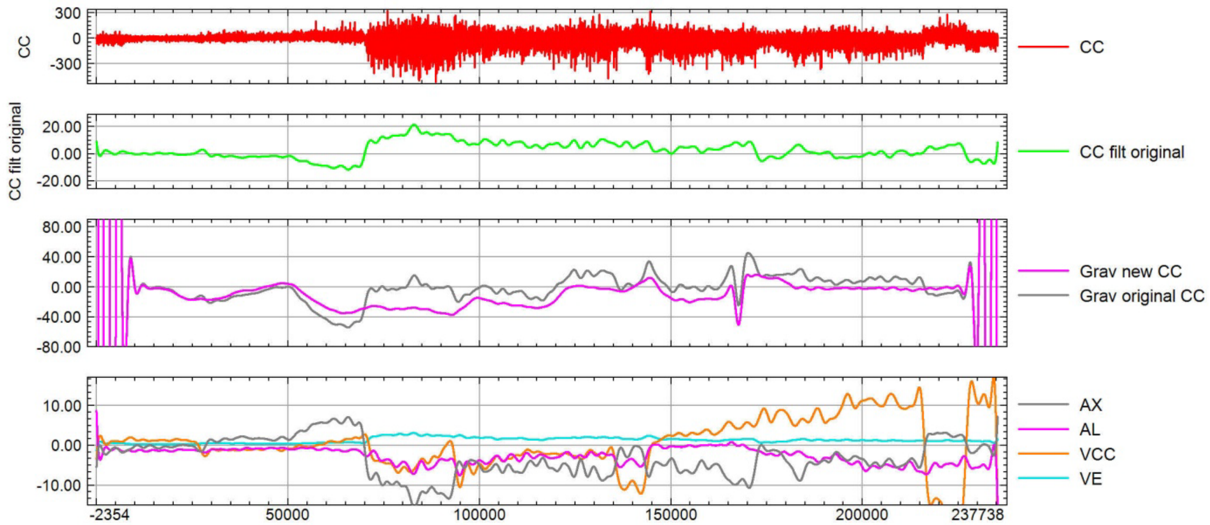


Figure 42. Impact of cross coupling (CC) on final gravity anomaly. Note there should be no correlation. Panel 1 shows unfiltered cross coupling, note jump in CC vales at 75,000 associated with poor weather. Panel 2 shows filtered CC values. Panel 3 shows Gravity anomaly based on the original (grey) and new (pink) coefficients. Panel 4 shows individual CC factors. Note correlation of AX with gravity anomaly.

Finally it was noted that the physical position of the platform within the frame is not well constrained by the shock cords. This means that even in moderate swell the platform can clash with components of the control system or frame. In particular this is seen with the corners of the system power module. When replacing the power module it was noted that the lower corners of the spare unit were already worn, indicating this is likely a long term problem with this platform type. It is not clear if this has an impact on the data, but this is clearly not an ideal situation.

7.7.3 Gravity time line

19th September: The system was installed and tested by NMFSS technicians in Immingham (UK). It was noted at the time that the control system often took several attempts to boot, but once started the system typically remained stable. After installation the system was left with power supplied to the meter heater, but the control system turned off. The sensor was physically clamped in the stabilised platform, and the corners of the platform padded with foam to prevent movement against the frame in rough weather (Figure 40). Prior to the survey the ship's deck engineer was responsible for ensuring the shock mounts beneath the meter frame were kept inflated with fortnightly checks. Around 14th January the control system was turned on in error. The system booted, and the platform tried to level, despite being clamped in its frame. Some time subsequently the control computer crashed.

24th January: The first action on arriving at the ship in Punta Arenas Harbour was to pull the breaker switch to the torque motors to prevent the clamped platform from trying to level. Additionally the land gravity meter was powered on to allow its internal temperature to stabilise.

25th January: The ship-borne gravity system was turned on for the cruise. After un-clamping the sensor within its platform it took multiple attempts to get the control system to boot. Once up and running the system appeared stable and standard calibration checks were carried out. These included setting the Spring Tension value to match between the meter and computer system, setting the system zero and gain, and confirming the beam scale factor was correct.

26th January: After >24 hours stabilisation, the absolute gravity value at the ship-borne meter was calculated based on a tie to the Punta Arenas Harbour Administration Building (ISCN no. 51230N). To do this the gravity value at the dock side adjacent to the ship was found using a LaCoste & Romberg land gravity meter (see Appendix 7). The gravity effect for the vertical offset between the dockside reading and the ship-borne gravity meter was then calculated using the standard free air correction. To find the absolute difference in elevation between the dock side measurement and the gravity room a hand held laser range finder/tilt meter (Leica DISTO™ D3a) was used to measure the range and angle to a defined survey point on the ships rail. This survey point was determined by Parker Maritime during a survey in 2014, which also gives the coordinates of a reference point in the gravity room. The position of the dockside reading and the gravity meter centre of mass were transformed into the ship-borne coordinate system, and the difference in height calculated.

Logging of the raw gravity data to the SCS system was also set up on the 26th January. This data logging was via serial output from the gravity control system. Although logging to the SCS system appeared to work there were many single second data gaps. These gaps were not observed where the same output raw data stream was logged to the local laptop. Although such small data gaps are not significant for QC of the data, final processing should be carried out using data logged to the local laptop.

Time stamping of the gravity data was automatically set based on the control computer clock. The control computer time was therefore set to UTC +/- 1 second before the control program was started, however, a precise timing trigger could not be applied. It is therefore recommended that the position logged by the gravity system be cross correlated with the position logged by the SCS system to determine if any time offset is present.

30th January: Meter was unclamped in preparation for departure from Punta Arenas. It was noted the local logging laptop had crashed, and the local logging system was therefore re-started.

1st February: crossing the Drake Passage rough seas meant that poor quality data was being recorded. The free hanging beam in the gravity meter sensor was clamped and the Spring Tension tracking was turned off. The torque motor breaker was pulled, the sensor unit clamped within its platform, and foam padding added between the platform and the frame.

2nd February: After passing through rough weather the meter was unclamped padding foam removed, and torque motor breaker pushed in.

3rd – 14th February: Continuous successful collection of gravity data on both transits and coincident with seismic lines.

15th February: On a transit line in relatively heavy seas the meter control system failed. This caused the meter to ‘dump’ i.e. tilt violently and consistently over on one axis. About 20 minutes after initial failure the logging computer also failed. The control system would not re-boot, despite multiple attempts. The spare control system was therefore installed, and booted. Given the poor weather conditions it was decided not to re-start the gravity system, and it was left clamped and padded.

17th February: Gravity system re-started. On restart of the control system the platform dumps and the control system crashes. After several failed re-boot attempts the control system starts, however, it shows no communication with the platform. After consultation with NMFSS in Southampton input/output control cards in the control system were re-seated and the system restarted. On re-start of the control software all appears OK, however, after ~20 minutes the platform dumps again. Control software shut down and platform levels OK, but any communication between control software and platform makes the platform dump. After further consultation with NMFSS it is decided the power supply may be the issue. The power supply was therefore changed. The control system computer booted 1st time and successfully communicated with the platform, which remained stable.

Once a stable platform had been achieved it was necessary to re-calibrate the new control system to the meter, as had been done at the harbour side in Punta. Although Spring Tension value and zero could be set harbour side (very calm) conditions are required to set the gain value. We therefore copied the gain value set in Punta directly onto the new system.

26th February. On transit to Rothera station poor weather conditions meant the gravity system beam was clamped, and padding placed between the platform and the frame. The platform was allowed to continue to self level, and the control/logging system remained on.

27th February. For the final transit into Rothera, and while tied up against Biscoe Wharf at Rothera, gravity data were collected. At this time a tie to the land gravity base point was also made, following the same procedure as in Punta. Due to relatively high wind/wave noise seen on the land meter this tie should be regarded as of intermediate quality.

7.8 Magnetic equipment and processing

Tom Jordan

7.8.1 Magnetometer operation

Magnetic data were collected using a SeaSPY towed fish magnetometer. This Overhauser type magnetometer reported total magnetic field intensity, signal strength and sensor depth.

Data were recorded and time stamped at 1Hz directly by the SCS server. However, values reported for sensor depth were not realistic (>400 m depth).

Shipboard three component magnetometer (STCM) data were not recorded during the cruise because the y-component gave a constant reading, suggesting a problem with that fluxgate sensor. On previous occasions when a similar ‘flat line’ has occurred (usually on the z-component in high latitude areas) it has been possible to shift the reading into the measurable range by repositioning bar magnets in the sensor case on the Monkey Island, but on this occasion doing this did not solve the problem. At the end of the cruise the y-component sensor was replaced by a spare (from the system decommissioned from the RRS *Ernest Shackleton*) and this resolved the problem. During the cruise, however, is was observed that the part of the Monkey Island near the sensor case was being used to store several large steel beams, which probably significantly distorted the local magnetic field and could well have compromised STCM data if the system had been working.

The SeaSPY magnetometer was deployed on a ~200 m Kevlar cable over the stern of the ship. There were three modes of deployment. Firstly, when seismic data was not being collected the magnetometer was deployed directly over the stern of the ship on the starboard side of the A-frame crane. Secondly when seismic data was being collected the magnetometer was deployed through the starboard side ‘fairlead’ which extends out on a 5 m boom (Figure 43a). Unfortunately due to numerous fragments of icebergs for part of the survey we had to deploy the magnetometer through the centre of the A-Frame crane at the stern of the ship, between the seismic guns, and streamer (Figure 43b).

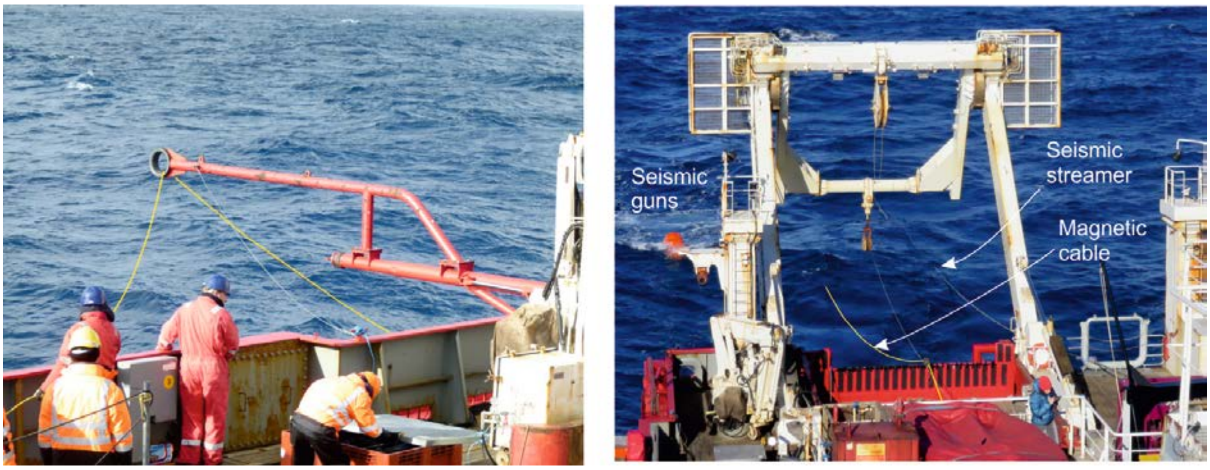


Figure 43. a) Starboard side fairlead magnetometer deployment (yellow cable) when collecting seismic data in ice-free conditions. b) Magnetometer deployment through A-frame when also collecting seismic data in icy conditions.

7.8.2 Onboard quality control processing

QC processing of the magnetic data was carried out using the Geosoft™ program. First the 1 Hz magnetic data were merged with Seatex positional data. The 2014 IGRF correction was then applied to the data to correct for variations in the global magnetic field. A non linear 'de-spiking' filter with a width of 10 and a tolerance of 1 was run to remove spikes in the data. Comparison with the ADMAP regional magnetic compilation revealed a residual DC offset of -116 nT in the SeaSPY data, which was corrected for.

Systematic noise with an approximate 10 minute period and 10 nT amplitude was apparent on some lines. This noise appeared to be heading dependent, worse S to N, and E to W, but not apparent in the reciprocal directions. The cause of this noise is unknown, but likely relates to the magnetic system itself. The ships electrical hull cleaning system (cathodic protection) was investigated as a possible cause, but showed no impact. The low amplitude of the noise relative to the observed regional anomalies means that the dataset remains a useful resource for regional studies. More detailed analysis will require additional processing to minimise this noise.

7.8.3 Magnetic data collection time line

28th January: Initial harbour side setup of magnetic system on rear deck of JCR. The magnetic system was easy to set up, with the fish simply screwing directly onto the end of the Kevlar data cable. The other end of the cable linked directly through to the SCS system, via a junction box in the UIC room. Data was initially viewed directly on the SCS system. On deck an average magnetic field value of ~10,000 nT was reported, ~30,000 less than expected, and there was also significant noise apparent on the system amounting to several thousand nT. Although alarming, this noise and offset is a signature of the shipboard environment, not a problem with the magnetic system.

1st February: Once outside of all territorial waters the magnetometer system was deployed. A smoothly varying signal was recorded, with mean amplitude of ~32,000 nT. From this time forward magnetic data were continuously recorded. However, the magnetometer was recovered and re-deployed every time the ship came to a coring station, and before the seismic streamer was deployed and before the seismic streamer was recovered.

7th February: Due to the risk to any equipment deployed over the side of the ship from small icebergs the magnetometer system was deployed over the stern of the ship through the centre of the A-frame gantry.

8th February: While collecting seismic and magnetic data ~10,000 nT spikes became visible on magnetometer graph, progressively getting more frequent until no usable data were being collected. This was due to the Magnetometer fish becoming tangled with the seismic streamer. The magnetometer was therefore retrieved, however, it became jammed around 100 m from the stern of the ship. At the end of the line 100 m of seismic streamer was then recovered and the magnetometer untangled. As deployment of the magnetometer outboard from the ship was not an option after discussion it was decided to re-deploy the magnetmoeter through the A-Frame, but to recover and re-deploy it on every turn when the seismic streamer was being towed.

12th February: Improving ice conditions mean magnetometer can be deployed through starboard fairlead during seismic survey. After around 40 minutes spikes were noted on the magnetometer system, but normal data collection resumed. After ~14 hours magnetic data stopped being collected. Magnetometer recovered to deck and cables checked. No obvious problem, although the voltage drop along the tether cable is slightly larger than expected.

13th February: Magnetometer re-deployed through A-Frame. Intermittent fault appears in magnetometer data stream, with logging to the SCS being sporadically interrupted. After ~11 hours magnetometer fails completely and is recovered. Magnetometer is stripped down and all components visually inspected with no evidence of a problem. Magnetometer cable is re-checked, and found to be faulty. No further magnetic data is collected.

7.9 Piston corer

Claus-Dieter Hillenbrand and Scott Polfrey

7.9.1 Build-up, deployment and recovery techniques

The build-up and deployment technique of the NIOZ-type piston corer applied and developed during JR298 were as follows:

1) Check that the piston and trigger corer bombs are clear and remove any ice or sediment from the inside, if required.

2) Feed piston wire (with 3.25 ton shackle attached at its piston end) through piston corer bomb.

3) Attach first two barrels to bomb, either by using crane or manually, and feed piston wire

through. Barrels may need to be elevated by wooden beams to allow insertion of the male into the female barrel end and use of chain wrench may be required. Secure barrels and bomb with nails, and tape connections.

4) Insert first liner (with female end on top), glue on second liner and tape connection, insert both liners into barrels and feed piston wire through. NOTE: Glue will harden within seconds.

5) Put third barrel into cradle (DO NOT ATTACH) and push through third liner.

6) Attach third liner to middle liner (DO NOT GLUE).

7) Attach third barrel to middle barrel (DO NOT SECURE WITH NAILS).

8) Cut excess length of bottom liner at base of third barrel (with hack saw) and push piston wire through.

9) Attach piston to 3.25 ton shackle on piston wire.

10) Pull piston into bottom liner so that core catcher can be inserted into base of bottom liner by pulling piston wire through bomb. The pulling requires at least three persons and needs to be carried out stepwise. If piston slips too far into the bottom liner, disconnect both the bottom barrel and the bottom liner, pull the piston through the entire bottom liner, detach it from the piston wire and repeat steps 6-10. If the piston is in the correct position, continue with step 11.

11) Detach bottom barrel and bottom liner, glue bottom liner onto middle liner. NOTE: One person has to pull piston wire through bomb when bottom liner is glued onto middle liner. Tape connection and attach bottom barrel to middle barrel. Secure barrels with nails, tape connections.

12) Insert core catcher into base of bottom liner and attach core cutter to base of bottom barrel. Secure bottom barrel and core catcher with nails, tape connections.

13) Measure slack piston wire length from top of bomb to point where trigger needs to be attached using Table 8, and mark this point with tape.

14) Insert core catcher into trigger core liner, insert liner into trigger core barrel, screw core cutter onto base of trigger core barrel and screw barrel top onto trigger corer bomb in trigger corer stand mounted onto the deck besides the cup.

15) Combine yellow ropes +/- chain with stainless steel shackles using trip wire lengths given in Table 8 and connect them via standard shackle to swivel on top of trigger corer bomb. NOTE: The spliced end of the yellow rope has always to be at the top end of the combined ropes.

16) Unlash midship’s gantry.

Tripcable length JCR 30-08-2014

Barrel length (m)	Depth (m)	Slack (m)	Trip cable length (m)		Ketting
5,4	500	1,56	8,72		0,2
5,4	750	2,74	9,62	0,9	1,5
5,4	1000	4,22	10,82	2,1	1
5,4	1500	5,13	11,22	[illegible]	
5,4	2000	6,94	12,52	3,8	
5,4	2500	7,09	12,72	4	
5,4	3000	7,17	12,72		
5,4	3500	7,2	12,72		
5,4	4000	7,2	12,72		
5,4	4500	7,21	12,72		
5,4	5000	7,21	12,72		
5,4	5500	7,21	12,72		
5,4	6000	7,21	12,72		
5,4	6500	7,21	12,72		
10,8	500	1,6	14,12	5,4	
10,8	750	2,95	15,17	1,05	1,5
10,8	1000	4,35	16,27	2,15	1
10,8	1500	5,72	16,67	[illegible]	
10,8	2000	7,09	17,97	3,85	
10,8	2500	7,19	18,12	4	
10,8	3000	7,28	18,12		
10,8	3500	7,3	18,12		
10,8	4000	7,3	18,12		
10,8	4500	7,3	18,12		
10,8	5000	7,31	18,12		
10,8	5500	7,31	18,12		
10,8	6000	7,31	18,12		
10,8	6500	7,31	18,12		
16,2	500	1,63	19,52	5,4	
16,2	750	3,16	20,72	1,2	1,5
16,2	1000	4,52	21,76	2,24	1
16,2	1500	5,36	22,06	[illegible]	
16,2	2000	7,19	23,36	3,84	
16,2	2500	7,31	23,52	4	
16,2	3000	7,38	23,52		
16,2	3500	7,4	23,52		
16,2	4000	7,4	23,52		
16,2	4500	7,41	23,52		
16,2	5000	7,41	23,52		
16,2	5500	7,41	23,52		
16,2	6000	7,41	23,52		
16,2	6500	7,41	23,52		

Table 8. Lengths for trip wire and slack wire to be used for the NIOZ-type BAS piston corer aboard RRS *James Clark Ross* for different barrel lengths and water depths (table provided by Jack Schilling for JRtri008).

17) Attach crane via sling to lifting bar on top of piston corer bomb.
18) Remove retaining pin from bucket.
19) Take cradle load on davit winch, remove sling from end of cradle, then veer davit winch

until piston corer is in vertical position, and secure steady line. Fill piston corer with seawater whilst lowering to prevent hydrostatic pressure moving the piston up the barrel.

20) Use crane to lift piston corer out of bucket and manoeuvre it into cup below midship's gantry. Use steadying lines to assist transfer into bucket. NOTE: Lifting bar on top of piston corer bomb has to be parallel to ship's long axis when corer is put into cup.

21) Feed end of piston wire through block mounted onto deck and connect this end to wire of deck winch via 12.5 ton hammerlock and 3.25 ton shackle. NOTE: Lower end of the hammerlock is attached to piston wire and its upper end is connected via the 3.25 ton shackle to deck winch wire.

22) Unhook crane from sling on lifting bar of piston corer bomb and remove sling.

23) Attach trigger to piston wire at position marked with tape and remove safety pin. NOTE: Eye below trigger arm is directed toward piston corer bomb.

24) Lift trigger with crane, clamp on lifting bar on top of bomb and insert trigger safety pin.

25) Coil slack wire into top of piston corer bomb and attach coiled wire to eye on top of bomb with string or cable tie. Fit hydrostatic release to trigger.

26) Haul deck winch wire so that piston wire is under tension.

27) Lift piston corer slightly out of cup so that trigger arm can be rotated outboards, pointing towards bow of ship, and put corer back into cup.

28) Attach wire from auxiliary winch to one of the spliced ends of trigger core rope using a standard shackle.

29) Luff gantry out over piston corer cup.

30) Spool trip wire onto auxiliary winch and lift trigger corer out of its stand.

31) Pay out auxiliary winch wire and lower trigger corer outboard until spliced eye at the top of the yellow rope is at the same height as the eye of the trigger arm.

32) Attach lose spliced rope end to trigger arm with standard shackle.

33) Remove safety pin from trigger.

34) Pay out auxiliary winch cable so that trigger corer weight is taken by trigger arm.

35) Disconnect spliced end from auxiliary winch wire and tape onto spliced end connected to trigger arm.

36) Inform Bridge.

37) Lift piston corer out of cup with deck winch and luff gantry out.

38) Pay out deck winch wire, zero wire when top of bomb is at sea surface, continue pay out until hammerlock is at chest height and luff in gantry, so that hammerlock is within reach.

39) Attach 10 ton swivel of main coring warp via 6.5 ton shackle to upper part of hammerlock.

40) Take tension onto main coring warp.

41) Pay out slack with deck winch and disconnect 3.25 ton shackle from deck winch wire.

42) Inform Bridge.

43) Luff gantry out and veer main coring warp at 50-60 m/min.

44) Move piston corer bucket and cradle into the horizontal position again and secure it.

45) Lower corer away at 50-60 m/min until it is at 200 m above seabed. Stop and let wire settle for ca. 1 min.

46) Get permission from Bridge to land corer.

47) Continue to veer at slower rate (~25 m/min) until corer has triggered (= sudden decrease in load).

48) Continue to veer for a further 10 metres.

49) Inform Bridge: Corer on the bottom.

The recovery technique comprised the following steps:

1) Immediately start to haul (at ~8 m/min) until pull out is complete and record maximum wire tension.

2) Inform Bridge: Corer clear of bottom.

3) Haul at max. speed (ca. 75 m/min) until end of main coring warp is at chest height and can be reached.

4) Luff in gantry and attach deck winch wire to 3.25 ton shackle in hammerlock.

5) Take tension onto deck winch wire.

6) Pay out main coring warp and disconnect 6.5 ton shackle from hammerlock.

7) Luff gantry out and haul deck winch wire until trigger is at chest height.

8) Attach auxiliary winch cable to lose spliced end of trip wire.

9) Take tension on auxiliary winch wire and disconnect trip wire from trigger arm.

10) Haul auxiliary winch wire until trigger core is above rail, lower into trigger core stand.

11) Pay out trip wire and disconnect from auxiliary winch wire.

12) Disconnect trigger from piston wire.

13) Luff out gantry and continue to haul with deck winch until core bomb is at surface, then haul slowly.

14) Luff in gantry and attach steady line to bomb.

15) Pay out deck winch wire and move corer into cup.
16) Pay out piston wire and disconnect from deck winch wire.
17) Secure gantry.
18) Lower cradle into vertical position and secure with steady line.
19) Attach sling to lifting bar of piston core bomb, crane corer out of cup into bucket assisting with steadying lines, and secure corer in bucket with retaining pin.
20) Inform Bridge.
21) Detach crane and sling, move cradle into horizontal position and secure.
22) Remove nails from uppermost barrel and piston corer bomb, wash off barrels.
23) Attach two 6 m strops to barrels and lift with crane onto trestles (thereby feeding piston wire through bomb to allow for slack). NOTE: Make sure that enough space is left at aft so that liner can be pushed out of barrel.
24) Detach piston cable from piston and remove core cutter.
25) To remove liners from bottom barrel push empty liner into top barrel. NOTE: Glued liner connections may break when liners are pulled out.
26) Unscrew trigger core barrel from trigger core bomb, unscrew trigger core cutter and extract liner from barrel.

7.9.2 Overall performance and issues encountered during the cruise

The overall performance of the piston corer was good, with the core preservation usually being excellent, i.e. with hardly any coring disturbance or coring deformation of the sediment being observed (apart from the deformation of coarse-grained layers with a thickness exceeding a few centimetres). At most JR298 piston coring stations the corer penetrated fully into the seabed with the recovery being decent and the recovery rate, i.e. the ratio between recovery and penetration depth, varying from 59% to 82% (average: 70%). The maximum core recovery of 15.8 m, which is theoretically possible with a 16.2 m barrel length deployment, was never achieved. Core PC736, which was collected near BAS Driscoll piston core PC466, retrieved a ca. 20 cm shorter sediment core when compared to the latter.

During the first full-length build-up of the corer at station PC723 it became apparent that, when the male and female ends of liners were glued together, the glue hardened immediately, so that the female end of the second liner did not slide completely onto the male end of the top liner. As a consequence, both liners had to be removed from the barrels and disconnected, and then the glue had to be scraped off with sand paper. Initially, the piston wire and deck winch wire during the deployment at site PC723 had been erroneously connected by a 4 ton twist-lock shackle only, which would have made the change-over from the deck winch wire to the main coring warp impossible. When the deployment was stopped to rectify this problem, it was discovered that the twist-lock shackle had got bent (this apparently happened when the shackle was pulled through the block mounted onto the deck) and become unusable. A combination of shackles had to be found then which (a) would fit through the blocks on both the deck and the midship's gantry and (b) could carry the full weight of the corer, with the shackle connecting the piston wire to the main coring warp after the change-over being able to carry the maximum wire tension during the corer pull-out from the seabed. The shackle combination found and used during following deployments is described in section 7.9.1.

During the build-up of the corer at station PC724 it was realised that pulling the piston into the bottom liner after the liners had been glued together and the barrels had been connected is an unsuitable approach. This is because the pulling of the piston into the liner occurs relatively uncontrolled, and consequently there is a high risk that the piston may be pulled too far into the liner. Procedures were changed thereafter (see section 7.9.1). During the deployment an attempt was made to remove the safety pin from the trigger when the corer was lifted out of the cup (i.e. after the trigger corer had been attached to the trigger arm). This could not be achieved until the corer had been returned into the cup. After the core recovery at site PC724 it became obvious that the trigger corer had over-penetrated, i.e. the seabed surface had not been sampled. Because the trigger corer bomb is a single, massive piece, no weight reduction was possible. Furthermore, the top liner of the main corer got stuck in the barrels during liner extraction and had to be pushed out from the top barrel (using an empty liner as a 'pusher') rather than pulled out from the bottom liner using mole-grip pliers.

At site PC727 the previous problem with the over-penetration of the trigger corer was tackled by attaching a washer to the valve, whose inner diameter was smaller than that of the valve. This hampered the extrusion of seawater through the valve and the intrusion of sediment into the liner. During the deployment of the main corer the trigger had to be re-attached to the piston wire because initially it had been attached in an incorrect position. During the penetration of the corer into the seabed a cobble was caught in the core catcher at some sub-bottom depth, which probably prevented a deeper penetration of the corer into the seafloor and a higher core recovery.

The problem of over-penetration of the trigger corer reappeared at site PC728. When the bottom liner of the main corer was pulled out from the barrels it came off the middle liner because the glued connection failed. It was then decided that at this and the following piston coring stations the liners were extracted from the barrels by pushing empty liners into the upper end of the top barrel rather than pulling the liners from the end of the bottom barrel. In addition, liners were not only glued but also taped together during corer build-up at the following piston coring stations (see section 7.9.1).

During the recovery of the main corer at site PC732 the 3.25 ton shackle used to connect the deck winch wire to the 12.5 ton hammerlock of the piston wire was trapped between the 6.5 ton shackle of the main coring warp and the hammerlock so that the eye of the deck winch wire could not be attached. An additional shackle was then connected to the lower part of the hammerlock (i.e. the part connected directly to the piston wire), to allow for a temporary change-over from the main coring warp to the deck winch wire. Because the resulting shackle combination would not have fit through the gantry block and the block mounted to the deck, the 3.25 ton shackle was freed, the hammerlock of the piston wire was re-connected to the 6.5 ton shackle of the main coring warp, and the additional shackle was removed, before the eye of the deck winch wire could finally be connected to the piston wire using the 3.25 ton shackle.

At site PC736 the main coring warp became trapped at the portside aft corner of the cup plate during the deployment. This problem probably arose from a modification of the cup which had been carried out in summer 2014 in order to move the centre of the cup directly under the mid-ship's gantry. The problem can easily be resolved by rounding off the corresponding corner of the cup plate.

7.10 Giant box corer

Claus-Dieter Hillenbrand and Scott Polfrey

7.10.1 Loading, deployment and recovery techniques

The loading, deployment and recovery technique of the Ocean Instruments Inc. BX-650 giant box corer (dimensions of the box: 50 x 50 x 60 cm) used during JR298 included the following steps:

1) Remove the horizontal metal retaining bar at the front of the box corer by unscrewing the four bolts using spanners or drive socket wrenches.

2) With the core box and spade assembly mounted on top of it, roll the jacking dolly under the box corer.

3) Using the hydraulic jack, raise the dolly until the spade and box assembly are properly aligned with the box corer and the box is securely seated in the head.

4) Replace the horizontal metal retaining bar at the front of the box corer and tighten the four bolts.

5) Securely connect the spade to the corer arms by rotating the four clamps located at both sides of the spade onto the horizontal bars at the end of the arms. NOTE: A temporary loosening of the nuts attaching the clamps to the spade will make it easier to rotate the clamps onto the trigger arm. Then fasten the clamps with their bolts using the Allen key.

6) Lower the jacking dolly and remove from under the box corer.

7) Pull the spade arm down to the horizontal position and lock into place as follows:

a) Place the arming bar (trigger) into the rectangular slot in the cable-end.

b) Secure the arming bar into position by pushing down on the pre-release preventer latch. NOTE: The pre-release preventer latch is the long vertical metal bar that runs down the front of the box corer column.

c) Connect the surgical bungee to the rear of the arming bar (trigger pin) and secure it to the reduced bolt at the back side of the upper head assembly. NOTE: Make sure that it runs over the fairlead and that the metal hooks on the bungees are spread open wide enough to permit secure connection to their attachment points on the box corer.

d) Tie the pre-release preventer latch to the screw on the side of the bar guide with a cable tie (medium strength) to keep the hook from dropping prematurely.

8) Ensure that the “T”-shaped handles of the two yellow safety pins point away from the spade, that ropes are attached to the “Ts” and that their circular disks are not trapped in the rectangular frames around the column.

9) Fasten the automatic door release mechanism in the open position by placing the two 3/32" cables with loops in the ends into the notches in the "T" bar mounted on the side of the core box head.

10) Unlash the midship’s gantry.

11) Put a sling through the 6.5 ton shackle at the lifting point of the box corer and transfer the corer with the crane under the gantry.

12) Unhook the crane and remove the sling.

13) Connect the 4.75 ton shackle attached to the eye of the trigger cable of the box corer to the swivel of the main coring warp.

14) Inform Bridge: Giant box corer is ready for deployment.

15) Haul the main coring warp and lift the corer slightly.

16) Attach two steadying lines to the legs of the box corer and hold steady the ropes attached to the “Ts” of the two yellow safety pins.

17) Continue to haul the main coring warp until its legs are above the rail and luff out the gantry.

18) When the corer is lifted over the side, veer the main coring warp and rotate the corer using the steadying lines so that the bottom of the spade faces the ship. Pull out the yellow safety pins when they are at chest height and remove the steadying lines.

19) Zero the wire when the box corer reaches the sea surface.

20) Inform Bridge: Giant box corer is in the water.

21) Lower the box corer approximately 5 meters, stop and check to make sure that the corer has not inadvertently tripped while being lowered through the sea.

22) Continue veer at 50-60 m/min until ca. 100 m above the seafloor. Wait for 2 minutes.

23) Get permission from Bridge to land corer.

24) Lower the box corer with 15 m/min to the seabed until corer has triggered (= sudden decrease in load).

25) Continue to veer for a further 6-7 metres.

26) Inform Bridge: Corer on the bottom.

The recovery technique was carried out as follows:

1) Haul slowly until corer is free from seabed.

2) Inform Bridge: Corer clear of bottom.

3) Haul at max. speed (ca. 75 m/min) until box corer is near the sea surface.

4) Haul slowly until legs of box corer are above rail. Attach steadying lines to corer legs and luff in gantry.

5) Lower box corer down to just above the deck, insert yellow safety pins and then land corer on deck.

6) Inform Bridge: Corer on deck

7) Disconnect main coring warp from box corer.

8) Open doors on top of box and jam doors in open position (e.g. with rubber mallet).

9) Drain excess water with plastic tubes through doors and/or by removing the upper screws from the removable front plate of the box using a Phillips screw driver.

10) Move jacking dolly under spade and box. Jack up dolly until it takes the load of spade and box. NOTE: Ensure that jacking-up is carried out equally at both sides of the spade.
11) Remove the two inch wide, horizontal metal retaining bar at the front of the box corer by unscrewing the four bolts with the spanners or drive socket wrenches.
12) Detach the spade from the trigger arms by unscrewing the bolts in the clamps using the Allen key and rotating the clamps back onto the spade. NOTE: A temporary loosening of the nuts attaching the clamps to the spade will make it easier to rotate the clamps.
13) Lower down the jacks so that the spade with box rests fully on the jacking dolly.
14) Pull out jacking dolly from underneath box corer and transfer spade with box to sampling location on deck.
15) Lower spade with box onto the deck and drain any remaining excess seawater. NOTE: Initial jacking down of one side of the spade will accumulate remaining excess water at one side of the box.
16) Take photo of box corer surface, describe sample and recovered sediment surface, measure core recovery.
17) Take surface sediment samples with spoon and push in sharpened plastic liners for collecting sub-cores from the box core.
18) Remove box from recovered sediment sample either by lifting up the box (using ropes as handles) or by unscrewing the front plate of the box using the Phillips screw driver.
19) Scratch off sediment from sub-cores using a trowel. NOTE: One person needs to hold sub-cores in place. Remove each sub-core from spade and close bottom end of liner with end cap. NOTE: Put end caps into hot water before using them and insert cable tie between cap and liner when attaching the cap so that air can escape.
20) Collect residual sediment for wet sieving or discard.
21) Wash off sediment from box, spade and box corer with seawater. Clean deck.
22) Load giant box corer for next deployment.

7.10.2 Overall performance and issues encountered during the cruise

The overall performance of the giant box corer Ocean Instruments Inc. BX-650 was good. At all but one site (GBC733) the box corer recovered a pristine seabed surface with a good recovery varying from 0.30 m to 0.45 m. The draining of excessive water, access to the core surface and extraction of sub-cores is very easy when compared to the difficult draining and access to samples of the old BAS box corer (e.g. see cruise reports JR179, JR244, JR284).

During the first deployment of the giant box corer at site GBC722 it was realised that the two safety pins need to be secured with a strap around the column when the corer is moved by crane across the deck and that the pins need to have a long tag line attached to them to allow for their easy removal when the corer has been moved over the side. After recovery it was noted that some simple tools (e.g. wooden boards) are needed to keep the flaps open for siphoning off the excessive seawater. The draining of water by using flexible plastic tubes initially worked well but got more difficult when the water level sank within the box because of the coiling of the plastic tubes. Preparation of two special draining tools (‘mini octopus’) assured easy drainage of the water at following GBC stations. During JR298 no attempt was made to drain the excessive water by removing the screws at the front plate of the box. At sites GBC722 and GBC724, the box initially jammed when attempts were made to remove it from under the corer using the jacking dolly. This problem highlights the need for (i) a good alignment of the jacking dolly under the box and the corer, and (ii) simultaneous and well coordinated jacking-up of the shovel when using the hydraulic pumps on the two sides of the dolly. At site GBC722, it was discovered that the supplied box handles do not fit between the spade and the box when attempts were made to remove the box from the shovel during the sample processing. An attempt to remove the front plate by unscrewing it failed because of use of a metric instead of an imperial screw driver, which resulted in fouling of the screws. At following GBC stations, handles made of rope allowed the box to be pulled off.

During the deployment of the corer at site GBC725 one of the safety pins got trapped with its disk in between the two frames surrounding the centre column of the corer. This prevented the pin from being pulled out and required the corer to be brought inboard briefly before it could be redeployed.

At site GBC731 a failure of the CLAM system (see section 7.13) required the GBC to be recovered from about 700 m above the seafloor (i.e. before landing). The giant box corer could not be redeployed until several hours later when the problem with the CLAM system had been resolved.

The only location where the seabed surface sediments recovered with the giant box corer were disturbed was site GBC733. Here, a compact sub-surface layer of well-sorted sand at least 10 cm thick apparently prevented complete closure of the shovel, so that seawater drained out when the corer was lifted above the seawater surface during recovery which seems to have resulted in the observed disturbance of the surface sediments.

7.11 CTD system

Tom Williams

A Sea-Bird Conductivity-Temperature-Depth (CTD) unit with a 24 bottle rosette was used to vertically profile the water column and collect samples for geochemical analysis (dissolved inorganic carbon, trace metal analysis and bottom water neodymium isotopic values). Additional instruments on the CTD unit from which measurements were recorded included a fluorometer, an oxygen sensor, a photosynthetically active radiation (PAR) sensor, a transmissometer and an altimeter. A total of five casts were carried out during the cruise, and water samples were collected in the 12 L capacity Niskin bottles. CTD cast locations are included in Appendix 3.

7.12 Lowered Acoustic Doppler Current Profiler (LADCP) – CTD mounted

Kathryn Gunn

At the beginning of the cruise it was found that one Teledyne RDI Workhorse 300 kHz was mounted on the CTD, a downlooker/master LADCP, which could potentially provide a velocity-depth profile for the water column. Several people were interested in the collection of such data, so LADCP data were collected for each of the 5 CTD casts of the cruise.

Two command files were used during the cruise. The first command file was applied at CTD_001 and CTD_002, which used 128 bins of 16 m. The parameters were adapted from the command file used in JR302 in an attempt to collect deeper water samples, however the new commands only acted to collect more noise rather than longer profiles. After email communication with Brian King (NOC), the parameters were returned to their original values, 25 bins of 8 m. Unfortunately the LADCP data from cast 001 and 002 are too noisy to be of use, therefore there are 3 casts (003, 004 and 005) from which data were collected successfully. The data will be processed at a later date onshore.

7.13 Cable Logging and Monitoring (CLAM) system

Rob Larter, Paul Morgan and Mark Preston

The CLAM system was used for monitoring the amount of wire out, hauling and veering rates and wire tension during piston corer, giant box corer and CTD deployments. The system performed well until it crashed without warning at 10:24 UTC on 21st February, with 1827 m wire out as the giant box corer was being lowered to the sea floor. The system was rebooted and following some testing the deployment was resumed about an hour after the initial crash, only for another crash to occur a few minutes later. Following this second system failure the giant box corer was recovered to deck to allow a more thorough investigation of the problem. A series of tests revealed that the PC controlling the system could be booted up and would run without crashing, but that a crash could be triggered by initiating a signal to it from the metering sheave in the winch room. The motherboard and I/O card in the PC were replaced by spares, and then test deployment of a weight confirmed that the system was working normally again. Subsequent close inspection of the replaced motherboard revealed several blown capacitors. Finally, the giant box corer was redeployed at 18:11 UTC, about eight and a half hours after its initial deployment at the site (GBC 731).

7.14 XBT/XCTD probes and control system

Rob Larter

In total 19 T5 XBT, 4 T7 XBT and 11 XCTD-1 probes were deployed during the cruise. Metadata from these casts are tabulated in Appendix 4. Five of the T5 probes failed to collect useful data as far as 300 m water depth, but the remaining T5s all recorded profiles extending to >790 m depth. One of the T7 probes only collected useful data to 305 m water depth, but the other three recorded profiles either to the sea floor or their design limit of 760 m. Two of the XCTD probes stopped collecting useful data at around 250 m water depth, and another recorded valid data to 333 m. The other eight XCTD probes recorded profiles extending either to the sea floor or their design limit of 1100 m.

In several cases premature termination of profiles was most probably a result of entanglement of the wire with the seismic streamer, a conclusion supported by the fact that wire from the probes was found snagged on some of the depth controllers when the streamer was recovered. Three of the casts which failed at <300 m, however, were made before any seismic equipment had been deployed. The first two of these may have been a result of using T5 probes from a batch that had been in storage for several years. In order to reduce the likelihood of wire becoming entangled with the streamer, all casts from 8th February onwards were deployed through a 6 m length of gravity core liner that was pushed through the fairlead on the port quarter boom. This was done with the boom in its retracted position and most of the liner extending outboard of it (Figure 44)

Figure 44. XBT deployment through gravity core liner pushed through port quarter boom fairlead.

Shortly before the cruise the WinMK21 data acquisition and processing software on the PC in the UIC room that was used to control casts had been updated to version 3.0.5.2, in order to enable logging of data from XCTD probes.

On 18th February a way was found of adjusting parameters in the WinMK21 software to allow data to be recorded from probes at depths beyond their design limit. This parameter adjustment was first used for cast XBT_08 and was also used for a number of other casts subsequently.

7.15 Oceanlogger

Rob Larter

The Oceanlogger was used during the cruise to monitor changes in surface water properties that could affect sound propagation, and hence indicate when it might be necessary to change the SVP being used by the EM122 multibeam echo sounder.

The flow of uncontaminated sea water that is required by the Oceanlogger was too slow from about 22:00 on 14th February until an adjustment was made by the Deck Engineer the following morning. The water properties logged on the SCS system and included in the EM122 weblog during this interval are unreliable.

7.16 Navigation systems

Rob Larter

7.16.1 Seapath 320 System

This combined GPS and motion reference unit provides navigational data for the Kongsberg EM122 multibeam and TOPAS sub-bottom profiler systems. In some previous seasons differential corrections were obtained from a Racal Skyfix unit via an Inmarsat feed and applied in real time by the GPS receiver. However, the subscription to the Skyfix service has been discontinued, so differential GPS data were not available during this cruise. Data from this unit were logged onto both the Kongsberg EM122 system and the NOAA Scientific Computing System (SCS).

7.16.2 Furuno GP-32 GPS Receiver

This GPS receiver is located on the Bridge and used primarily by the deck officers. The position fixes from the unit were logged to the NOAA SCS. Positional data from this system were used in the gravity web logseet.

7.16.3 Ashtech GG24 GPS/GLONASS Receiver

This was operated throughout the cruise and position fixes calculated by this system were logged to the NOAA SCS.

7.16.4 Ashtech GDU-5 3D GPS and TSS300 Systems

These instruments provide heading, pitch, roll and heave information. Data from both systems were logged to the NOAA SCS. Positional data from the Ashtech GDU-5 was used in the web logsheets, except for the gravity one.

7.17 NOAA Shipboard Computing System

Rob Larter

Since the summer of 2000, the main shipboard data logging system on *JCR* has been a Windows-based system provided by the U.S. National Oceanic and Atmospheric Administration (NOAA), called the Scientific Computer System (SCS). The SCS program allows data to be logged centrally on a server featuring RAID disk tolerance. Time stamping of data is achieved by synchronising to a GPS receiver. The SCS is also a NTP server which allows other machines onboard to synchronise their time.

Data on the SCS system is stored in two formats:

RAW data written to disk in exactly the same format it was sent from the instrument.

ACO ASCII Comma Delimited, data is stored in plain ASCII text.

The following data streams were logged to the SCS during JR298:

Stream name	Data Source
anemometer	Anemometer
ashtec	Ashtech 3D GPS
dopplerlog	Sperry doppler speed log (water speed)
ea600	Kongsberg Simrad EA600 single-beam echo sounder (12 kHz)
em122	Kongsberg Simrad EM122 multibeam echo sounder (12 kHz)
emlog	Chernikeeff Aquaprobe Mk5 electromagnetic speed log
furuno	Furuno GP-32 GPS Receiver
glonass	Ashtech GG24 GPS/GLONASS Receiver
gravity	Gravity meter
gyro	Gyro
oceanlogger	Oceanlogger
Seaspy	Seaspy towed magnetometer
seatex	Seapath combined differential GPS and motion reference unit
tsshrp	TSS300 heave, roll and pitch sensor
winch	Cable Logging and Monitoring (CLAM) System

The EM122 centrebeam depths logged on the SCS are 6 to 7 metres less than those reported by the EM122 itself as the depths in the data stream being logged by the SCS are not corrected for the ship’s draft.

8. ICT and AME Reports

8.1 ICT report

Andy England (ICT Engineer)

8.1.1 SCS Logging system / Data logging

Newleg & ACQ started at 12:01 23rd Jan 2015 (UTC)

SCS ACQ version : 4.5.1.1063

8.1.2 Systems

UNIX

There is an intermittent issue with the SCS server disconnecting from the U: drive provided by Samba from JRLB. During this cruise, these disconnects occurred when the backup software removed the snapshot creating during disk backup. Further investigation is required.

Installed Promax 5000.8.5.1 on jrlpromaxa.

Windows

Warning light on SCS1 indicates a memory module error. This did not prevent host from working normally so memory module will be swapped on return to Punta Arenas.

The network time on SCS1 has occasionally needed resynchronising with the Galleon network clock.

Network

No problems reported with the ships network.

8.1.3 Event Log

26 January 2015

1. Gravity meter configured and connected to SCS. RMC data taken from Furuno, using port 27.
2. Setup temporary monitor displaying underway data in UIC for seismic team.

27 January 2015

1. Temporary Windows 7 PC setup for analysing cores.
2. Setup a TTL using time from SEATEX string in the SCS using port 25 for seismic equipment.
3. Created GPS string using SEATEX in SCS, using port 32 for seismic streamer equipment

30 January 2015

1. Setup a local copy of blog

31 January 2015

1. SCS compression for gravity-dat stopped. Restarted.

1 February 2015

1. jrlpromaxa hung during replication. Restarted.

2 February 2015

1. jrlc hung during replication. Restarted.

3 February 2015

1. jrlpromaxa hung during replication. Restarted.
2. Created a generic unix account jr298 for running mb.

4 February 2015

1. jrlc hung during replication. Restarted.
2. Underway data frozen. Restarted labview on jrw-lvdisp-v1.

5 February 2015

1. jrlc and jrlpromaxa hung during replication. Restarted and created new replication schedule for these two hosts which avoided impacting users on night shift.

6 February 2015

1. CTD log configured with manual fields. Corrected to use SCS data.

7 February 2015

1. 02:33 UTC Stopped and started sending SCS messages to change TTL string from 10 second interval to 12 seconds.

8 February 2015

1. Underway data frozen. Restarted labview on jrw-lvdisp-v1.

10 February 2015

1. 03:30 UTC SCS time synchronisation restarted due to difference in SCS and JRLB.
2. 19:30 UTC SCS stopped logging data to JRLB due to U: drive disconnection. Restarted SCS logging. Restarted SCS compression.

11 February 2015

1. 19:35 UTC SCS stopped logging data to JRLB due to U: drive disconnection. Restarted SCS logging. Restarted SCS compression.

12 February 2015

1. Adjusted backup tape retention period to improve backup scheduling.

14 February 2015

1. New veeam license applied.

15 February 2015

1. 16:57:55 GMT the gravity meter crashed. Control unit swapped and power disconnected before it would power on.

17 February 2015

1. Glonass compression restarted.
2. 19:00 UTC Stopped and started sending SCS messages to change TTL string from 12 second interval to 10 seconds.

18 February 2015

1. Noticed there was a hardware alarm on the SCS1 today and identified as a Memory Error.

20 February 2015

1. Wavex unable to connect to the internet. Reconfigured network settings.

21 February 2015

1. The winch pc (Clam PC) powered off due to blown capacitors on the motherboard. Rebuilt with spare parts and then tested.

22 February 2015

1. 19:45 UTC SCS U: drive disconnected. Restarted ACQ. At approximately 19:45pm GMT veeam was completing its backup to disk of JRLB. As this has been seen previously at this time adjusted JRLB backup time to start earlier.

24 February 2015

1. At 9:06 GMT the SCS clock was out by 6.7 seconds. Stop and restarted galleon time sync.
2. Built a replacement Clam PC.

25 February 2015

1. SCS compression for gravity-dat stopped. Restarted.
2. 02:26 UTC the SeaPath Processing Unit stopped communicating with the HMI unit and stopped sending data to the SCS. Rebooted the HMI and PU and this resumed logging to the SCS.

27 February 2015

1. Increased number of vCPU's assigned to the backup servers, re-enabled daily disk backup of JRLB for testing. Backup completed successfully.

1 March 2015

1. Underway data frozen. Restarted labview on jrw-lvdisp-v1.
2. Newleg & ACQ started

8.2 AME report

N.B. This report encompasses AME work on JR298 and the subsequent cruise.

Cruises JR298/JR272D/JR310 Start date: 25/01/2015 Finish date: 14/04/2015

Names of AME engineers: Mark Preston (JR298) Paul Morgan (JR272D/ JR310)

Names of principle scientists (PSOs): R. Larter (JR298) P. Abrahamsen (JR272D/JR310)

LAB Instruments

Instrument	S/N Used	Comments
AutoSal	65763	
Scintillation counter		
Magnetometer STCM1	Y	Magnetometer cable faulty. No Spare.
XBT	Y	It was discovered at the end of the cruise that the XBT rail mount has been broken.

ACOUSTIC

Instrument	S/N Used	Comments
ADCP	Y	
PES		
EM122	Y	
TOPAS	Y	
EK60	Y	
SSU		
K-SYNC	Y	
USBL		
10kHz IOS pinger		
Benthos 12kHz pinger S/N 1316 + bracket		
Benthos 12kHz pinger S/N 1317 + bracket		
MORS 10kHz transponder		

OCEANLOGGER

Instrument	S/N Used	Comments
UIC		
Barometer1	V145002	
Barometer2	V145003	
Foremast Sensors		
Air humidity & temp1	0060743898	
Air humidity & temp2	0060743896	
TIR1 sensor (pyranometer)	112993	

TIR2 sensor (pyranometer)	112992	Faulty
PAR1 sensor	110127	
PAR2 sensor	110126	
Prep Lab		
Thermosalinograph SBE45	T0130	
Transmissometer C-STAR	CST1279DR	
Fluorometer 10-AU	1100243	
Flow meter	05/811950	

CTD (all kept in cage/ sci hold when not in use)

Instrument	S/N Used	Comments
Deck unit SBE11plus	11P15759-0458	
Underwater unit SBE9plus	0541	
Temp1 sensor SBE3plus	03P2307	
Temp2 sensor SBE3plus	03P5043	
Cond1 sensor SBE 4C	04C3491	
Cond2 sensor SBE 4C	04C4090	Started to drift during cold weather CTDs replaced at the end of the cruise with
Pump1 SBE5T	053415	
Pump 2 SBE5T	052371	
Standards Thermometer SBE35	0051	
Transmissometer C-Star	CST-1479DR	
Oxygen sensor SBE43		
Flourometer	12-8513-01	
PAR sensor	7235	
Altimeter PA200	10127.244739	
CTD swivel+ linkage	196111	
LADCP	14897	
Notes on any other part of CTD e.g. faulty cables, wire drum slip ring, bottles, swivel, frame, tubing etc		

AME UNSUPPORTED INSTRUMENTS BUT LOGGED

Instrument	Working?	Comments
EA600	Y	
Anemometer	Y	
Gyro	Y	
DopplerLog	Y	
EMLog	Y	
Seapath 320+	Y	

INTAKE FAN CLEANING

Instrument	Cleaned?
Oceanlogger	Y
EM122, TOPAS, NEPTUNE UPSs	Y
Seatex Seapath	Y
EM120 Tween Deck	Y
TOPAS Tween Deck	Y

Additional notes and recommendations for change / future work

K-SYNC

K-SYNC had a glitch and would not communicate with the Swath system. A warning would show on the Swath computer. Resetting the transducer on the Tween Deck resolved this particular issue.

Magnetometer

Magnetometer developed a fault. This was due to an aged cable, no spares on board and manufacturer no longer supports the current model on the JCR. Magnetometer returned to the science cage until a suitable replacement cable can be sourced.

CLAM PC

CLAM system developed an intermittent fault where the computer would turn itself off. The issue was caused by several blown capacitors on the motherboard. The cause of the fault was not discovered until the spare motherboard had been fitted and used. After further inspection the spare motherboard had two blown capacitors but could still operate the CLAM software. With no more spares and coring relying heavily on the CLAM system, IT support (Andy England) used a spare computer for a back up (which is temporarily strapped to the side of the current CLAM system). With the reliability of the original CLAM system in question, the backup CLAM computer became the preferred option.

IT support mentioned the comm ports may reset if the pc is turned off but it has worked fine after the power outage.

Recommendation – Change the aged CLAM system for a more modern deck unit similar to the EK60 and K-Sync. This will greatly reduce the amount of space taken and will allow for a spare unit directly underneath, so that science operations can continue with minimal delay should a unit fail.

Acoustic Cabinet Fans

Replaced broken fans with used fans (kept in the electrical office) that were labelled as used but worked reasonably well, in order to use them up instead of brand new ones.

Science Cage

An opportunity has presented itself to expand the science cage. Simon Wright has mentioned a disused funnel/ air duct which runs through the science cage at the back on the left. Plan to empty the science cage into the explosive locker when the ship reaches Immingham and have the cage extended at refit 2015.

STCM

STCM Sensor faulty. Y axis displayed either 70 or -70. By altering the position of the magnet it showed no other magnitude. Sensor changed at the end of JR298 (removed s/n 1435 and replaced with s/n 827). Problem resolved.

CTD

Calibrations -

New termination. Alarm sounded, another termination. Soldered piece pierced through to short out when under load. During re-termination extra heat shrink was added to avoid this.

On the final CTD cast bottles two and four appear to have imploded. Bottle 3 has been checked and shows no visible signs of damages. Bottles two and four have been swapped for spares.

The secondary conductivity cell started to drift near the end of the cruise. It's now out of tolerance but the PSO didn't want to disrupt the trend of results they had gathered so far. The conductivity cell was changed at the end of JR310 for s/n 4C3248.

NavData Display

Keeps freezing/ glitching. Cannot see a pattern to when or why it glitches. Reset is fairly simple. Instructions are on the white board, Open Remote Desktop Connection etc ....

Anemometer

JCR Radio Officer wants to replace the current anemometer for a heated one and have a second placed on the main mast. This has been discussed and initially agreed upon, with hopes to be implemented during refit 2015.

UPS

There was a power outage when the computers had to rely on their UPSs in the UIC. None of the UPSs seem to last long enough to allow for a clean shut down of the instruments. I recommend all UPSs be tested during refit and replaced if required (including spares).

EA600

Information only – After the power outage a breaker in the gravity meter room tripped. It was a breaker box to the left.

Support Engineer: Paul Morgan Date: 14th April 2015.

9. Acknowledgements

We thank Captain Chapman, the officers and crew of the RRS *James Clark Ross* for helping to make this complex cruise productive and enjoyable. As on many previous cruises, the quality of support for the scientific programme from all of the ship's company was excellent.

Thanks are also due to many in the BAS Operations, Logistics and Human Resources Sections for arranging for people and equipment to be in the right places at the right time and making sure all members of the scientific party were well prepared. We are grateful to Mike Webb, Beth Woodward and Vicki Norton at NERC Swindon for their flexibility in the use of UK IODP Programme funds to enable hire of seismic equipment and technical support, and to upgrade existing coring equipment into a piston coring system. Without that flexibility the cruise could not have proceeded in this season. Jez Evans of NMFSS provided very helpful advice on the corer upgrade and Jack Schilling of NIOZ provided valuable guidance and help when the upgraded system was being mobilized for a sea trial.

10. Acronyms

AASW	Antarctic Surface Water
ADCP	Acoustic Doppler Current Profiler
AME	BAS Antarctic Marine Engineering Section
AWI	Alfred Wegener Institute for Polar and Marine Research, Germany
BAS	British Antarctic Survey
CC	Core catcher
CDP	Common datum point
CGS	NERC Collaborative Gearing Scheme
CLAM	Cable Logging and Monitoring system
CTD	Conductivity-Temperature-Depth
GBC	Giant box corer
GPS	Global Positioning System
IBCSO	International Bathymetric Chart of the Southern Ocean
ICT	BAS Information and Computing Technology Section
IGRF	International Geomagnetic Reference Field
IODP	International Ocean Discovery Program
IRD	Ice-rafted debris
JCR	RRS *James Clark Ross*
LADCP	Lowered Acoustic Doppler Current Profiler
LCDW	Lower Circumpolar Deep Water
MCS	Multichannel seismic
NERC	Natural Environment Research Council
NIOZ	Royal Netherlands Institute of Oceanography
NMFSS	National Marine Facilities Sea Systems
NMO	Normal move out
NOAA	U.S. National Oceanic and Atmospheric Administration
NOC	National Oceanography Centre
ODP	Ocean Drilling Program
PC	Piston corer
RPI	Relative (geomagnetic) palaeointensity
SCS	Shipboard Computing System
STCM	Shipboard Three-Component Magnetometer

SVP	Sound Velocity Profile
TC	Trigger corer
TMF	Trough mouth fan
TOPAS	TOpographic PArametric Sonar
TVG	Time variable gain
TWTT	Two-way travel time
UCDW	Upper Circumpolar Deep Water
UIC	Underway Instrumentation and Control room
UK-IODP	NERC research programme that funds research related to IODP
UPS	Uninterruptible power supply
WW	Winter Water
XBT	Expendable Bathythermograph
XCTD	Expendable Conductivity-Temperature-Depth probe or cast

11. Recommendations

1. Change the aged CLAM system for a more modern deck unit similar to the EK60 and K-Sync (see section 8.2).
2. Test all UPSs during refit and replace if required (see section 8.2).
3. Investigate cause of SIS software crashes and send details to Kongsberg (see section 7.2.2).
4. Cross correlate navigation coordinates logged by gravity control PC with those logged by the SCS system to determine if there was any time offset on the control PC (see section 7.7.3).

Appendix 1. Bridge Science Log

Time	Event	Lat	Lon	Comment
02/03/2015 05:00		-60.27224	-66.77079	Stop SWATH prior to entering Argentine EEZ
28/02/2015 11:00		-67.66531	-69.99447	Resume swath survey departing Marguerite Bay
27/02/2015 14:06		-67.5733	-68.13003	Vessel off DP approaching Biscoe Wharf
27/02/2015 13:00		-67.58494	-68.14144	V/L on DP in Ryder Bay
26/02/2015 17:00	109	-64.89637	-69.03836	Off DP - proceeding towards Rothera
26/02/2015 15:25	109	-64.89545	-69.03588	Barrel lifted into frame
26/02/2015 15:12	109	-64.89544	-69.03579	Corer horizontal
26/02/2015 15:09	109	-64.89545	-69.03578	Corer in the frame
26/02/2015 14:56	109	-64.89538	-69.03585	Frame in the vertical position
26/02/2015 14:41	109	-64.89543	-69.03579	PC transferred to aux. wire
26/02/2015 14:38	109	-64.89539	-69.0357	PC out of the water
26/02/2015 13:54	109	-64.89531	-69.03559	PC clear of the seabed
26/02/2015 13:50	109	-64.89531	-69.03562	PC on the seabed. Wire out - 2284m.
26/02/2015 13:42	109	-64.89532	-69.03562	PC all stopped at 2229m for 2 minutes
26/02/2015 12:58	109	-64.89583	-69.03389	PC in the water on the way down to 2229m
26/02/2015 12:54	109	-64.89584	-69.03373	PC transferred to main wire
26/02/2015 12:48	109	-64.89583	-69.0338	PC in the water
26/02/2015 12:43	109	-64.89584	-69.03378	PC attached to aux wire
26/02/2015 12:36	109	-64.89589	-69.03378	Gantry unlashed
26/02/2015 12:25	109	-64.89588	-69.03382	Trigger weight attached to corer
26/02/2015 12:17	109	-64.89587	-69.03381	PC transferred from frame into cup
26/02/2015 12:10	109	-64.89585	-69.03383	Frame in vertical position
26/02/2015 12:08	109	-64.89586	-69.03387	Crane attached to PC in frame
26/02/2015 12:04	108	-64.89591	-69.03358	GBC moved and secure
26/02/2015 11:48		-64.89609	-69.03247	V/l on DP at PEN-1B coring site
26/02/2015 02:00		-65.93797	-72.51974	V/l off DP proceeding to PEN-1B
26/02/2015 01:55		-65.9382	-72.51737	Deck secure for transit to PEN-1B site
26/02/2015 01:30	108	-65.93818	-72.51739	GBC out of the water
26/02/2015 01:23	108	-65.93819	-72.51736	GBC on deck
26/02/2015 00:27	108	-65.93819	-72.51724	GBC clear of the seabed
26/02/2015 00:24	108	-65.93818	-72.51737	GBC on the seabed. Wire out - 2998m.
26/02/2015 00:19	108	-65.93818	-72.51735	GBC at 2900m for 2 minutes
25/02/2015 23:14	107	-65.93816	-72.51736	Core transferred to deck
25/02/2015 23:13	108	-65.93815	-72.51738	GBC going down to depth 2900m
25/02/2015 23:11	108	-65.93815	-72.51734	GBC off deck
25/02/2015 23:06	108	-65.93816	-72.51736	GBC moved forward to gantry
25/02/2015 23:04	107	-65.93815	-72.51738	Frame in horizontal position
25/02/2015 23:01	107	-65.93814	-72.51736	Piston corer transferred to frame
25/02/2015 22:49	107	-65.93815	-72.51733	Corer back in the cup
25/02/2015 22:43	107	-65.93817	-72.51732	Trigger weight recovered to deck
25/02/2015 22:35	107	-65.93815	-72.51734	Piston Corer transferred to aux wire
25/02/2015 22:27	107	-65.93815	-72.51732	Wire load test completed. Continuing to recover corer
25/02/2015 22:22	107	-65.93816	-72.51734	Commence load test of Auxillary winch wire termination
25/02/2015 21:56	107	-65.93817	-72.51731	Piston corer stopped at 99m so that the auxillary winch wire can be reterminated
25/02/2015 21:02	107	-65.93813	-72.51731	Piston corer clear of the seabed
25/02/2015 20:59	107	-65.93814	-72.51728	Corer in the seabed
25/02/2015 20:56	107	-65.93815	-72.51735	Corer at 2900m. Clear to go in the seabed
25/02/2015 19:58	107	-65.93835	-72.51596	Corer going down to approx 2900m
25/02/2015 19:54	107	-65.93836	-72.51596	Corer transferred to the coring wire
25/02/2015 19:52	107	-65.93836	-72.51598	Piston corer in the water
25/02/2015 19:50	107	-65.93835	-72.51599	Trigger weight attached to corer
25/02/2015 19:36	107	-65.93833	-72.51599	Trigger mechanism attached to corer
25/02/2015 19:30	107	-65.93835	-72.51597	Corer in the cup
25/02/2015 19:28	107	-65.93835	-72.51598	Piston corer vertical in frame
25/02/2015 19:25	107	-65.93835	-72.5159	Commence piston corer deployment PC734
25/02/2015 19:18		-65.93852	-72.51553	Vsl on DP
25/02/2015 16:00	106	-66.37085	-73.70146	Off DP
25/02/2015 15:32	106	-66.37216	-73.70444	Box corer recovered to deck
25/02/2015 15:30	106	-66.37219	-73.70445	Box vorer clear of the water
25/02/2015 15:27	106	-66.37216	-73.70446	USBL beacon recovered
25/02/2015 14:13	106	-66.37211	-73.70446	GBC clear of seabed

Time	Event	Lat	Lon	Comment
25/02/2015 14:07	106	-66.37212	-73.70443	GBC on the seabed. Wire out - 3859m. EA600 - 3882m
25/02/2015 13:59	106	-66.37213	-73.70444	GBC continue to seabed
25/02/2015 13:57	106	-66.37213	-73.70444	GBC all stopped at 3700m for 2 minutes
25/02/2015 12:37	106	-66.37213	-73.70442	GBC going down to depth of 3700m
25/02/2015 12:35	106	-66.37213	-73.70443	GBC deployed
25/02/2015 12:32	106	-66.37215	-73.70442	USBL gate valve open. Pole fully extended
25/02/2015 11:56	105	-66.3721	-73.70445	CTD on deck
25/02/2015 11:51	105	-66.37212	-73.70446	CTD clear of the water
25/02/2015 10:33	105	-66.37211	-73.70446	CTD stopped at 3837m. Commence hauling
25/02/2015 09:23	105	-66.3721	-73.70438	CTD veering to approx 3840m. EK60 depth 3856m
25/02/2015 09:21	105	-66.37211	-73.70439	CTD in the water
25/02/2015 09:17	105	-66.37208	-73.70438	Commence deploying CTD
25/02/2015 08:48		-66.37376	-73.69857	Vsl on DP
25/02/2015 07:54	104	-66.25861	-73.9864	Vsl off DP
25/02/2015 07:42	104	-66.25692	-73.99427	Bulwark door closed
25/02/2015 07:38	104	-66.25694	-73.9943	Air Guns recovered to deck.
25/02/2015 07:37	104	-66.25693	-73.99432	Bulwark door lowered
25/02/2015 07:30	104	-66.25692	-73.9943	Lifting umbilical (and Air Guns) with gilson winch
25/02/2015 07:26	104	-66.25691	-73.9943	Restarting Air Gun recovery - manually pulling umbilical onboard
25/02/2015 07:12	104	-66.25692	-73.9943	Vsl stopped on DP
25/02/2015 07:00	104	-66.26188	-73.99467	Streamer recovered
25/02/2015 07:00	104	-66.26188	-73.99467	Vsl on DP desk slowing down
25/02/2015 05:07	104	-66.37609	-73.92076	Commence streamer recovery
25/02/2015 05:00	104	-66.37616	-73.90494	Recovery line broken. Air gun recovery delayed
25/02/2015 04:57	104	-66.37597	-73.90072	Com air gun recovery
25/02/2015 04:50	85	-66.37575	-73.88632	Seismic survey complete
25/02/2015 03:54	103	-66.37239	-73.71529	XCTD deployed
25/02/2015 03:49	103	-66.37201	-73.69999	XCTD deployed
24/02/2015 17:01	102	-66.06567	-72.01014	XBT failed
24/02/2015 17:00	102	-66.06506	-72.00783	XBT 023 deployed
24/02/2015 15:30	101	-65.99929	-71.78983	XBT failed
24/02/2015 15:28	101	-65.99778	-71.78515	XBT 022 deployed
24/02/2015 14:40	85	-65.96349	-71.67497	Turn complete
24/02/2015 14:35	85	-65.96014	-71.66586	Commence turn onto 233
24/02/2015 11:54	85	-65.83406	-71.33408	Turn complete. v/l on 227
24/02/2015 11:00	85	-65.85773	-71.26611	Commence turn onto next transect of 227deg
24/02/2015 03:08	85	-66.3009	-72.21788	Turn complete
24/02/2015 02:28	85	-66.27799	-72.2773	Commence turn onto next transects of 136 then 044 degrees
24/02/2015 01:04	85	-66.21084	-72.08396	V/l on next transect of 229
24/02/2015 00:42	85	-66.21022	-72.02851	Commence turn onto next transect of 229
23/02/2015 23:39	85	-66.27073	-71.91225	V/l passing coring site PEN-2B. Onto next leg of 322
23/02/2015 22:52	85	-66.3163	-71.82397	Two whales sighted 1000m off port bow
23/02/2015 22:48	85	-66.38032	-71.69902	Whales sighted on starboard bow approx 1mile
23/02/2015 22:43	85	-66.32619	-71.8036	Whales sighted on port bow approx 1mile
23/02/2015 21:43	85	-66.38503	-71.68902	Turn completed starting transect Co.322
23/02/2015 21:35	85	-66.39419	-71.68278	Commence turn onto next transect
23/02/2015 21:01	85	-66.43851	-71.68263	Turn completed starting transect Co.000
23/02/2015 20:20	85	-66.43291	-71.75651	Commence turn onto next transect
23/02/2015 16:50	85	-66.17664	-71.60783	Alteration complete
23/02/2015 16:00	85	-66.1793	-71.53969	Commence alteration to 193
23/02/2015 11:24	85	-66.44451	-72.06552	V/l on next transect of 038
23/02/2015 11:20	85	-66.44805	-72.07479	Commence turn onto next transect
23/02/2015 11:15		-66.45242	-72.08614	2 whales sighted ahead 600m
23/02/2015 10:24	85	-66.49733	-72.20231	Turn completed starting transect Co.046
23/02/2015 09:45	85	-66.47623	-72.26574	Commence turn onto next transect
23/02/2015 08:24	85	-66.38553	-72.13083	Vessel alters course to 211
23/02/2015 06:33	85	-66.27139	-71.9071	Vessel passes through PEN-2B site
23/02/2015 04:30	100	-66.14844	-71.67425	XBT complete
23/02/2015 04:24	100	-66.14275	-71.66263	XBT deployed
23/02/2015 02:27	99	-66.02757	-71.44356	XBT 020 complete
23/02/2015 02:19	99	-66.01962	-71.42909	XBT 020 deployed
23/02/2015 02:06	85	-66.00711	-71.40545	Turn complete. v/l on next transect of 218
23/02/2015 01:50	85	-65.99997	-71.36346	Commence turn onto next transect

Time	Event	Lat	Lon	Comment
23/02/2015 01:12	98	-66.0193	-71.26255	XCTD 010 complete
23/02/2015 01:00	98	-66.02582	-71.22957	XCTD 010 deployed
22/02/2015 23:50	85	-66.06479	-71.04091	Vessel on next transect of 297
22/02/2015 23:21	97	-66.08534	-70.97292	XCTD 009 complete
22/02/2015 23:13	97	-66.09142	-70.95265	XCTD 009 deployed
22/02/2015 22:58	96	-66.10308	-70.91653	XBT 019 completed
22/02/2015 22:55	96	-66.10538	-70.90886	XBT 019 deployed
22/02/2015 22:16	85	-66.1367	-70.81331	Turn completed starting transect Co.308
22/02/2015 22:02	85	-66.1504	-70.7912	Commence turn onto next transect
22/02/2015 21:24	95	-66.19832	-70.7655	XBT 018 failed at 330m
22/02/2015 21:23	95	-66.19955	-70.76498	XBT 018 deployed
22/02/2015 21:15	94	-66.20902	-70.76001	XCTD 008 failed at 260m
22/02/2015 21:14	94	-66.21025	-70.75924	XCTD 008 deployed
22/02/2015 20:42	85	-66.25064	-70.73759	Seal sighted 30m off port bow
22/02/2015 20:00	93	-66.30334	-70.70801	XCTD 007 deployment complete
22/02/2015 19:57	93	-66.30694	-70.70614	XCTD 007 deployed
22/02/2015 19:18	85	-66.35474	-70.67506	Turn completed starting transect Co.347
22/02/2015 19:01	85	-66.37258	-70.69491	Commence turn onto next transect
22/02/2015 18:32	92	-66.39587	-70.75964	XCTD 006 deployment complete
22/02/2015 18:30	92	-66.3975	-70.76404	XCTD 006 deployed
22/02/2015 16:57	91	-66.4756	-70.98179	XBT 017 deployment complete
22/02/2015 16:56	91	-66.47648	-70.98409	XBT 017 redeployed
22/02/2015 16:48	91	-66.48334	-71.00315	XBT 017 deployed
22/02/2015 15:57	90	-66.52589	-71.12183	XCTD 005 deployment complete
22/02/2015 15:55	90	-66.52755	-71.12625	XCTD 005 deployed
22/02/2015 15:08	89	-66.56567	-71.23503	XBT 016 deployment complete
22/02/2015 15:06	89	-66.56725	-71.2398	XBT 016 deployed
22/02/2015 14:26	88	-66.56506	-71.34064	XCTD 004 complete
22/02/2015 14:21	88	-66.56039	-71.3499	XCTD 004 deployed
22/02/2015 12:42	87	-66.47365	-71.55297	XCTD 003 complete
22/02/2015 12:32	87	-66.46646	-71.57859	XCTD 003 deployed
22/02/2015 10:58	85	-66.39536	-71.80417	Commence turn onto next transect
22/02/2015 10:46	86	-66.38217	-71.82183	XCTD 002 Completed
22/02/2015 10:40	86	-66.37574	-71.83035	XCTD 002 deployed
22/02/2015 09:51	85	-66.32243	-71.90397	Turn completed starting transect Co.151
22/02/2015 09:40	85	-66.31129	-71.92162	Commence turn onto next transect
22/02/2015 05:56	85	-66.08628	-72.34825	Commence seismic survey
22/02/2015 05:45	84	-66.07579	-72.36915	Marine mammal watch complete
22/02/2015 05:37	84	-66.06984	-72.38122	Air guns deployed
22/02/2015 05:23	84	-66.06379	-72.39154	Commence air gun deployment
22/02/2015 05:19	84	-66.06061	-72.39686	Streamer deployment complete
22/02/2015 05:15	84	-66.057	-72.403	Commence marine mammal watch
22/02/2015 03:36	84	-65.96409	-72.57891	Off DP. Commence streamer deployment
22/02/2015 03:30	84	-65.96169	-72.58403	Commence tail bouy deployment
22/02/2015 03:24	84	-65.96137	-72.58799	On DP
22/02/2015 03:18	84	-65.96898	-72.58045	Commence slow down
22/02/2015 01:37	83	-66.19084	-72.09912	Coring equipment secure. v/l increase speed to 11kts for seismic site
22/02/2015 00:42	83	-66.26189	-71.92409	Vessel off DP. Proceeding at 4kts to seismic deployment site
22/02/2015 00:20	83	-66.27218	-71.90849	Crane and gantry lashed
22/02/2015 00:06	83	-66.27215	-71.90844	Piston cores inboard
21/02/2015 23:54	83	-66.27217	-71.90843	Frame in horizontal position
21/02/2015 23:49	83	-66.27217	-71.90845	Piston corer vertical in frame
21/02/2015 23:32	83	-66.27217	-71.90845	Corer in the cup
21/02/2015 23:16	83	-66.27222	-71.90844	PC on surface and transferred to aux wire
21/02/2015 22:10	83	-66.27221	-71.90839	Corer clear of the seabed
21/02/2015 22:06	83	-66.27217	-71.90848	Corer in the seabed. Wire out 2605m
21/02/2015 21:14	83	-66.27212	-71.90886	Corer veering
21/02/2015 21:13	83	-66.27213	-71.90892	Piston corer transferred to coring wire
21/02/2015 21:07	83	-66.27213	-71.90881	Corer in the water
21/02/2015 21:03	83	-66.27214	-71.90891	Trigger weight attached to corer
21/02/2015 20:35	83	-66.2721	-71.90888	Corer in the cup
21/02/2015 20:29	83	-66.27213	-71.90883	Commence piston corer deployment
21/02/2015 20:07	82	-66.27211	-71.90883	GBC recovered to deck

Time	Event	Lat	Lon	Comment
21/02/2015 19:14	82	-66.27213	-71.90889	Corer clear of the seabed
21/02/2015 19:11	82	-66.27212	-71.90882	Corer on the seabed. Wire out 2657m
21/02/2015 19:03	82	-66.27213	-71.90885	GBC stopped at 2500m for 1 mins
21/02/2015 18:11	82	-66.27209	-71.90879	Box corer deployed
21/02/2015 18:00	82	-66.27215	-71.90846	Commence box corer deployment
21/02/2015 17:57	81	-66.27218	-71.90849	Test weight recovered
21/02/2015 17:35	81	-66.2722	-71.90847	Test weight stopped at 1000m
21/02/2015 17:00	81	-66.27224	-71.90872	Test weight in the water
21/02/2015 16:54	81	-66.27218	-71.90876	Commence test
21/02/2015 12:25	80	-66.27216	-71.90891	GBC recovered to deck. Vessel remaining on DP at PEN-2B site
21/02/2015 11:40	80	-66.27219	-71.90897	Commence recovery of GBC to deck to investigate/repair computer problem
21/02/2015 11:32	80	-66.27218	-71.90892	Gantry computer system failed - GBC all stop at depth
21/02/2015 11:25	80	-66.27212	-71.9092	Gantry computer system fixed continue GBC deployment
21/02/2015 10:47	80	-66.27218	-71.90904	Computer system power supply possiably failing – repairing
21/02/2015 10:24	80	-66.27222	-71.90897	Gantry metering computer system failed (GBC stopped at 1827m and system being rebooed)
21/02/2015 09:43	80	-66.27212	-71.90841	GBC in the water
21/02/2015 09:39	80	-66.27214	-71.9084	Re-commence deploying GBC 731
21/02/2015 09:26	80	-66.27194	-71.90703	deployment stopped - wire to be reled
21/02/2015 09:25	80	-66.27196	-71.90705	Commence deploying GBC 731
21/02/2015 09:10	80	-66.27192	-71.90667	Moving GBC along deck to gantry
21/02/2015 08:48		-66.27146	-71.90428	Vsl on DP
21/02/2015 04:38	79	-65.89967	-72.6646	Vessel passes through PIC170 site
21/02/2015 04:24	79	-65.93316	-72.70469	Commence slow down to 8 knots for TOPAZ survey
20/02/2015 20:00	78	-67.49219	-74.38045	Decks secure vessel proceeding to next site
20/02/2015 19:51	78	-67.33271	-74.43051	Tail buoy recovered
20/02/2015 18:01	78	-67.43114	-74.31982	Commence streamer recovery
20/02/2015 18:00	78	-67.4315	-74.31967	Air guns recovered
20/02/2015 17:53	78	-67.43473	-74.31689	Commence air gun recovery
20/02/2015 17:38	66	-67.44969	-74.31644	Survey complete
20/02/2015 17:04	77	-67.48749	-74.37355	XBT 015 complete
20/02/2015 17:00	77	-67.49219	-74.38045	XBT 015 deployed
20/02/2015 14:15	66	-67.66956	-74.64367	Vessel passing through coring site PEN-3B
20/02/2015 11:19	66	-67.85693	-74.9187	Vessel on next transect of 029deg
20/02/2015 00:46	66	-68.09576	-76.40714	V/l onto next transect of 102
20/02/2015 00:20	66	-68.0609	-76.91785	Vessel commence turn onto next transect of 102
19/02/2015 21:52	66	-68.11235	-77.34975	Turn completed starting transect Co.074
19/02/2015 21:11	66	-68.08254	-77.38156	Commence turn onto next transect
19/02/2015 20:00	76	-68.01462	-77.20593	XBT 014 completed
19/02/2015 19:54	76	-68.00875	-77.19131	XBT 014 deployed. Ships speed 4.5kts
19/02/2015 19:08	66	-67.96474	-77.07885	Seal sighted less than 20m off stbd side (fwd)
19/02/2015 17:34	66	-67.8766	-76.85576	Seal sighted 200m off stbd bow
19/02/2015 16:38	75	-67.82604	-76.72455	XBT 013 complete
19/02/2015 16:31	75	-67.81933	-76.7081	XBT 013 deployed
19/02/2015 16:28	74	-67.81663	-76.70124	XCTD 001 complete
19/02/2015 16:23	74	-67.81229	-76.69038	XCTD 001 deployed
19/02/2015 12:59	73	-67.63	-76.22758	XBT 012 complete
19/02/2015 12:52	73	-67.62392	-76.21185	XBT 012 deployed
19/02/2015 10:57	66	-67.52172	-75.95487	Whales sighted on port bow approx 1mile
19/02/2015 09:49	72	-67.46028	-75.92321	XBT 011 Completed
19/02/2015 09:43	72	-67.45498	-75.7875	XBT 011 deployed. Ships speed 4.5kts
19/02/2015 09:06	66	-67.4208	-75.70289	Turn completed starting transect Co.224
19/02/2015 08:08	66	-67.44983	-75.66548	Commence turn onto next transect
19/02/2015 02:45	66	-67.49205	-76.70581	V/L on next transect of 084deg
19/02/2015 02:10	66	-67.48951	-76.65213	Commence turn onto next transect of 084deg
18/02/2015 23:16	66	-67.65721	-77.22419	Vessel passing through coring site PEN-5C
18/02/2015 21:30	66	-67.75094	-77.48966	Vsl on new transect heading 047
18/02/2015 21:07	66	-67.74547	-77.55299	Commence turn onto next transect
18/02/2015 18:00	66	-67.51919	-77.76387	Turn to 160 complete
18/02/2015 17:30	66	-67.50036	-77.71569	Comm turn to 160
18/02/2015 17:05	71	-67.51984	-77.65386	XBT 010 fails
18/02/2015 17:02	71	-67.5221	-77.6467	XBT 010 deployed

Time	Event	Lat	Lon	Comment
18/02/2015 16:57	70	-67.52574	-77.63516	XBT 009 fails
18/02/2015 16:53	70	-67.52876	-77.62621	XBT 009 deployed
18/02/2015 15:51	66	-67.57807	-77.47171	2 Minke whales sighted crossing bow from stbd to port at appox 50m
18/02/2015 14:05	69	-67.66286	-77.20353	XBT 008 deployed
18/02/2015 11:25	66	-67.78339	-76.80411	2 whales sighted 500m off stbd bow closing
18/02/2015 10:51	68	-67.8098	-76.71642	XBT 007 completed
18/02/2015 10:47	66	-67.81276	-76.70676	Seal sighted approx 1000m from stern
18/02/2015 10:45	68	-67.81429	-76.70183	XBT 007 deployed. Ships speed 4.5kts
18/02/2015 07:29	67	-67.9654	-76.19869	XBT 006 completed
18/02/2015 07:23	67	-67.96974	-76.18481	XBT 006 deployed. Ships speed 4.5kts
18/02/2015 07:00	66	-67.98673	-76.12936	Turn to 309 complete
18/02/2015 06:36	66	-68.01082	-76.1265	Com turn to 309
18/02/2015 03:40	66	-68.12889	-76.61626	Vessel on 057
18/02/2015 03:00	66	-68.1139	-76.70095	Commence turn to 057
17/02/2015 22:38	66	-67.86708	-76.18487	Passing through coring site PEN4B
17/02/2015 20:14	66	-67.71997	-75.8894	Commence seismic survey
17/02/2015 20:10	65	-67.71615	-75.879	Whale sighted approx 500m 2 points to starboard
17/02/2015 19:53	65	-67.71395	-75.82366	Whales sighted on stbd side approx 3-4 miles away
17/02/2015 19:44	65	-67.72357	-75.81197	Commence turn to start survey position
17/02/2015 19:29	65	-67.74167	-75.80393	Marine mammal watch completed. Commence firing air guns
17/02/2015 19:18	65	-67.75207	-75.79905	Air guns deployed
17/02/2015 19:15	65	-67.75369	-75.79812	Airguns in the water
17/02/2015 19:09	65	-67.75695	-75.79641	Seal at stern last sighted
17/02/2015 19:08	65	-67.75752	-75.79608	Seal sighted approx 200m from stern
17/02/2015 19:06	65	-67.7588	-75.79551	Whales sighted on port beam approx 2-3miles away
17/02/2015 18:51	65	-67.76761	-75.7903	Marine mammal watch begins
17/02/2015 18:48	65	-67.7705	-75.78871	Streamer deployed
17/02/2015 17:08	65	-67.87719	-75.73436	At 4 knots for streamer deployment
17/02/2015 17:06	65	-67.87893	-75.73249	Off DP
17/02/2015 17:04	65	-67.87961	-75.73192	Tail buoy deployed
17/02/2015 17:00	65	-67.87979	-75.73173	On DP
17/02/2015 15:54	64	-67.86443	-76.17944	Off DP
17/02/2015 15:16	64	-67.86443	-76.17939	Box corer recovered
17/02/2015 14:21	64	-67.8644	-76.17935	GBC 730 clear of seabed
17/02/2015 14:18	64	-67.8644	-76.17929	GBC 730 on seabed. Wire out - 2672m.
17/02/2015 14:03	64	-67.8644	-76.17939	GBC 730 at 2500m for 2 mins
17/02/2015 13:12	64	-67.86443	-76.17934	GBC 730 deployed. Going down to 2500m
17/02/2015 12:43	64	-67.8644	-76.17934	Master deems weather suitable for GBC deployment. Crane gantry unlashed.
17/02/2015 12:30	64	-67.86461	-76.17789	V/l on auto pos DP at PEN-4B site
17/02/2015 09:06	63	-67.86449	-76.17884	Waiting on weather to improve
17/02/2015 08:54	63	-67.8655	-76.17814	Vsl on DP. Assessing weather conditions.
17/02/2015 02:38	62	-68.49449	-76.47402	End of Swath survey heading to PEN4B
14/02/2015 21:06	62	-67.86567	-76.17626	Deck and gantry secure. Vessel off DP beginning swath survey.
14/02/2015 20:25	61	-67.8658	-76.17668	CTD recovered to deck
14/02/2015 19:24	61	-67.86575	-76.17656	CTD stopped at 2650m
14/02/2015 18:37	61	-67.86577	-76.17656	CTD deployed
14/02/2015 17:56	61	-67.86579	-76.17636	Assesment made to continue with CTD
14/02/2015 17:48	61	-67.86616	-76.17496	On DP
14/02/2015 14:18		-67.66823	-74.64227	V/l off DP. Into manual and proceeding to PEN-4B
14/02/2015 13:38	60	-67.6682	-74.64248	GBC 729 on deck
14/02/2015 12:48	60	-67.66816	-74.64233	GBC 729 clear of the seabed
14/02/2015 12:45	60	-67.66815	-74.64237	GBC 729 on the seabed. Wire out - 2455m
14/02/2015 12:37	60	-67.66816	-74.64233	GBC 729 stopped at 2357m for 2 mins
14/02/2015 11:48	60	-67.66867	-74.64386	GBC 729 deployed
14/02/2015 09:50	59	-67.66827	-74.64236	Barrel on deck
14/02/2015 09:35	59	-67.66823	-74.6423	Corer and frame recovered to deck
14/02/2015 09:32	59	-67.66825	-74.64233	Corer in the frame
14/02/2015 09:24	59	-67.66826	-74.64232	Corer in the cup
14/02/2015 09:14	59	-67.66827	-74.64232	Trigger weight recovered to deck
14/02/2015 09:12	59	-67.66827	-74.64231	Corer removed from main wire onto aux wire
14/02/2015 08:05	48	-67.66827	-74.64232	Piston corer on the seabed - 2406m cable

Time	Event	Lat	Lon	Comment
14/02/2015 07:07	59	-67.66826	-74.64232	Corer going down to approx 2300m
14/02/2015 07:05	59	-67.66828	-74.64231	Piston corer transferred to coring wire
14/02/2015 07:00	59	-67.66828	-74.64227	Corer in the water
14/02/2015 06:59	59	-67.66827	-74.64229	Pilot weight attached to corer
14/02/2015 06:34	59	-67.66829	-74.64232	Corer in the cup
14/02/2015 06:31	59	-67.66829	-74.64232	Rack vertical
14/02/2015 06:20	59	-67.66828	-74.6423	Commence corer deployment
14/02/2015 06:18	59	-67.6691	-74.64324	On Station on DP
14/02/2015 06:06	59	-67.67723	-74.67781	Commence slow down
14/02/2015 03:06		-67.86428	-76.17928	V/l off DP. Proceeding to next coring site
14/02/2015 02:59	58	-67.86439	-76.17931	Gantry and crane secure
14/02/2015 02:42	58	-67.86441	-76.17925	Cores removed to deck
14/02/2015 02:24	58	-67.86438	-76.17922	Frame recovered to deck
14/02/2015 02:18	58	-67.8644	-76.17923	Piston corer transferred to frame
14/02/2015 02:10	58	-67.86439	-76.17924	Piston corer in cup
14/02/2015 01:54	58	-67.86439	-76.1793	PC 727 at the surface
14/02/2015 01:21	58	-67.86438	-76.17933	Corer removed from main wire onto aux wire
14/02/2015 01:00	58	-67.86437	-76.17936	Corer clear of the seabed
14/02/2015 00:54	58	-67.86437	-76.17936	PC 727 on seabed. Cable 2624m
14/02/2015 00:44	58	-67.86439	-76.17936	PC 727 on way to seabed
14/02/2015 00:42	58	-67.86438	-76.1794	PC 727 stopped at 2500m for 2 mins
13/02/2015 23:54	58	-67.86437	-76.1794	PC 727 deployed. On the way down to 2700m
13/02/2015 23:51	58	-67.86439	-76.1794	Piston corer transferred to coring wire
13/02/2015 23:38	58	-67.86438	-76.17943	Wire through gantry
13/02/2015 22:54	58	-67.86439	-76.17944	Corer in the cup
13/02/2015 22:50	58	-67.86434	-76.17904	Piston corer veritcal in frame
13/02/2015 22:45	58	-67.86425	-76.17834	Commence piston corer 727 deployment
13/02/2015 22:30	58	-67.86496	-76.1754	Vsl on DP
13/02/2015 11:32	57	-69.01587	-81.16599	Magnetometer recovered to deck
13/02/2015 11:28	57	-69.01932	-81.18393	Magnetometer failed. Commence Magi recovery.
13/02/2015 00:54		-70.17221	-85.95871	V/l at sea speed proceeding to Station PEN-4B
13/02/2015 00:52	56	-70.17474	-85.97002	Magnetometer at 300m and secure
13/02/2015 00:45	56	-70.18282	-86.00648	Magnetometer deployed
13/02/2015 00:22	55	-70.21004	-86.08665	Streamer recovered to deck. All equipment inboard
12/02/2015 23:24	55	-70.24926	-85.95078	Airguns recovered to deck
12/02/2015 23:20	55	-70.25087	-85.94541	Commence recovery of airguns. v/l spd 2.0kts
12/02/2015 23:18		-70.25218	-85.94026	Turn complete. v/l head to wind
12/02/2015 22:35	47	-70.25998	-86.00008	End of Seismic survey
12/02/2015 17:46	54	-69.91599	-85.80423	Magi recovered
12/02/2015 17:27	54	-69.89374	-85.78619	Communication lost with Magi
12/02/2015 17:25	47	-69.89144	-85.78484	Commence alteration for ice
12/02/2015 07:38	47	-69.16637	-85.65089	V/l on new course of 180 deg
12/02/2015 05:21	47	-68.9996	-85.71869	vessel alters course to 172
12/02/2015 02:12	53	-68.78632	-86.00104	Magnetometer at full length on stbd boom
12/02/2015 02:06	53	-68.77887	-86.01046	Magnetometer deployed
12/02/2015 01:36	47	-68.74374	-86.05701	V/l on new course of 154deg
12/02/2015 01:12	47	-68.72173	-86.01709	Commence turn onto next transect
12/02/2015 01:09	52	-68.72121	-86.00788	Magnetometer recovered to deck
11/02/2015 18:54	51	-68.64043	-84.77528	Magi redeployed
11/02/2015 18:45	47	-68.63909	-84.74524	Turn complete
11/02/2015 18:14	47	-68.65318	-84.65623	Commence turn to 260
11/02/2015 18:13	50	-68.65433	-84.65569	Magi recovered
11/02/2015 18:10	50	-68.65781	-84.65404	Commence recovering Magi for turn
11/02/2015 14:20	50	-68.9374	-84.49831	Magnetometer deployed
11/02/2015 14:18	47	-68.93977	-84.49661	V/L proceeding on the next transect of 350deg
11/02/2015 13:45	47	-68.9643	-84.56287	Commence turn onto next transect of 350deg
11/02/2015 13:44	49	-68.96453	-84.56609	Magnetometer recovered to deck
11/02/2015 08:12	47	-69.03407	-85.68858	Whale sighted approx 500m on starboard bow crossing to port as ship passed blowing regularly.
11/02/2015 01:18	48	-69.11425	-87.13371	Magnetometer line at 300m
11/02/2015 01:06	48	-69.11585	-87.17735	Magnetometer deployed
11/02/2015 01:06	47	-69.11585	-87.17735	Commence BELS-1 survey
10/02/2015 23:33	46	-69.04186	-87.40397	V/l increase speed to 4.5kts
10/02/2015 23:28	46	-69.03747	-87.40838	Airguns deployed
10/02/2015 23:19	46	-69.03229	-87.41435	V/l speed reduced to 2kts

Time	Event	Lat	Lon	Comment
10/02/2015 23:17	46	-69.0303	-87.41622	Marine mammal watch complete - 30 mins no sightings
10/02/2015 22:49	46	-69.00164	-87.44586	Streamer deployed
10/02/2015 22:47	46	-68.99949	-87.44819	Whales last sighted approx 1300m from stern on port side
10/02/2015 22:44	46	-68.99636	-87.45146	Commence Whale Watch
10/02/2015 22:39	46	-68.99128	-87.4564	9th bird on the line
10/02/2015 22:34	46	-68.98598	-87.46233	10th bird on the line
10/02/2015 22:29	46	-68.98036	-87.46801	11th bird on the line
10/02/2015 22:23	46	-68.97399	-87.47538	12th bird on the line
10/02/2015 22:23		-68.97399	-87.47538	Two whales sighted approx 500m off Starboard bow
10/02/2015 22:18	46	-68.96854	-87.48146	13th bird on the line
10/02/2015 22:14	46	-68.96422	-87.48624	14th bird on the line
10/02/2015 22:08	46	-68.95777	-87.49298	15th bird on the line
10/02/2015 22:04	46	-68.95373	-87.4973	16th Bird on the line
10/02/2015 22:00	46	-68.9497	-87.50181	Off DP. 17th bird on the line
10/02/2015 21:57	46	-68.94838	-87.50388	Commence tail bouy deployment
10/02/2015 21:30	46	-68.94686	-87.50588	Vsl on DP
10/02/2015 21:17	45	-68.96065	-87.53791	Magi recovered to deck
10/02/2015 21:13	45	-68.96437	-87.54255	Commence Magi recovery
10/02/2015 21:06	45	-68.97729	-87.55398	Comm slow down for Magi
10/02/2015 19:39	44	-69.17059	-87.99482	Finish swath heading up to seismic deployment position
10/02/2015 10:12	44	-69.05635	-88.10238	Waiting on weather to improve for seismics
09/02/2015 21:30		-69.53161	-93.9152	Aft crane and decks secure. VSL off DP
09/02/2015 19:38	43	-69.53167	-93.91587	Barrel on deck
09/02/2015 19:26	43	-69.53165	-93.91587	Corer and frame recovered to deck
09/02/2015 19:24	43	-69.53168	-93.91596	Corer in the frame
09/02/2015 19:13	43	-69.53168	-93.91592	Corer in the cup
09/02/2015 19:06	43	-69.53169	-93.91589	Trigger weight recovered to deck
09/02/2015 18:58	43	-69.53167	-93.91597	Commence recoverey
09/02/2015 18:15	43	-69.53167	-93.91592	Barrel cleaned and stowed
09/02/2015 17:52	43	-69.53167	-93.91589	Corer clear of seabed
09/02/2015 17:47	43	-69.53168	-93.91588	Corer in the seabed
09/02/2015 17:41	43	-69.53168	-93.9159	Corer on the way to the seabed
09/02/2015 17:39	43	-69.53168	-93.91589	Corer stopped at 3500m
09/02/2015 16:32	43	-69.53166	-93.916	Corer deployed on the way down to 3500m
09/02/2015 16:22	43	-69.53165	-93.91598	Corer tranfered to the coring wire
09/02/2015 16:15	43	-69.53166	-93.91598	Corer in the water
09/02/2015 16:13	43	-69.53165	-93.91598	Corer back in the cup
09/02/2015 16:04	43	-69.53166	-93.91596	Corer lifted clear of the cup
09/02/2015 15:32	43	-69.53168	-93.91597	Corer in the cup
09/02/2015 15:26	43	-69.53169	-93.91593	Piston corer veritcal in frame
09/02/2015 15:23	43	-69.53168	-93.91595	Commence piston corer deployment
09/02/2015 14:31	42	-69.53166	-93.9159	GBC 725 on deck
09/02/2015 13:24	42	-69.53166	-93.91589	GBC 725 clear of seabed
09/02/2015 13:19	42	-69.53166	-93.91588	GBC 725 on seabed. Cable - 3646m
09/02/2015 13:09	42	-69.53167	-93.91587	GBC 725 at 3500m for 2min
09/02/2015 11:59	42	-69.53168	-93.91592	GBC 725 deployed
09/02/2015 11:36		-69.53166	-93.91593	V/L on full auto pos DP
09/02/2015 11:24		-69.52923	-93.96097	V/l off DP proceeding to new coring station (away from icebergs)
09/02/2015 11:16	41	-69.52971	-93.96067	CTD on deck
09/02/2015 09:59	41	-69.53117	-93.95726	CTD stopped at 3616m. Commence hauling
09/02/2015 08:58	41	-69.53119	-93.95724	CTD veering. EK60 depth 3647m
09/02/2015 08:55	41	-69.53119	-93.95723	CTD in the water
09/02/2015 08:48	41	-69.53109	-93.95712	Commence deploying CTD
09/02/2015 08:42		-69.53116	-93.95724	Vsl on DP
09/02/2015 08:02	40	-69.55144	-93.88683	End of Topaz transect
09/02/2015 07:43	40	-69.53173	-93.9553	Comm Topaz transect
09/02/2015 05:43	39	-69.52955	-94.56182	Vessel passes through BELS-3B site
09/02/2015 04:50	39	-69.59119	-94.78553	Vessel turning for TOPAZ survey
09/02/2015 04:49	38	-69.59073	-94.78436	Streamer recovered
09/02/2015 03:51	38	-69.55155	-94.67641	Commence streamer recovery
09/02/2015 03:49	38	-69.5502	-94.67263	Air guns recovered
09/02/2015 03:45	38	-69.54683	-94.66279	Commence recovering air guns
09/02/2015 03:38	37	-69.5405	-94.644	Magi recovered
09/02/2015 03:33	37	-69.53641	-94.62948	Commence Magi recovery

Time	Event	Lat	Lon	Comment
09/02/2015 03:27	35	-69.58557	-94.7553	Survey track complete
08/02/2015 22:38	36	-69.53291	-93.57023	Magi deployed
08/02/2015 22:34	36	-69.53302	-93.556	Commence Magi deployment
08/02/2015 22:32	32	-69.53303	-93.5485	Turn completed starting next line
08/02/2015 21:53	35	-69.56525	-93.51442	Streamer redeployed
08/02/2015 21:47	35	-69.56678	-93.53358	Redploying Streamer
08/02/2015 21:44	34	-69.5664	-93.54301	First Bird and Magi recovered to deck
08/02/2015 21:38	34	-69.5633	-93.56098	Commence recovering streamer
08/02/2015 21:35	32	-69.56073	-93.56898	Commence turn to port
08/02/2015 19:10	34	-69.45188	-93.98636	Magi believed to be caught on first bird of streamer waiting until end of line to recover
08/02/2015 18:47	34	-69.43637	-94.05625	Commence shortening Magi
08/02/2015 15:41	32	-69.27162	-94.51053	Vessel alters to 120
08/02/2015 15:04	32	-69.23458	-94.58869	Turn completed v/l steering 143deg
08/02/2015 13:57	32	-69.2162	-94.48478	Commence early turn onto next transect due to restricted vis
08/02/2015 13:24	33	-69.25541	-94.51574	XBT deployed
08/02/2015 09:31	32	-69.53469	-94.56234	Turn completed
08/02/2015 09:15	32	-69.41256	-94.56222	Comm altering course to 000
08/02/2015 07:48	32	-69.61863	-94.83157	Turn completed
08/02/2015 07:33	32	-69.6265	-94.87664	Comm altering course to 050
08/02/2015 03:00	32	-69.40719	-95.33572	V/L proceeding on the next transect of 180deg
08/02/2015 02:36	32	-69.38919	-95.2795	V/L commence altering course to 180degrees
07/02/2015 18:18	32	-69.37347	-93.50192	Vessel crosses start line for BELS2 survey
07/02/2015 18:10	31	-69.37588	-93.75094	Magi deployed
07/02/2015 18:08	31	-69.37586	-93.74933	Commence Magi deployment
07/02/2015 17:52		-69.36833	-93.41254	Whale watch complete. None sighted
07/02/2015 17:46	30	-69.36792	-93.40064	Air guns deployed
07/02/2015 17:39	30	-69.36786	-93.38742	Speed reduced to 2 knots for air gun deployment
07/02/2015 17:23	29	-69.36502	-93.33607	Streamer deployed
07/02/2015 17:22		-69.36478	-93.33287	Marine Mamal watch begins
07/02/2015 16:24	29	-69.35116	-93.14833	Off DP
07/02/2015 16:21	29	-69.35103	-93.14614	Tail buoy in the water streaming
07/02/2015 16:16	29	-69.35096	-93.14582	Commence deployment
07/02/2015 16:12	29	-69.37568	-93.73121	On DP for Seismic streamer deployment
07/02/2015 15:18		-69.37557	-93.7242	Off DP proceeding to deployment position
07/02/2015 14:36		-69.38524	-93.58192	V/L on DP near BELS 2B start wpt to assess iceberg and growler movement
07/02/2015 07:34	28	-69.18485	-90.1417	Magnetometer recovered to deck
06/02/2015 23:42	28	-68.97488	-85.79343	V/l increase speed to 12kts. Proceeding to BELS 2B site
06/02/2015 23:37	28	-68.95953	-85.78712	Mag. deployed at full length
06/02/2015 23:35	28	-68.95508	-85.78775	Magnetometer deployed
06/02/2015 23:30	28	-68.9458	-85.78928	V/l off DP increasing to 6kts for Mag.
06/02/2015 23:26	28	-68.94317	-85.79006	Argo float 7020 deployed. v/l speed .8kts
06/02/2015 23:11	27	-68.94293	-85.79001	GBC and gantry secured for sea
06/02/2015 21:46	27	-68.94291	-85.78999	GBC 724 on the seabed. Wire out 3073m
06/02/2015 20:44	27	-68.9429	-85.78998	GBC 724 in the water and veering to approx. 2900m
06/02/2015 20:35	27	-68.94287	-85.7899	Commence deploying GBC 724
06/02/2015 20:04	26	-68.9429	-85.78985	Corer recovered to frame
06/02/2015 19:47	26	-68.94288	-85.78991	Corer back in the cup
06/02/2015 19:20	26	-68.94287	-85.79026	Commence removing trigger weight
06/02/2015 18:17	26	-68.94284	-85.79031	Corer clear of the seabed
06/02/2015 18:14	26	-68.94286	-85.79038	Corer in the seabed
06/02/2015 18:07	26	-68.94283	-85.79034	Corer at 2900m
06/02/2015 17:20	26	-68.94287	-85.7903	Corer on the way down to 2900m
06/02/2015 17:10	26	-68.94283	-85.79034	Corer in the water
06/02/2015 16:38	26	-68.94287	-85.7903	Trigger weight recovered to deck
06/02/2015 16:10	26	-68.94287	-85.79037	Corer operations stop for break
06/02/2015 15:50	26	-68.94287	-85.79023	Corer back in the cup
06/02/2015 15:39	26	-68.94285	-85.79018	Corer in the water
06/02/2015 14:25	26	-68.94274	-85.78973	Commence deployment of piston corer 723
06/02/2015 12:41	25	-68.94268	-85.78945	CTD on deck
06/02/2015 11:23	25	-68.94268	-85.78923	CTD at depth. Cable - 3074m
06/02/2015 10:30	25	-68.9427	-85.78926	CTD veering to approx 3000m. EK60 depth 3074m
06/02/2015 10:25	25	-68.94269	-85.78922	CTD in the water

Time	Event	Lat	Lon	Comment
06/02/2015 10:20	25	-68.9427	-85.78921	Commence deploying CTD
06/02/2015 09:54		-68.94247	-85.78779	Vessel on DP
06/02/2015 09:27	24	-68.92235	-85.68769	2nd Transect aborted returning to BELS-1
06/02/2015 09:02	24	-68.96349	-85.7079	Comm Topaz transect
06/02/2015 08:17	23	-68.94856	-85.83074	End of Topaz transect
06/02/2015 07:47	23	-68.93128	-85.70206	Comm Topaz transect
06/02/2015 07:40	22	-68.93182	-85.67927	Magi recovered
06/02/2015 07:36	22	-68.93435	-85.64488	Speed reduced to 5kts. Commence recovering MAGI
05/02/2015 07:42	21	-67.21759	-73.7082	Magi fully deployed to 300m
05/02/2015 07:36	21	-67.21152	-73.67816	Magi in the water
05/02/2015 07:24	20	-67.20722	-73.65794	Vsl off DP
05/02/2015 07:02	20	-67.21481	-73.69563	Glidder on board
05/02/2015 06:50	20	-67.21004	-73.66203	Glider line on board
05/02/2015 06:30	20	-67.20516	-73.62552	Glidder sighted
05/02/2015 05:48	19	-67.0804	-73.3822	Magi recovered
05/02/2015 05:36	19	-67.058	-73.33866	Commence Magi recovery
04/02/2015 15:42	19	-64.91075	-69.05696	Magi deployed
04/02/2015 15:32	19	-64.89601	-69.03131	Commence Magi deployment
04/02/2015 15:22		-64.89575	-69.03595	Off DP
04/02/2015 14:21	18	-64.89537	-69.03594	GBC 722 on deck. v/l remain on station for securing
04/02/2015 13:31	18	-64.89529	-69.03563	GBC 722 clear of seabed
04/02/2015 13:27	18	-64.89525	-69.03558	GBC 722 on seabed - 2336m
04/02/2015 13:23	18	-64.89527	-69.03564	GBC 722 at depth
04/02/2015 12:26	18	-64.8952	-69.03557	GBC 722 going down to seabed
04/02/2015 12:23	18	-64.89522	-69.03559	Giant box corer (GBC 001) off deck
04/02/2015 11:34	17	-64.8952	-69.03551	CTD on deck
04/02/2015 10:32	17	-64.89515	-69.03553	CTD all stopped at 2195m
04/02/2015 09:51	17	-64.89521	-69.0355	CTD veering to approx 2333m. EA600 depth 2435m
04/02/2015 09:47	17	-64.89523	-69.03552	CTD in the water
04/02/2015 09:38	17	-64.89522	-69.03551	Commence deploying CTD
04/02/2015 09:12	17	-64.89613	-69.03855	Vsl on DP
04/02/2015 06:09	16	-65.298	-69.91735	Deck secure vessel heading for CTD station
04/02/2015 05:56	16	-65.29508	-69.90662	Tail buoy recovered
04/02/2015 05:48	16	-65.29231	-69.89851	Vessel stopped begin recovering tail buoy
04/02/2015 04:03	16	-65.2304	-69.755	Repair made to streamer. Continue recovery
04/02/2015 03:44	16	-65.21893	-69.72838	Leak detected on streamer
04/02/2015 03:30	16	-65.21025	-69.70938	Commence streamer recovery
04/02/2015 03:25	16	-65.20789	-69.70397	Air guns recovered
04/02/2015 03:21	16	-65.20653	-69.7002	Air guns vented
04/02/2015 03:17	16	-65.20528	-69.69635	Commence recovering air guns
04/02/2015 03:11	15	-65.20131	-69.68736	Magi recovered
04/02/2015 03:06	15	-65.19661	-69.67758	Commence recovering Magi
03/02/2015 22:24	14	-64.93899	-69.12753	1 seal within approx 500m of the ship on the port bow
03/02/2015 22:11	14	-64.92721	-69.10251	2 Whales crossed the bow at approx. 4miles
03/02/2015 20:07	14	-64.81288	-68.86476	Pod of seals sighted off starboard bow
03/02/2015 18:18	14	-64.71282	-68.6564	Complete turn onto 221
03/02/2015 17:58	14	-64.71519	-68.6055	Commence turn onto 221
03/02/2015 15:36	14	-64.85445	-68.34537	Whale sighted. Balaenopteridae posibly a Fin or Sei whale appoached the vessel from the port bow to about 50m blowing regularly.
03/02/2015 14:12	14	-64.93625	-68.19316	V/l proceeding along next transect of 322deg
03/02/2015 13:48	14	-64.96357	-68.17348	Commence turn onto next transect of 322deg
03/02/2015 11:05	14	-65.16156	-68.25497	End of turn starting transect
03/02/2015 10:45	14	-65.17163	-68.29834	Starting turn onto next transect
03/02/2015 07:16	14	-65.09044	-68.89622	End of turn starting transect
03/02/2015 07:07	14	-65.08308	-68.91717	Starting turn onto next transect
02/02/2015 22:27	14	-64.49929	-69.53422	Comm. Seismic Survey
02/02/2015 21:40		-64.45481	-69.49848	Commence turn on to survey line
02/02/2015 21:38	12	-64.45492	-69.49267	Commence firing air guns
02/02/2015 21:35	13	-64.45515	-69.48382	Magi fully deployed
02/02/2015 21:24	13	-64.45606	-69.45376	Magi in the water
02/02/2015 21:21	12	-64.55144	-69.46333	All clear given by MMO's to start firing air guns
02/02/2015 21:18		-64.45656	-69.44003	Ships speed increased to 3.5knts
02/02/2015 21:09	12	-64.45758	-69.4254	Airguns in the water. Paying out umbilical
02/02/2015 21:05	12	-64.45826	-69.42068	Comm. deploying air guns

Time	Event	Lat	Lon	Comment
02/02/2015 20:55		-64.54819	-69.46792	Ships speed reduced to 2knts
02/02/2015 20:50	12	-64.46032	-69.401	Comm. Whale Watch
02/02/2015 20:48	12	-64.46052	-69.39721	Streamer fully deployed
02/02/2015 20:38	12	-64.46179	-69.37674	1st bird on the line
02/02/2015 20:24	12	-64.46349	-69.34944	2nd bird on the line
02/02/2015 20:17	12	-64.46453	-69.33582	3rd bird on the line
02/02/2015 20:11	12	-64.46531	-69.32352	4th bird on the line
02/02/2015 20:05	12	-64.46595	-69.3104	5th bird on the line
02/02/2015 19:58	12	-64.46655	-69.29612	6th bird on the line
02/02/2015 19:52	12	-64.46707	-69.28409	7th bird on the line
02/02/2015 19:31	12	-64.46881	-69.24565	Commence redeploying streamer (Bird 8 in the water)
02/02/2015 18:50	12	-64.46921	-69.16832	Cable stoppered off and split. Removing section
02/02/2015 18:27	12	-64.46941	-69.12294	Heaving cable back up to join due to problem with cable
02/02/2015 18:16	12	-64.46881	-69.09324	8th bird on the line
02/02/2015 18:11	12	-64.46847	-69.07855	9th bird on the line
02/02/2015 18:05	12	-64.4681	-69.06096	10th bird on the line
02/02/2015 18:00	12	-64.46793	-69.04625	11th bird on the line
02/02/2015 17:54	12	-64.46795	-69.02965	12th bird on the line
02/02/2015 17:48	12	-64.46791	-69.01324	13th bird on the line
02/02/2015 17:42	12	-64.46762	-68.99581	14th bird on the line
02/02/2015 17:36	12	-64.46715	-68.97942	15th bird on the line
02/02/2015 17:29	12	-64.4666	-68.96415	Off DP. 16th bird on the line
02/02/2015 17:26	12	-64.46654	-68.95859	Commence streaming cable
02/02/2015 17:24	12	-64.46652	-68.95786	2nd bird on the line
02/02/2015 17:14	12	-64.46656	-68.95211	Bouy deployed
02/02/2015 17:10	12	-64.46655	-68.95129	Commence tail bouy deployment
02/02/2015 16:48	11	-64.46657	-68.94939	XBT complete vessel at 0.5 knots fot streamer deployment
02/02/2015 16:38	11	-64.4666	-68.94342	XBT deployed
02/02/2015 16:30	10	-64.46699	-68.93484	Magi on deck
02/02/2015 16:26	10	-64.46769	-68.92558	Comm shortening Magi
02/02/2015 16:24		-64.46147	-68.92374	Comm slow down
02/02/2015 11:24		-63.44855	-68.89967	V/L resume original co. and spd
02/02/2015 11:11	8	-63.44029	-68.86274	Magnetometer line back to 300m
02/02/2015 11:07	9	-63.44116	-68.85615	ARGO float 7013 deployed
02/02/2015 11:03	8	-63.44172	-68.8506	Magnetometer line shortened to 20m
02/02/2015 11:00		-63.44243	-68.84166	V/l commence reducing spd for argo float deployment
02/02/2015 00:48		-61.67087	-67.8873	V/L resume original co. and spd
02/02/2015 00:40	7	-61.67409	-67.8547	Magnetometer line back to 300m
02/02/2015 00:34	7	-61.67518	-67.84552	ARGO float 7022 deployed
02/02/2015 00:30	7	-61.67599	-67.83884	Magnetometer line shortened to 20m
02/02/2015 00:24	7	-61.67335	-67.82347	V/L reducing speed for ARGO float 4
01/02/2015 18:24		-60.51623	-67.30735	Vessel continues on passage
01/02/2015 18:18		-60.49965	-67.30291	Magnetometer line back to 300m
01/02/2015 18:07	6	-60.51023	-67.28643	XBT deployed
01/02/2015 17:56		-60.51751	-67.27861	Magnetometer line shortened to 20m
01/02/2015 17:56	5	-60.51751	-67.27861	ARGO float 7019 deployed
01/02/2015 17:54	5	-60.51912	-67.27225	Comm slow down for Argo float deployment
01/02/2015 12:37	4	-59.60164	-66.87774	Vessel back on original course to wpt 19. Speed increased to 11.8kts.
01/02/2015 12:19	4	-59.59859	-66.87651	Magnometer all fast
01/02/2015 12:14	4	-59.59552	-66.87524	Magnometer deployed. v/l speed 4.0kts
01/02/2015 11:58	3	-59.50323	-66.74237	XBT 002 failed
01/02/2015 11:49	3	-59.50755	-66.72544	XBT 001 failed
01/02/2015 11:45	3	-59.5094	-66.71755	XBT 001 deployed. V/L heading 295deg at 4.0kts
01/02/2015 11:30	2	-59.5154	-66.69567	V/l off DP. Into manual for XBT deployment
01/02/2015 11:27	2	-59.51594	-66.69441	Argo Float 7018 deployed
01/02/2015 11:25	2	-59.5162	-66.69416	V/L on DP joystick
01/02/2015 11:20	2	-59.58035	-66.86862	V/L reducing speed for station
01/02/2015 05:24		-58.40371	-66.11191	Vessel proceeding to next station
01/02/2015 05:16	1	-58.40703	-66.1033	Argo float deployed
01/02/2015 05:06		-58.42294	-66.13259	Comm slow down for Argo float deployment

Appendix 2. Coring station table (see section 5.6). PC: piston corer, GBC: giant box corer.

Gear	Station	Date	Start (UTC)	At seafloor (UTC)	End (UTC)	Location	Latitude (°S)	Longitude (°W)	Water depth (m)	Recovery (m)
GBC	722	04/02/2015	12:23	13:25	14:19	Crest of Drift 4, western Antarctic Peninsula continental rise (near IODP 732-FULL2 site PEN-1 and PC466; same site as CTD001)	64° 53.72'	69° 02.14'	2329	0.37
PC	723	06/02/2015	17:11	18:14	19:47	Distal part of Belgica Trough Mouth Fan, southern Bellingshausen Sea (IODP 732-FULL2 site BELS-1)	68° 56'.57	85° 47.42'	3075	11.09
GBC	724	06/02/2015	20:43	21:45	22:41	Distal part of Belgica Trough Mouth Fan, southern Bellingshausen Sea (IODP 732-FULL2 site BELS-1; same site as PC723 and	68° 56.57'	85° 47.40'	3073	0.435
GBC	725	09/02/2015	11:58	13:18	14:31	Near crest of mound, southern Bellingshausen Sea (IODP 732-FULL2 site BELS-2C; ; same site as CTD003)	69° 31.90'	93° 54.95'	3660	0.450
PC	726	09/02/2015	16:31	17:47	19:39	Near crest of mound, southern Bellingshausen Sea (IODP 732-FULL2 site BELS-2C; same site as GBC725)	69° 31.90'	93° 54.95'	3663	12.00
PC	727	13/02/2015-14/02/2015	23:52	00:54	02:09	Near crest of Drift 7, western Antarctic Peninsula continental rise (IODP 732-FULL2 site PEN-4B)	67° 51.86'	76° 10.76'	2681	9.90
PC	728	14/02/2015	07:00	08:04	09:32	Crest of Drift 6, western Antarctic Peninsula continental rise (IODP 732-FULL2 site PEN-3B)	67° 40.10'	74° 38.54'	2454	12.17
GBC	729	14/02/2015	11:49	12:47	13:39	Crest of Drift 6, western Antarctic Peninsula continental rise (IODP 732-FULL2 site PEN-3B; same site as PC728)	67° 40.10'	74° 38.58'	2449	0.29
GBC	730	17/02/2015	13:11	14:18	15:16	Near crest of Drift 7, western Antarctic Peninsula continental rise (IODP 732-FULL2 site PEN-4B; same site as PC727 and CTD004)	67° 51.86'	76° 10.76'	2680	0.335
GBC	731	21/02/2015	18:11	19:10	20:07	Crest of Drift 5, western Antarctic Peninsula continental rise (IODP 732-FULL2 site PEN-2B)	66° 16.33'	71° 54.53'	2654	0.32
PC	732	21/02/2015	21:07	22:06	23:53	Crest of Drift 5, western Antarctic Peninsula continental rise (IODP 732-FULL2 site PEN-2B; same site as GBC731)	66° 16.33'	71° 54.51'	2647	9.40

Gear	Station	Date	Start (UTC)	At seafloor (UTC)	End (UTC)	Location	Latitude (°S)	Longitude (°W)	Water depth (m)	Recovery (m)
GBC	733	25/02/2015	12:30	14:06	15:33	Channel between Drifts 5 and 6, western Antarctic Peninsula continental rise (same site as CTD005)	66° 22.33'	73° 42.27'	3857	0.20-0.30
PC	734	25/02/2015	19:52	20:59	23:06	Crest of Drift 5, western Antarctic Peninsula continental rise (SE of BAS core PC107)	65° 56.29'	72° 31.05'	3000	12.93
GBC	735	25/02/2015-26/02/2015	23:11	00:23	01:23	Crest of Drift 5, western Antarctic Peninsula continental rise (SE of BAS core PC107; same site as PC734)	65° 56.29'	72° 31.04'	2998	0.35-0.36
PC	736	26/02/2015	12:58	13:49	15:20	Crest of Drift 4, western Antarctic Peninsula continental rise (near IODP 732-FULL2 site PEN-1 and PC466; same site as GBC722)	64° 53.72'	69° 02.13'	2325	10.255

Appendix 3. CTD station table

CTD cast	CTD name	Station / site	Date	Jday	Time (GMT)	Latitude (degrees decimal minutes)	Longitude (degrees decimal minutes)	Bottles fired	LADCP file	Operator
001	JR298_001	PEN-1	4th February 2015	035	09:46	64° 53.71’ S	069° 02.13’ W	15	JR298_001m.000	MOPR
002	JR298_002	BELS-1	6th February 2015	037	10:26	68° 56.56’ S	085° 47.35’ W	16	JR298_002m.000	PAUMOR
003	JR298_003	BELS-2C	9th February 2015	040	08:54	69° 31.87’ S	093° 57.43’ W	22	JR298_003m.000	PAUMOR
004	JR298_004	PEN-4B	14th February 2015	045	18:36	67° 51.95’ S	076° 10.60’ W	19	JR298_004m.000	PAUMOR
005	JR298_005	Deep channel between Drift 5 & 6	25th February 2015	056	09:20	66° 22.33’ S	073° 42.27’ W	16	JR298_005m.000	PAUMOR

Appendix 4. XBT/XCTD cast table

XBT / XCTD cast number	XBT / XCTD profile number	Probe Type	Serial number	Date	Time (GMT)	Latitude (degrees decimal minutes)	Longitude (degrees decimal minutes)	Notes	Terminal Depth (m)	Profile Depth (m)
XBT_01	T5_00001	T-5	00326808	1st February 2015	11:44:59	59° 30.564' S	66° 43.050' W	Failed after ~100m	1830	133
XBT_02	T5_00002	T-5	00322244	1st February 2015	11:51:06	59° 30.403' S	66° 43.752' W	Profile looked poor - not sensible	1830	0
XBT_03	T5_00003	T-5	00322244	1st February 2015	18:07:08	60° 30.607' S	67° 17.194' W	Different launch gun used. Serial number incorrect as same as previous.	1830	1830
XBT_04	T5_00004	T-5	00367867	2nd February 2015	16:38:42	64° 27.997' S	68° 56.627' W	Profile looks poor beyond 300m	1830	1830
XBT_05	T5_00005	T-5	00326812	8th February 2015	13:23:49	69° 15.338' S	94° 30.955' W	XBT05 deployed to test modified launcher over port side (aft) of ship when running seismics . Used one of old batch of XBTs. Deployment successful and good profile created.	1830	1830
XBT_06	T5_00006	T-5	00326814	18th February 2015	07:23:36	67° 58.158' S	76° 11.169' W	XBT06 deployed over port side of ship with core-liner and white launcher for seismic oceanography. One of old probes used; good profile.	1830	1830
XBT_07	T5_00007	T-5	00326816	18th February 2015	10:45:08	67° 48.851' S	76° 42.131' W	XBT_07 Deployed. Out of data T5 used, good profile received.	1830	1830
XBT_08	T5_00008	T-5	unknown	18th February 2015	14:05:10	67° 39.763' S	77° 12.238' W	Extended the maximum depth recorded. Profile is good to roughly 2300m. Used an out of date T5.	3500	2233
XBT_09	T5_00009	T-5	00326815	18th February 2015	16:53:05	67° 31.722' S	77° 37.583' W	Out of date XBT. Got stuck on some mud in the middle of the pipe so had to be jiggled about a lot to get it to go through the pipe. Once deployed produced a good profile until about 800m depth, where it jumped to 37 degrees. Washed out the pipe at the end of deployment.	3500	797

XBT / XCTD cast number	XBT / XCTD profile number	Probe Type	Serial number	Date	Time (GMT)	Latitude (degrees decimal minutes)	Longitude (degrees decimal minutes)	Notes	Terminal Depth (m)	Profile Depth (m)
XBT_10	T5_00010	T-5	00326811	18th February 2015	17:02:21	67° 31.311' S	77° 38.851' W	Deployed to try and improve upon previous. Did not get stuck in the pipe and was released smoothly. It produced a good profile until just under 1000m, where it also shot up to 37 degrees.	3500	965
XBT_11	T5_00011	T-5	00322238	19th February 2015	09:42:44	67° 27.285' S	75° 47.214' W	Extended depth profile to just over 2200m.	2500	2216
XBT_12	T5_00012	T-5	00322235	19th February 2015	12:52:26	67° 37.459' S	76° 12.770' W	T5 (out of date). Good profile to 2200 m.	2500	2213
XCTD-01	C3_00001	XCTD-1	14067757	19th February 2015	16:23:01	67° 48.738' S	76° 41.424' W	XCTD-01 launched to test the XCTD's before next seismic survey. Launch was successful and depth of profile was roughly 1100m.	1100	1100
XBT_13	T5_00013	T-5	00322242	19th February 2015	16:31:51	67° 49.207' S	76° 42.610' W	Depth of profile extended to roughly 2200m.	2500	2223
XBT_14	T5_00014	T-5	00367871	19th February 2015	19:54:12	68° 0.536' S	77° 11.506' W	Depth of profile extended to roughly 2200m.	2500	2222
XBT_15	T5_00015	T-5	00367875	20th February 2015	16:59:43	67° 29.552' S	74° 22.855' W	Good profile to 1900m.	2500	1880
XCTD-02	C3_00002	XCTD-1	14067760	22nd February 2015	10:40:39	66° 22.587' S	71° 49.763' W	Deployed at the shallowest part of the drift. Deployment successful and profile looks good.	1100	1100
XCTD-03	C3_00003	XCTD-1	14067754	22nd February 2015	12:33:56	66° 28.066' S	71° 34.412' W	Profile is good but finished at roughly 900m depth.	1100	899
XCTD-04	C3_00004	XCTD-1	14067756	22nd February 2015	14:21:19	66° 33.640' S	71° 20.961' W	Profile successful and terminated at 500m (sea floor).	1100	477
XBT_16	T7_00016	T-7	00290734	22nd February 2015	15:06:37	66° 34.006' S	71° 14.302' W	*Awaiting entry in XBT log*	760	760
XCTD-05	C3_00005	XCTD-1	14067752	22nd February 2015	15:54:43	66° 31.668' S	71° 7.614' W	Profile successful	1100	506

XBT / XCTD cast number	XBT / XCTD profile number	Probe Type	Serial number	Date	Time (GMT)	Latitude (degrees decimal minutes)	Longitude (degrees decimal minutes)	Notes	Terminal Depth (m)	Profile Depth (m)
XBT_17	T7_00017	T-7	00290732	22nd February 2015	16:56:04	66° 28.586' S	70° 59.040' W	Profile good.	760	690
XCTD-06	C3_00006	XCTD-1	14067759	22nd February 2015	18:29:24	66° 23.881' S	70° 45.925' W	Profile successful	1100	544
XCTD-07	C3_00007	XCTD-1	14067755	22nd February 2015	19:57:14	66° 18.398' S	70° 42.377' W	Profile looked good but for some reason ended at roughly 330m although sea depth is roughly 500m.	1100	333
XCTD-08	C3_00008	XCTD-1	14067751	22nd February 2015	21:14:00	66° 12.615' S	70° 45.555' W	Profile good until around 260m, then terminated. Sea depth ~500m. Perhaps catching round seismic cables?	1100	265
XBT_18	T7_00019	T-7	00290737	22nd February 2015	21:23:33	66° 11.932' S	70° 45.917' W	T7_00019 profile created, as error entering sequence number in launch info. Profile terminated early - definitely heading into seismic gear. Thinking of changing launch location.	760	305
XBT_19	T7_00020	T-7	00290733	22nd February 2015	22:55:08	66° 6.317' S	70° 54.550' W	T7, made full depth. Deployment from starboard aft deck - 2 deck crew holding the yellow deployment tube partially over the side, and XBT gun temporarily brought across aft deck to deploy from opposite side to normal. Wire just reaches, so extension cable not needed. Incorrectly labelled xbt20 in .EDF file.	760	760
XCTD-09	C3_00009	XCTD-1	14067758	22nd February 2015	23:15:01	66° 5.391' S	70° 57.494' W	Deployed to full depth (>1100m), profile looks fine.	1100	1100
XCTD-10	C3_00010	XCTD-1	14067753	23rd February 2015	01:00:20	66° 1.539' S	71° 13.826' W	Stopped recording data after 240m, no obvious reason why.	1100	240
XBT_20	T5_00020	T-5	unknown	23rd February 2015	02:19:30	66° 1.209' S	71° 25.801' W	Unusual profile.	2500	2227
XBT_21	T5_00021	T-5	00322237	23rd February 2015	04:24:10	66° 8.574' S	71° 39.778' W		2500	2227

XBT / XCTD cast number	XBT / XCTD profile number	Probe Type	Serial number	Date	Time (GMT)	Latitude (degrees decimal minutes)	Longitude (degrees decimal minutes)	Notes	Terminal Depth (m)	Profile Depth (m)
XBT_22	T5_00022	T-5	00322234	24th February 2015	15:28:26	65° 59.886' S	71° 47.161' W		2500	225
XBT_23	T5_00023	T-5	00322241	24 February 2015	17:01:00	66° 3.939' S	72° 0.607' W		2500	122
XCTD-11	C3_00011	XCTD-1	14067750	25 February 2015	03:49:27	66° 22.323' S	73° 42.072' W		1100	1071

Appendix 5. Argo float deployment table

Argo deployment	Date	Jday	Time (GMT)	Latitude (degrees decimal minutes)	Longitude (degrees decimal minutes)	Float serial no.
1	1st February 2015	032	05:16	58° 24.4 S	066° 06.2' W	5595
2	1st February 2015	032	11:27	59° 31.0' S	066° 41.7' W	7018
3	1st February 2015	032	17:56	60° 30.55' S	067° 16.75' W	7019
4	2nd February 2015	033	00:34	61° 40.5' S	067° 50.8' W	7022
5	2nd February 2015	033	11:07	63° 26.5' S	068° 51.4' W	7021
6	6th February 2015	037	23:26	68° 56.6' S	085°47.4' W	7020

Appendix 6. Typical sonar system parameter settings

A6.1 EM122 Acquisition Parameters

MBES screen, “EM122 Runtime Menu”

Sector Coverage
Max Port Angle: 30–68°
Max Starboard Angle: 30–68°
Angular Coverage: Manual
Beam Spacing: HD Eqdst (Equidistant)

Depth Settings
Min Depth(m):10 or Used to constrain the window when struggling to find return
Max Depth (m):5000 or Used to constrain the window when struggling to find return
Dual swath mode: Dynamic
Ping Mode: Very deep (mostly to avoid finding free running TOPAS returns), on shelf set to Medium
FM disable: unchecked

Transmit Control
Pitch stabilization: checked
Along Direction (deg): 0
Auto tilt: Off

Yaw stabilization:
Mode: Rel. Mean heading
Heading: 0.0
Heading filter: Medium

Min. Swath Dist (m): 0
External trigger: checked

3D scanning – not enabled

Sound Speed Profile
Use Sound Speed Profile: see table 4 in cruise report
Abs. Coeff. Files, salinity: D:\sisdata\common\svp_abscoeff\20150123\ *SVP profile*Abs. Coeff. Files, CTD: D:\sisdata\common\svp_abscoeff\default

Sound Speed at Transducer:
Source: Profile
Sound Speed (m/sec): 1524.5 – does this change with profile selected?
Sensor Offset: 0.0 m/s
Filter (sec): 60

Filter and Gains
Filtering
Spike Filter Strength: Medium
Range Gate: Normal

Phase ramp: Normal
Penetration Filter Strength: Off
Slope: On
Aeration: Off
Sector Tracking: On
Interference: Off

Absorption Coefficient
Source: Salinity
Salinity (parts per thousand): 35
12.0 kHz: 1.397 (greyed out)
Mammal protection
TX power level (dB): Max
Soft startup ramp time (min): 0
Water Column
Log R: 30
dB offset: 20
Special mode
Sonar: unchecked
Passive: checked (and greyed out)
Backscatter Adjustment
Normal incidence corr. (deg): 6
Beam Intensity: Use Lambert's Law – unchecked

Data Cleaning
Real Time Data Cleaning: slider at "None", Rule set: Automatic1 (Advanced button contains full details of this)

GPS and Delayed Heave – nothing activated

Simulator – nothing activated

Survey Information – auto-populated with details when creating a new survey.

A6.2: TOPAS Acquisition Parameters

Only the activated menus have been documented, if a section is not mentioned then it was not enabled.

Acquisition Menu

Transmitter

Transmit mode: Normal
Trigger mode: Internal (though external through K-sync did occur, mostly on shelf using the JR298_shallow <500m settings)
Trig interval: Manual
Ping interval[ms]: 5700 (ranged between 7500 and 2000)
Pulse form: Chirp (LFM)
Start frequency [kHz]: 1.5
Stop frequency [kHz]: 5.0
Chirp length [ms]: 10.0
Power level [dB]: -2 or -3
HRP Stabilization – on
Beam control: Manual
Beam offset pitch [deg]: 0.0
Beam offset roll [deg]: 0.0
Transducer sound speed: 1500ms

Receiver

Delay control: Manual
Master trig delay [ms]: 0.0
Delay offset [ms]: controlled by sonar watch (range 0 to 5500)
Sample rate [kHz]: 20.0
Trace length [ms]: 400
Gain [dB]: controlled by sonar watch (range 2dB to 15dB)
HP-filter [kHz]: 1 or 2

Processing Menu

Filters
Enabled – on
Filter type: Matched
Corner frequencies: Auto
Replica shaping – on

Bottom Tracker
Enabled – on
Show master depth – on
Envelope detection – on
Auto search – on

Time variable gain
Enabled – on

TVG control: Tracking

Attribute processing
Enabled – on
Attributes: Inst. Amplitude
Transient – off

Display

Echogram
Trace width [pixel]: 1
Adjust to current window – off
Adjust to current trace length – on
Grid enabled – on
Grid depth unit: ms
Ping tick spacing: 100
Depth tick spacing: 50
Downsampling: Average

Legend
View mode: Normal
Polarity: +/-
Scale: Logarithmic
Color map: INVGRAY
Upper threshold [dB]: 0
Lower threshold [dB]: -54
Maximum value [dB]: 0.0
Dynamic range [dB]: 54.0
Scale unit: dB

Printers

EPC9800 printer
Source: Print from now on - on
Colors – same as Legend menu
Annotation
- Automatic: Time
- Interval (sec/trace): 300
- Print time – on
- Print position – on
- Number of grid lines: 9
- Font size: 8

Drawing
- Downsampling: Average
- Reverse data – off
- Trace zooming – on
- Fixed range – on
- Print start [ms]: controlled by sonar watch (range 0 to 5400)
- Print length [ms]: 900 in deep water and 500 on the shelf.

Appendix 7. Gravity base ties

Date:	26/01/2015	
Location:	Punta Arenas, Chile	
Station name:	Harbour Admin. Bldg.	
Lat:	-53.15	
Lon:	-70.9	
Elevation:	32.9	
Gravity:	981320.82	

Reference numbers:	
Station no.	9337-50
ISCN no.	51230N
BGI station	2165

Ship meter No:

	Value	Time (UTC)
Ship meter value before tie (counter units)	12710.7	10:59:00
Ship meter after gravity tie (counter units)	12710.5	11:54:00
Average	12710.6	
Ship gravity meter calibration constant	0.9967	
Corrected shipsmeter grav (mGal)	12668.65502	

Land Meter

Land gravity meter model number	G167
Land gravity meter interval factor	1.05095

Station	**value**	**time**	**temp °C**	**Date**	**average**
Pier measurement 1 (meter units)	4793.45	11:11	48.9		**mGal**
Pier measurement 2 (meter units)	4793.44				5037.672774
Pier measurement 3 (meter units)	4793.45	11:14			
average (meter units)	4793.446667				
Base measurement 1 (meter units)	4794.1				**mGal**
Base measurement 2 (meter units)	4794.09				5038.348886
Base measurement 3 (meter units)	4794.08	11:32			
average (meter units)	4794.09				
Pier measurement 4 (meter units)	4793.46				**mGal**
Pier measurement 5 (meter units)	4793.47				5037.693793
Pier measurement 6 (meter units)	4793.47				
average (meter units)	4793.466667				

Difference

station to pier (1-3)	-0.676111167
station to pier (4-6)	-0.655092167
average difference	-0.665601667
gravity at pier	981320.1544
Elevation of pier relative to ship meter C of G (m)	1.4795
Earth's gravity gradient mGal/m	0.3086
gravity at ships meter	981320.611

Notes: Operator Tom Jordan Height of ship above pier (PI) measured using laser range finder from L & R base plate to 15 cm above ship survey point #12.

Note gravity station P1 was 23.34 meters aft of the gravity meter. A new station (P2) was measured adjacent to the gravity meter room and found to be 0.03 mGal higher.
The values reported here are those measured at P1, corrected for the shift to P2.

Date:	28/02/2015				Reference numbers:	
Location:	Rothera, Antarctica				USGS station reference	200960
Station name:	USGS gravity point					
Lat:	-67.5683333					
Lon:	68.125					
Elevation:	12.1					
Gravity:	982465.92					

Ship meter No:	S83	
	Value	**Time (UTC)**
Ship meter value before tie (counter units)	13855.19	16:22:00
Ship meter after gravity tie (counter units)	13855.18	17:16
Average	13855.185	
Ship gravity meter calibration constant	0.9967	
Corrected shipsmeter grav (mGal)	13809.46289	

Land Meter	
Land gravity meter model number	G167
Land gravity meter interval factor	1.04981

Station	**value**	**time**	**temp °C**	**Date**	**average**
Pier measurement 1 (meter units)	5882.15	16:11:00	48.9		**mGal**
Pier measurement 2 (meter units)	5882.14	16:12:00			6175.139892
Pier measurement 3 (meter units)	5882.16	16:14:00			
average (meter units)	5882.15				
Base measurement 1 (meter units)	5884.16	16:29:00			**mGal**
Base measurement 2 (meter units)	5884.17	16:30:00			6177.260508
Base measurement 3 (meter units)	5884.18	16:31:00			
average (meter units)	5884.17				
Pier measurement 4 (meter units)	5882.13	17:00:00			**mGal**
Pier measurement 5 (meter units)	5882.12	17:01:00			6175.115396
Pier measurement 6 (meter units)	5882.13	17:03:00			
average (meter units)	5882.126667				

Difference	
station to pier (1-3)	-2.1206162
station to pier (4-6)	-2.145111767
average difference	-2.132863983
gravity at pier	982463.7871
Elevation of pier relative to ship meter (m)	1.772
Earth's gravity gradient mGal/m	0.3086
gravity at ships meter	982464.334

Notes: 1
Loop tie also made to Rother Hanger gravity point shows same offset via USGS point as the direct tie (see sheet 2 of this spreadsheet.

2 Windy beside ship. Reading taken when line was symetrical +/- ~2 divisions on the beam galvo.

3 Position of Pier measurement relative to Parker survey point #42 measured using Leica Disto hand held range finder.
3.474 m port.
2.159 m below
0.150m to stern

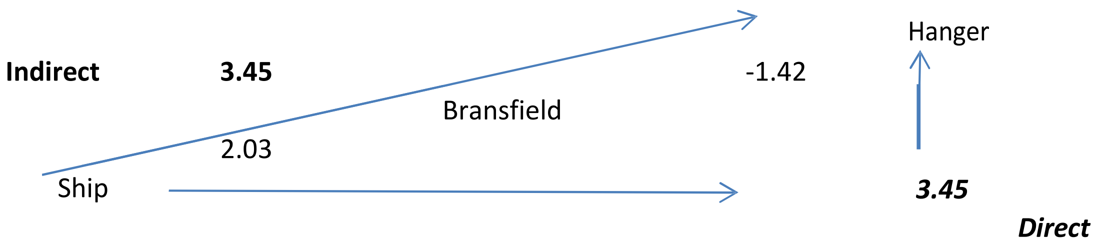
Predicted grav from shipborne meter	982461.69	
Drift since 26/01/2015 start of survey	-2.643975217	26/01/2015
Shipborne drift per day	-0.082624226	27/02/2015
		32

Rothera USGS absolute
9824659.2

ship1	USGS point, old Bransfield	Hanger	ship 2
5882.15	5884.16	5885.59	5882.13
5882.14	5884.17	5885.59	5882.12
5882.16	5884.18	5885.59	5882.13
5882.15	5884.17	5885.59	5882.127

ship1 to B	2.02
Hanger to B	-1.42
ship2 to B	2.04333333
ship 1 to H	3.44
ship2 to H	3.46333333
ship 1 to 2	0.02333333

Loop **check**



Date:	04/03/2015				Reference numbers:	
Location:	Punta Arenas, Chile				Station no.	9337-50
Station name:	Harbour Admin. Bldg.				ISCN no.	51230N
Lat:	-53.15				BGI station	2165
Lon:	-70.9					
Elevation:	32.9					
Gravity:	981320.82					

Ship meter No:

	Value	Time (UTC)
Ship meter value before tie (counter units)	12707.81	
Ship meter after gravity tie (counter units)	12707.81	
Average	12707.81	
Ship gravity meter calibration constant	0.9967	
Corrected shipsmeter grav (mGal)	12665.87423	

Land Meter

Land gravity meter model number	G167
Land gravity meter interval factor	1.05095

Station	value	time	temp °C	Date	average
Pier measurement 1 (meter units)	4792.46	18:32	49		mGal
Pier measurement 2 (meter units)	4792.46	18:34			5036.63934
Pier measurement 3 (meter units)	4792.47	18:36			
average (meter units)	4792.463333				
Base measurement 1 (meter units)	4793.11	18:45			mGal
Base measurement 2 (meter units)	4793.11	18:48			5037.318955
Base measurement 3 (meter units)	4793.11	18:49			
average (meter units)	4793.11				
Pier measurement 4 (meter units)	4792.5	19:02			mGal
Pier measurement 5 (meter units)	4792.49	19:04			5036.674372
Pier measurement 6 (meter units)	4792.5	19:06			
average (meter units)	4792.496667				

Difference

station to pier (1-3)	-0.679614333
station to pier (4-6)	-0.644582667
average difference	-0.6620985
gravity at pier	981320.1579
Elevation of pier relative to ship meter (m)	1.495
Earth's gravity gradient mGal/m	0.3086
gravity at ships meter	981320.6193

Notes:
Final tie at Punta.

Calculation shows that drift calculated to Rothera, shows very similar value as drift rate calculated back to Punta.

Average value is therefore used.

Position of Pier measurement relative to Parker survey point #42 measured using Leica Disto hand held range finder.
3.332 m port.
2.436 m below
0.150m to stern

Final drift calculation

Place	Date	Jday	Grav from ship	True grav at ship	Difference	drift per day
Punta	26/01/2015	26	981320.61	981320.61	0	
Rothera	27/02/2015	58	982461.69	982464.334	2.643975217	0.082624226
Punta	04/03/2015	63	981317.58	981320.6193	3.0392585	0.082142122
					average	0.082383174

RRS James Clark Ross Cruise JR298
Julian day, start of (Universal Time)
Small crosses marked at intervals of 4 hours along track
Giant box core site
Piston core site
CTD cast
XBT cast
XCTD cast
Multichannel seismic reflection profile
Proposed drill site (IODP proposal 732-Full2)
Previous DSDP and IODP drill sites
Previous sediment core site (selected sites labelled)
Previous multichannel seismic reflection profile
Bathymetry contours derived from IBCSO v1 dataset
Inset map is Polar Stereographic projection, scale 1:15,000,000 at the pole
Box on inset map shows location of main map
1:1,600,000 at 67°S
Mercator projection
Spheroid: WGS84
0 50 100 km
0 500 1000 km
BELLINGSHAUSEN SEA
Peter I Island
BELGICA FAN
BELGICA TROUGH
Charcot Island
Wilkins Ice Shelf
ALEXANDER ISLAND
George VI Ice Shelf
PALMER LAND
Marguerite Bay
MARGUERITE TROUGH
Adelaide Island
Rothera Station
Drift 4
Drift 5
Drift 6
Drift 7
BELS-1
BELS-2C
BELS-3B
PEN-1
PEN-2B
PEN-3B
PEN-4B
PEN-5C
1095
1096
1097
1101
325