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North of 62N Geophysical Survey RRS Discovery Cruise D265 BGS Project 02/01 Operations Report

Continental Shelf and Margins Programme
Internal Report IR/02/198

BRITISH GEOLOGICAL SURVEY

INTERNAL REPORT IR/02/198

North of 62N Geophysical Survey
RRS Discovery Cruise D265
BGS Project 02/01 Operations Report

C P Brett

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Foreword

This report covers the operation of Discovery Cruise D265, BGS Project 02/01, a regional geophysical survey of the UK Continental Shelf north of 62°N, carried out from 2 to 23 September 2002. This field operation was the second part of a two year geophysical survey programme, the first phase being completed in 2001. It was funded by the BGS Science Budget and represents completion of the first phase of the mapping of the UK designated area north of 62°N which should be followed by seabed sampling and shallow drilling to produce the final geological maps.

Acknowledgements

Any offshore programme is a team effort, with each and every person playing their full part in the continuous 24 hour operations. A full list of the BGS personnel taking part is included in the report and their contribution to the success of the operations is acknowledged. Grateful thanks are also due to Capt. Robin Plumley, the crew of RRS Discovery and the technical support provided by the Research Ship Unit and SOC UKORS.

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Summary

This report describes the operation of Discovery Cruise D265, BGS Project 02/01, a regional geophysical survey of the UK Continental Shelf north of 62°N, carried out from 2–23 September 2002. The vessel proved to be excellent for the work and the survey was extremely successful. There was no weather downtime and survey operations were continuous throughout the period in the survey area. The basic programme was completed with seventeen additional lines being run over areas of specific interest. A total of 2625Km of very good quality data were collected. The survey was allocated Discovery Station Number 15042.

This survey was the second in a two year programme to map the UK Continental Shelf north of 62N. Details of the 2001 survey can be found in BGS Internal Report IR/01/178.

1 Narrative

The vessel sailed from Fairlie at 1210 on the 2nd September on completion of equipment mobilisation and commenced passage to the survey area. Sailing had been delayed from 0800 due to the non-arrival of fire alarm boards for the containers. These were supplied by SOC UKORS and should have been delivered to the vessel at the start of the mobilisation on 29th August. Equipment preparations continued throughout the day and a boatdrill/safety exercise was carried out during the afternoon. Passage and equipment preparation continued throughout the following day with the vessel reaching the edge of the survey area in the early afternoon of 4th September. The vessel slowed to deploy equipment at 1255, commencing with the pinger and PES towfish. The airguns were deployed next, but one gun failed to seal. The guns were recovered and the gun exchanged for the spare before being re-deployed. The sparker, two hydrophones and magnetometer were then deployed and all systems run up. The optimum tow configuration had been established in the previous survey and was adopted again. This configuration is shown in Fig 1. Survey operations commenced with the start of Line 1 at 1620.

During the course of Line 1 problems were experienced with one of the primary airgun compressors and it became necessary to run the third, back-up unit. No fire alarm board had been supplied for this unit but a risk assessment was conducted in conjunction with the Master and Chief Engineer, leading to an agreed method of operation and monitoring. Following repairs both primary compressors were back in action after some sixty hours and the third unit was not required again throughout the survey.

The entire survey was carried out in an unprecedented period of calm weather which lasted throughout the entire cruise. These conditions were against all reasonable expectations for this area and time of year and much appreciated by all onboard. Survey operations were conducted on a continuous basis without disruption. The airguns proved to be very reliable and virtually all routine maintenance was carried out on scheduled turns between lines. On only one occasion was a longer turnround requested for extended maintenance, resulting in the loss of half an hour.

With the calm weather the seismic data, airgun, sparker and pinger was generally of excellent quality. The latter appeared to be consistently better than the 2001 data. Gravity data also benefited from the sea conditions. However, the UKORS echo sounder struggled in the deeper parts of the survey and the BGS magnetometer suffered a series of technical problems throughout the survey period. Further details are given in the equipment section.

The entire two year survey plan, with the exception of part of one line which had been designated low priority following the 2001 survey, was completed. Seventeen additional lines were run over areas of specific interest which had been identified during the course of the 2001 survey and further delineated during this survey. A total of 35 survey lines were run, totalling 2625Km of high quality seismic data.

Figure 2 shows a summary of the time utilisation and Figure 3 gives a summary track chart.

2 Equipment Used

2.1 AIRGUN SYSTEM

Source: An array of 5 x 40 cu.in. Bolt 600B airguns with waveshape kits and time break solenoids. Routinely, up to four guns were fired simultaneously, keeping the fifth gun as a ready spare. The number of guns used was varied with water depth, with a minimum of two being used in the shallower areas. The firing rate varied from 6 – 8 seconds depending on water depth. Gun synchronisation was achieved by monitoring the time break solenoids and manually adjusting as required. This introduced a short time delay into the system of between 36 and 38 msec and thus the sea-bed return time was not an absolute measurement of depth. Air was supplied by BGS containerised Compair Reavell VHP 36 compressors. Three units were available, two in a standard 20' container and a third in a separate container. The pair in the single container were regarded as the main source with the third one as back-up. This was only required briefly near the start of the survey and thereafter the dual units in the 20' container were used throughout.

Hydrophone: Two channel Geomechanique summed to give a single channel 30m active length.

Recording: CODA DA200 four channel digital recording and processing system. The data was recorded on Exabyte tape in CODA format with a sampling interval of 0.2msec, record length of 4 seconds and bandpass filter of 25-500Hz. The start of recording was delayed in deep water to permit a minimum of 2 seconds of data below the sea bed. The CODA system also received a navigation data string from the navigation processor, and logged position on each shot. During the course of the survey low frequency acoustic interference was observed on occasion. The source of this interference was not identified, but it appeared to be directional, affecting lines run in the NW/SE direction. To combat this problem the high pass filter was increased to 40Hz.

On-line processing: In addition to the recording described above, the CODA system was also used to process the data on-line and to produce a real time hard copy output on a Waverley 3710 thermal printer. Processes applied were time varied gain (TVG), time varied filtering (TVF) and trace mixing. Both TVG and TVF were applied from the sea bed, which was tracked automatically. A 1.4sec record length was used for the on-line hard copy, with a delay adjusted to give an optimum record in the prevailing water depth. Other records were replayed off-line at the request of the geologist.

2.2 SPARKER SYSTEM

Source: EG&G, nine candle, multi-tip array with 135 tips.

High Voltage Power Supply: Applied Acoustic Engineering CSP3000 capacitor charging unit. This was a single unit, powered from the ship's mains and with a switchable output up to a maximum of 2.2KJ.

Hydrophone: Teledyne, 10m, 7 channels with all summed to give a single output.

Recording: The same CODA DA200 four channel digital recording and processing system as for the airgun with the data being recorded on the same Exabyte tape in CODA format. The data were recorded with a sampling interval of 0.1msec, record length of 1.5 seconds and a bandpass filter of 130-2000Hz. The start of recording was delayed in deep water to permit a minimum of 1 second of data below the sea bed. As with the airgun, position was recorded with every shot.

On-line processing: A second CODA system was used to process the data on-line and to produce a real time hard copy output on a Waverley 3710 thermal printer. Processes applied were time varied gain (TVG), time varied filtering (TVF), swell filter and trace mixing. Both TVG and TVF were applied from the sea bed, which was tracked automatically. A 500msec record length was used for the on-line hard copy, with a delay adjusted to give an optimum record in the prevailing water depth. Other records were replayed off-line at the request of the geologist.

2.3 SUB- BOTTOM PROFILER

IOS 3.5kHz system: This is a high resolution, deep water (up to 6000m) swept or 'chirp' frequency profiling system consisting of 4 major components; the Recorder, Transceiver, Correlator and towfish. The transceiver is Raytheon PTR 105B producing 6 kWatts of acoustic power, the recorder is a Waverley 3710 Linescan recorder and was selected for a 480msec sweep. A small programmer allows the transceiver and recorder to be pulsed at an optimum repetition rate for a given depth range. The correlator is of IOS design and converts the 28ms reflected swept pulse to a filtered 1.5 ms, 3.5 kHz output pulse for greater noise immunity. The towfish contains four TR109F Massa transducers wired in a parallel series combination.

2.4 GRAVITYMETER

The gravity meter was a LaCoste and Romberg AIR-SEA system. This consists of a highly damped, zero-length spring type gravity sensor (LaCoste and Romberg S84) mounted on a gyro-stabilised platform, together with associated control and recording electronics. The sensor and

control electronics were located two decks below the main laboratory within the Stable Laboratory close to the centre of motion of the vessel.

Gravity was measured continuously and the gravity, spring tension and cross coupling correction values logged, at a one second interval in L&R Long Format, onto the ship's Level ABC logging and processing system. Data were also output to a colour printer for QC purposes. Data were first processed to produce a Free Air anomaly, sub sampled to 10 seconds, edited to remove erroneous data (such as that obtained on turns) and smoothed using a Gaussian filter with a 20-sample window. The marine meter calibration factor was 0.9967 mgal/meter div.

2.5 MAGNETOMETER

The system used was a Direct Reading Barringer M123 marine proton precession magnetometer with 1 gamma sensitivity. The sensor was towed 200m astern and the system was triggered by the seismic control system such that the sensor was polarising when the sparker fired. This eliminated electrical interference from the sparker discharge.

From within a few hours of the start, almost continuous problems were experienced with the magnetometer throughout the survey period. Initially the noise was thought to arise from the sensors/cables and plugs, the most common sources of interference. Extensive investigations of these lead to temporary improvements in data quality but did not eliminate the overall problem. The root cause of the problem was then traced to the laboratory console of the magnetometer and various repairs were carried out, each time appearing to clear the noise for a short while. It was concluded that the root cause of the problems were poor earthing connections within the laboratory electronics and several joints were re-soldered. Problems were completely eliminated for the last thirtysix hours of survey when the data was very good. Whilst the data was noisy throughout there are long periods of operation during which the data can be recovered by filtering.

It proved impossible to interface the magnetometer to the vessel's logging system so data was logged on the BGS TRAC 'C' system at 10 second intervals. This was then periodically transferred to the ship's system and merged with other logged parameters.

2.6 ECHO SOUNDER

This was a Simrad EA500 Hydrographic Echo sounder with a 9 element tow fish operating at 10kHz. Serial data, showing depth in meters and reflected power, were logged on the ship's Level ABC system. Echograms were displayed onto colour monitors during operation and for QC purposes.

The performance of the echo sounder was somewhat poor compared with the operation in 2001. Using the tow fish, good bottom tracking was achieved to a depth of approximately 1800m, when tracking deteriorated and the seabed was lost completely by approximately 2400m. In very deep water the hull transducer was used and this proved much superior in the calm conditions being experienced. Later, in a water depth of approximately 1700m, the sea conditions deteriorated slightly, but with enough motion to disrupt bottom tracking using the hull transducer. In this situation, reverting to the towed fish gave considerable improvement.

In general the performance of the towed fish transducer would appear to be well below par given that it is supposed to be a deep water echo sounder.

Data were processed by editing out erroneous and null values (registered as a Zero depth) and converting to true depth by applying the appropriate Carter corrections to the 1500 m/second data.

2.7 NAVIGATION, PROCESSING AND DATA LOGGING

The process of calculating the position of the ship and thus the navigation of the ship is done using a mixture of dead reckoning and GPS inputs.

The ships gyro and the Chernikoeff log provide the dead reckoning side of the navigation. This is processed to make a relative motion file called relmov. The bestnav program then takes this data along with data from a primary fix file (data from a Trimble GPS_4000DL) and if this is not available from a secondary fix file (data from an Ashtech GG-24 (combined GPS + GLONASS)). The differential corrections for both of these file's are fed from a Sea Star (3000L DGPS set to Eik EMS). In practice the dead reckoning data is almost never used in the final navigation as GPS data is updated at a rate of once every second.

All position data are referred to the WGS 84 datum.

3 Preliminary Interpretation of Seismic Data

Ruth Hoult

A preliminary interpretation has been made of the seismic data, which complete the survey grid for the north of 62°N area. To help with this, cross-reference was possible with interpretations of the 2001 dataset, existing data, such as published papers and periodicals, or other interpretations in and around the survey area, including:

- BGS maps of the Cormorant, Miller and Flett sheets
- ENAM airgun data
- GEM and Seabed project reports
- BGS Neogene stratigraphic atlas

Depth maps at a scale of 1:500 000, which were produced for several horizons in 2001, have been augmented and modified in line with the acquired data. As before, these depths are taken from the airgun record for consistency, although reference to the sparker data has been made in the upper section, where data quality is generally high. The following maps have been produced:

- Intra-Naust O
- Top Tampen slide deposits
- Top Tampen slide 'parental'
- Top Miller Slide deposits
- Top Ferder Formation equivalent
- Intra-Neogene Unconformity (INU)
- Latest Oligocene/earliest Miocene Unconformity (LOEMU)
- Top Paleocene basalt

3.5 kHz pinger data were also studied, but not used for mapping purposes. The depths to the horizons were also fed into an Excel spreadsheet to produce graphic printouts of the interpretations for each line. Examples from lines 5 and 30 are attached. Line 5 is a NW – SE line located in the SW of the study area, and illustrates the depocentre of the Miller slide deposits. Line 30 is a SW – NE line across the west-central portion of the North Sea Fan within the study area. The Tampen slide sidewall and Tampen slide deposits are mapped, as is the seabed escarpment that appears to be directly related to the Tampen Slide sidewall. Diapiric activity obscures reflections in the central portion of some of the lines, notably lines 6 and 7 in the area of a volcanic high.

The areal limits of other features have also been modified in the light of the new data. These include the North Sea Fan, and the distribution of deep, shallow and surface diapirism, together with the complete limits of the Miller slide deposits north of 62°N, and several other possible slides or slide headwalls/sidewalls, and faults.

Together with the 2001 data, these data provide coverage over and above that originally planned for the north of 62°N area. Due to consistently good weather conditions, additional lines were achieved over the area of the Tampen Slide, the seabed escarpment and the diapiric region. These data will significantly help in the geological interpretation of the area and of these features in particular. Geological controls on the Tampen head/sidewall features and the control on diapirism of a basalt high along trend from the Fugloy Ridge will be addressed. An area of surface slips and slides along the northern edge of the Fugloy Ridge, seen on both 2001 and 2002 datasets, may be investigated using data from other sources.

4 Personnel

BGS

Colin Brett	Geophysicist, Principal Scientist
David Wallis	Electronics Engineer, 2 I/C
Davie Baxter	Mechanical Engineer
John Derrick	Mechanical Engineer
Ruth Hoult	Geologist
Christian Wilson	Scientific Watchkeeper
Michael Wilson	Electronics Engineer

SOC UKORS

Rob Lloyd	Computing
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RRS Discovery

Robin Plumley	Master
Derek Noden	Ch. Officer
John Mitchell	2 nd Officer
Mike Hood	3 rd Officer
Ian McGill	Ch. Engineer
Ian Slater	2 nd Engineer
Gary Slater	3 rd Engineer
Chris Uttley	4 th Engineer
Alan Hayes	Electrical Officer
Bob Hewison	Eng. Cadet
Tiny Pook	Bosun
Greg Lewis	Bosun Mate
Stewart Barrett	Deck
Gary Crabb	Deck
Steve Day	Deck
John Ridley	Deck
Bill Robinson	Deck
Eddie Staite	Catering Manager
Stephen Nagle	Chef
Mark Eaton	Asst. Chef
James Sergeant	Steward
Gary Mackinnon	Steward

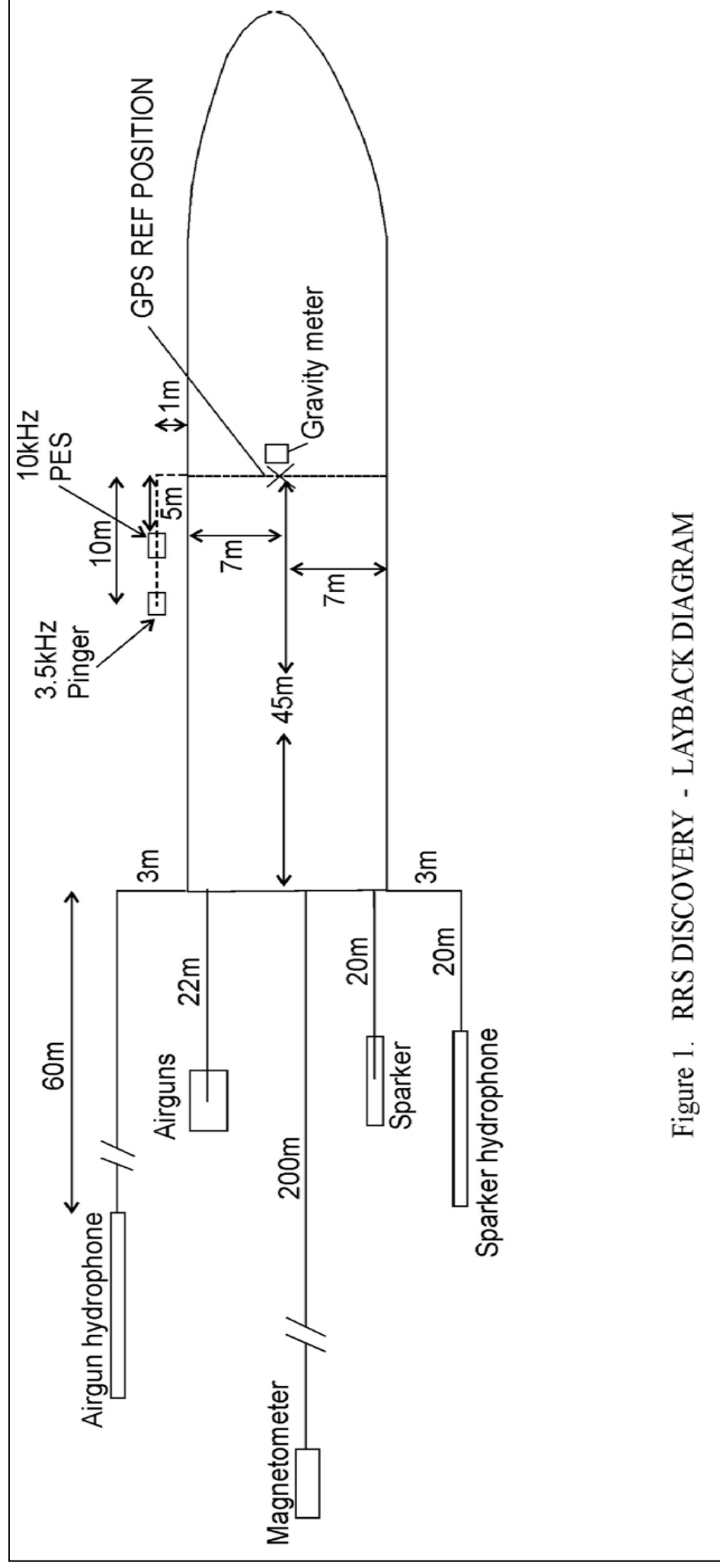


Figure 1. RRS DISCOVERY - LAYBACK DIAGRAM

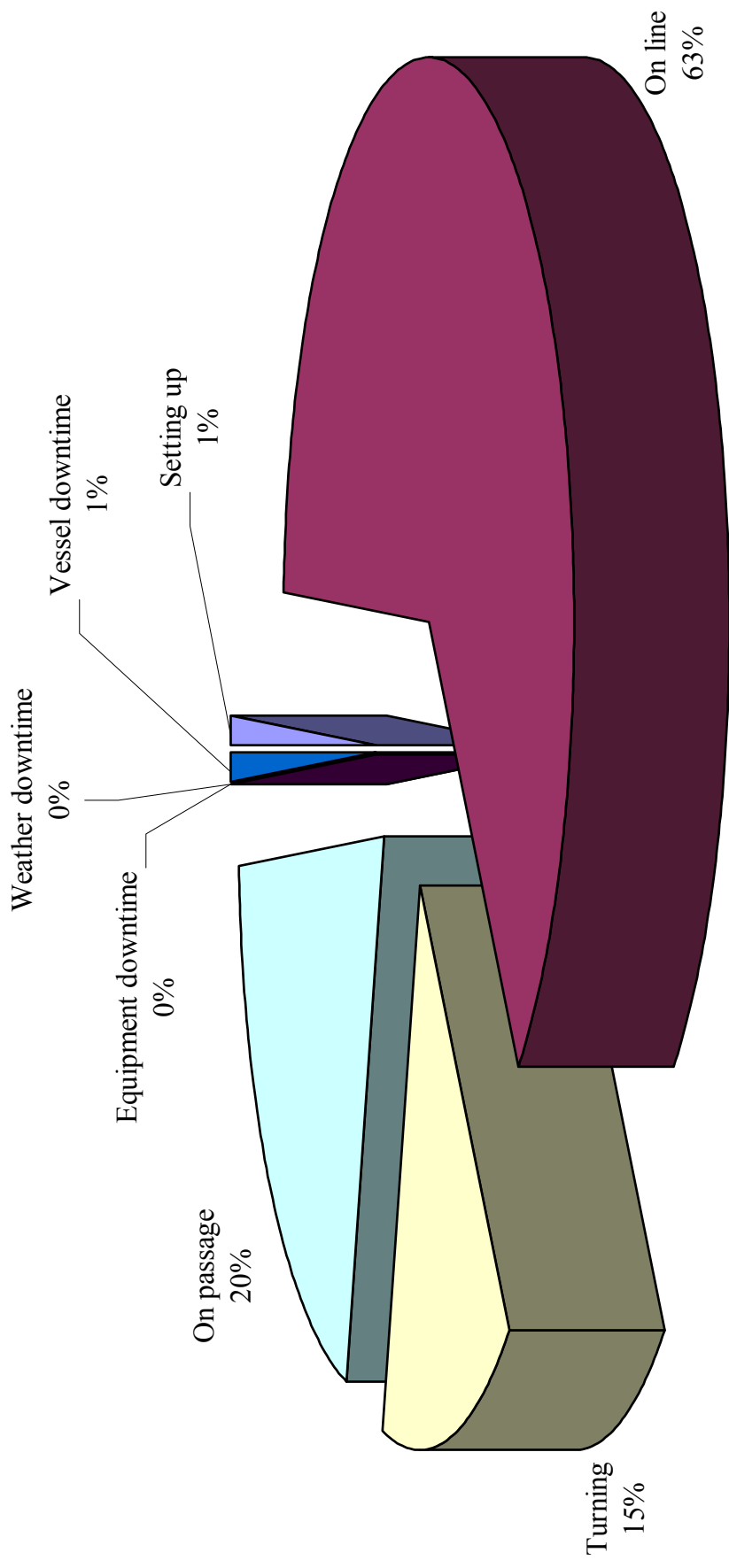


Figure 2. Time Utilisation Summary

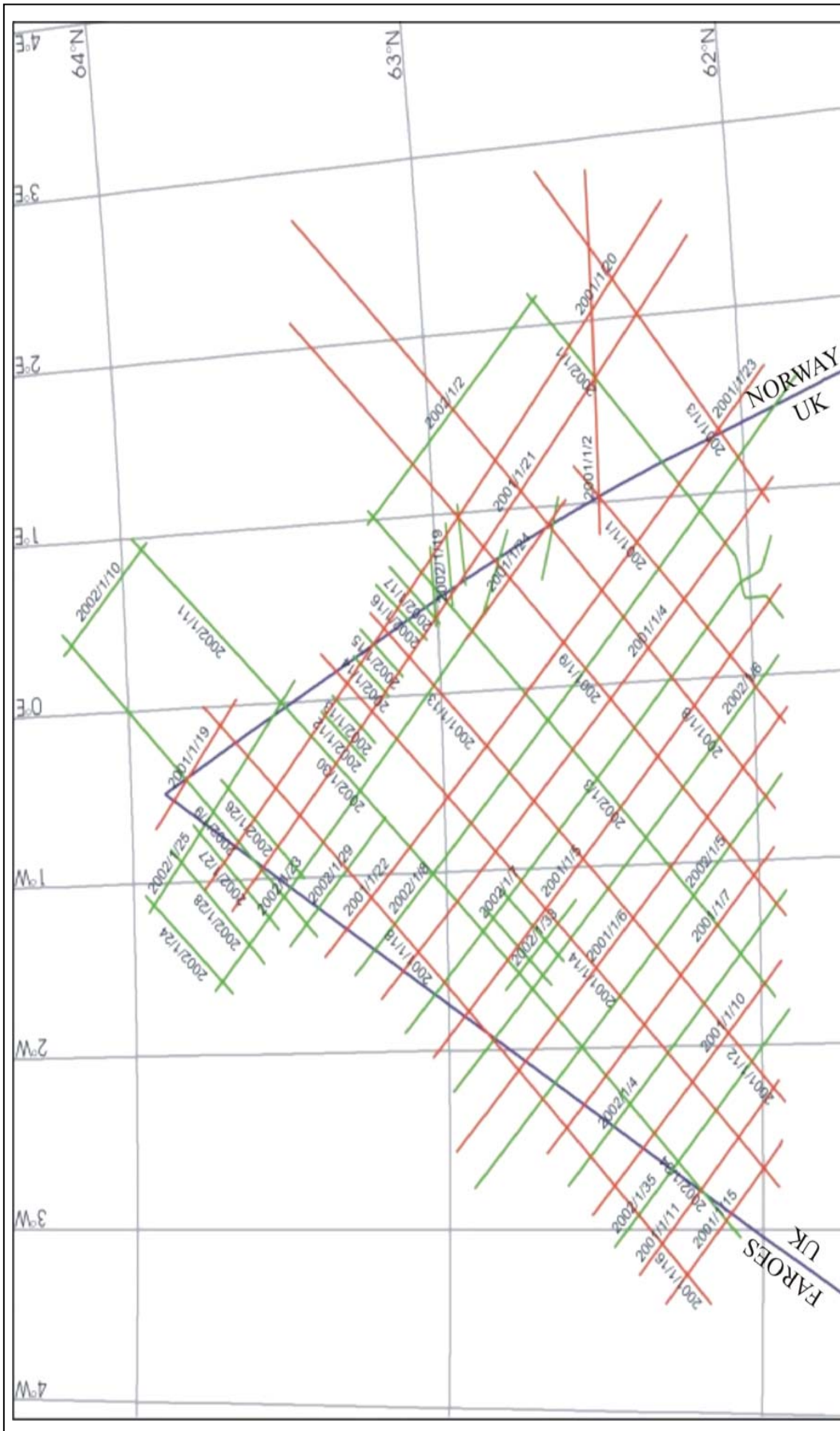


Figure 3. North of 62
 Summary Track Chart
 Project 02/01 - This report - GREEN
 Project 01/01 - Report IR/01/178 - RED

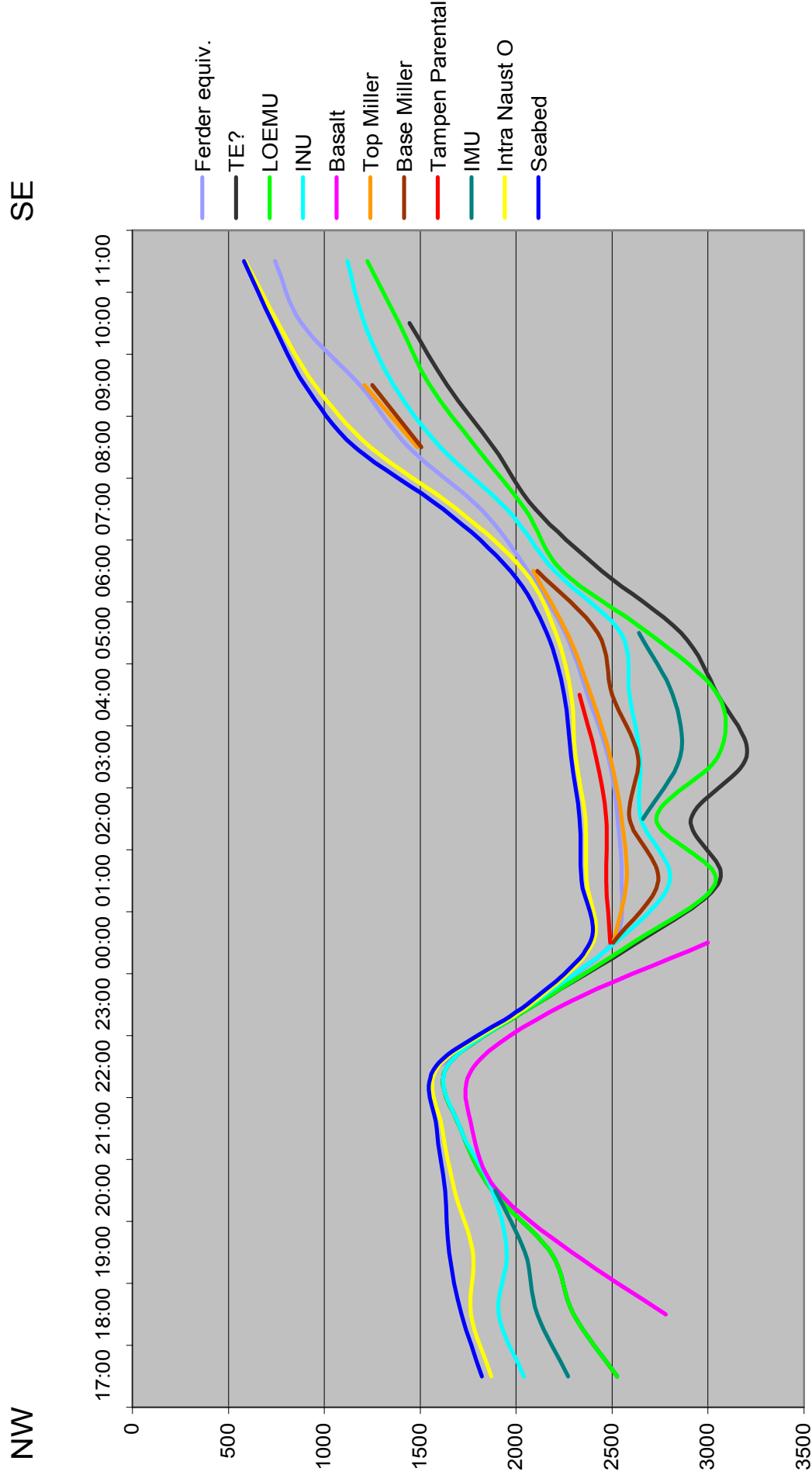


Figure 4. Example Interpretation -Line 5

Appendix I Daily Summary Log

Summary Daily Log

Date: 1 September J.D. 244

Time

13:30 Joined vessel at Fairlie

14:00 Safety brief carried out

Preparations continuing throughout day

Total km of completed lines:

	Today (hours)	Total (hours)
Mob/demob, setting up	0.0	0.0
On line	0.0	0.0
Turning	0.0	0.0
Steaming	0.0	0.0
Weather downtime	0.0	0.0
Equipment downtime	0.0	0.0
Vessel downtime	0.0	0.0
Port	0.0	0.0

Summary Daily Log

Date: 2 September J.D. 245

Time

12:10 Vessel left berth heading for survey area-following delay waiting for UKORS equipment

15:15 Emergency drill carried out
Preparations continuing on passage

Total km of completed lines:

	Today (hours)	Total (hours)
Mob/demob, setting up	0.0	0.0
On line	0.0	0.0
Turning	0.0	0.0
Steaming	11.9	11.9
Weather downtime	0.0	0.0
Equipment downtime	0.0	0.0
Vessel downtime	4.1	4.1
Port	0.0	0.0

Summary Daily Log

Date: 3 September J.D. 246

Time

00:00 On passage to the survey area
Equipment preparation and testing continuing throughout

Total km of completed lines:

	Today (hours)	Total (hours)
Mob/demob, setting up	0.0	0.0
On line	0.0	0.0
Turning	0.0	0.0
Steaming	24.0	35.9
Weather downtime	0.0	0.0
Equipment downtime	0.0	0.0
Vessel downtime	0.0	4.1
Port	0.0	0.0

Summary Daily Log

Date: 4 September J.D. 247

Time

00:00 On passage to the survey area
 12:55 Slowing to commence equipment deployment
 13:17 PES and Pinger fish deployed over port side
 13:30 Airguns deployed and tested - one gun leaking
 13:50 Guns recovered
 14:40 Airguns deployed - now all fine
 15:00 Sparker deployed
 15:10 Both hydrophones deployed
 15:30 Magnetometer deployed
 16:20 SOL 1 - Airguns, sparker, manetometer, gravitymeter, echo sounder, pinger
 17:20 A/C to avoid fishing long liner
 18:19 Gun 3 added
 18:27 Compressors struggling with three guns, one compressor had shut down completely
 18:43 Airguns off while compressor problems investigated
 19:00 Decided to mobilise third compressor to replace faulty machine
 19:55 Airguns back on firing Guns 1 and 2
 21:15 TRAC C crashed
 21:40 TRAC C operational again
 23:59:00 Running Line 1

Total km of completed lines:

0

	Today (hours)	Total (hours)
Mob/demob, setting up	3.4	3.4
On line	7.6	7.6
Turning	0.0	0.0
Steaming	13.0	48.9
Weather downtime	0.0	0.0
Equipment downtime	0.0	0.0
Vessel downtime	0.0	4.1
Port	0.0	0.0

Summary Daily Log

Date: 5 September J.D. 248

Time

00:00 Running Line 1
 02:30 Bridge DGPS dropped out, logging DGPS OK
 04:55 Sparker tripped out
 05:10 Sparker back on line - seismic control fault
 06:15 EOL 1
 06:30 Sparker recovered for trimming and redeployed
 07:00 SOL 2
 10:13 Vessel drifted 100+m off-line -requested return to line
 10:25 Gun 3 failed - no timebreak
 10:26 Gun 4 not firing either, gun 5 on
 14:15 Gun 4 now fine
 14:45 Magnetometer becoming slightly noisy
 17:40 EOL 2 Guns recovered to service gun 3, sparker in for trimming
 17:45 Magnetometer deck plug cleaned - no real difference
 18:40:00 Guns and sparker redeployed
 19:10 SOL 3
 20:15 Airgun data poor - cause under investigation
 20:40 Airgun problems traced to trigger to the CODA - relay box inerted in trigger line

Total km of completed lines: 219 Kms

	Today (hours)	Total (hours)
Mob/demob, setting up	0.0	3.4
On line	21.8	29.4
Turning	2.2	2.2
Steaming	0.0	48.9
Weather downtime	0.0	0.0
Equipment downtime	0.0	0.0
Vessel downtime	0.0	4.1
Port	0.0	0.0

Summary Daily Log

Date: 6 september J.D. 249

Time

00:00 Running Line 3
06:00 Airgun hydrophone picking up bursts of low frequency (40Hz) interference
07:40 Magnetometer becoming increasingly noisy - adjuste triger to no effect
12:00 Magnetometer switched off to recover
12:15 Second magnetometer deployed
13:15 Second magnetometre suffering occasional dropout
14:00 A very large swell picking up - seismic data suffering
18:47 EOL 3
19:00 Guns and sparker recovered for maintenance
20:00 Guns and sparker redeployed
22:55 SOL 4
23:59 Running Line 4

Total km of completed lines: 420 Kms

	Today (hours)	Total (hours)
Mob/demob, setting up	0.0	3.4
On line	19.9	49.3
Turning	4.1	6.3
Steaming	0.0	48.9
Weather downtime	0.0	0.0
Equipment downtime	0.0	0.0
Vessel downtime	0.0	4.1
Port	0.0	0.0

Summary Daily Log

Date: 7 September J.D. 250

Time

00:00	Running Line 4
11:23	Reduced to 3 guns in shallower water
12:40	EOL 4 Sparker recovered for trimming
12:59	Sparker redeployed - speed increased to 5.5knts for transit
13:00	Guns off to change over compressors
13:18	Now running two compressors in 20' container
16:10	Slowed - starting turn
16:40	SOL 5

Total km of completed lines: 533Kms

	Today (hours)	Total (hours)
Mob/demob, setting up	0.0	3.4
On line	20.0	69.3
Turning	4.0	10.3
Steaming	0.0	48.9
Weather downtime	0.0	0.0
Equipment downtime	0.0	0.0
Vessel downtime	0.0	4.1
Port	0.0	0.0

Summary Daily Log

Date: 8 September J.D. 250

Time

00:00 Running Line 5
 07:30 Firing rate changed to 6 secs
 11:00 EOL 5 - sparker inboard for trimming
 11:27 Sparker redeployed - speed increased for transit between lines
 11:33 Checked playback of CODA data - all fine
 14:10 Slowed, starting turn onto line
 14:30 SOL 6
 14:45 Magnetometer deck lead moved to reduce interference
 17:00 Brief problem with bridge navigation system - vessel offline >100m
 22:00 Additional earth to HV container - attempting to eliminate maggy interference
 23:59 Running Line 6

Total km of completed lines: 693Kms

	Today (hours)	Total (hours)
Mob/demob, setting up	0.0	3.4
On line	20.5	89.8
Turning	3.5	13.8
Steaming	0.0	48.9
Weather downtime	0.0	0.0
Equipment downtime	0.0	0.0
Vessel downtime	0.0	4.1
Port	0.0	0.0

Summary Daily Log

Date: 9 September J.D. 252

Time

00:00 Running Line 6
05:20 Firing rate to 8 sec.
07:15 Difficulty with Simrad E/S bottom tracking
10:20 EOL 6 - turning to next line
10:25 Sparker inboard for trimming
10:45 Sparker redeployed - speed increased for transit
12:40 Started turn onto next line
13:00 SOL 7
17:10 Occasional Low frequency interference on airgun hydrophone
23:59 Running Line 7

Total km of completed lines: 862 Kms

	Today (hours)	Total (hours)
Mob/demob, setting up	0.0	3.4
On line	21.3	111.1
Turning	2.7	16.5
Steaming	0.0	48.9
Weather downtime	0.0	0.0
Equipment downtime	0.0	0.0
Vessel downtime	0.0	4.1
Port	0.0	0.0

Summary Daily Log

Date: 10 September J.D. 253

Time

00:00	Running Line 7
01:12	Firing cyle to 7 secs.
02:15	Air pressure down to 1300 p.s.i. - under investigation
02:50	Compressor problem cleared - firing 3 guns
03:00	Air up to full pressure - firing 4 guns
08:53	A/C for fishing longliner - same area as Day 247
09:46	A/C back to line
10:50	EOL 7 - turning to next line
11:13	Sparker inboard for trimmng - guns off for compressor maintenance
11:25	Sparker redeployed - speed increased for transit
12:20	Compressors on
15:00	Turning towards line
15:40	SOL 8 4 guns, 6 sec firing
16:00	Intermittant sparker signal dropout
23:59	Running Line 8

Total km of completed lines: 1052 Kms.

	Today (hours)	Total (hours)
Mob/demob, setting up	0.0	3.4
On line	19.1	130.2
Turning	4.9	21.4
Steaming	0.0	48.9
Weather downtime	0.0	0.0
Equipment downtime	0.0	0.0
Vessel downtime	0.0	4.1
Port	0.0	0.0

Summary Daily Log

Date: 11 September J.D. 254

Time

00:00 Running Line 8
 03:00 Gun 3 failed - running 1,2,4,5
 06:02 Gun 3 back on - working fine, running guns 1,2,3,4
 11:00 Firing rate to 7 secs.
 13:02 Magnetometer increasingly noisy - conducting tests
 13:41 Magnetometer suddenly extremely noisy
 13:58 Magnetometer off to change sensor
 14:12 Gun 3 erratic - not sealing on occasion - switched off. Using 5 instead
 14:15 Magnetometer on using other sensor - still noisy but better
 14:22 Firing rate to 8 secs,
 16:26 Sparker switched off - water depth too great - 1800m
 16:30 Airguns to 6 sec firing
 17:42 Magnetometer off - data poor - testing shipboard unit
 18:05 Sparker recovered
 19:46 EOL 8 - turning to next line
 19:55 Airguns recovered - gun 3 exchanged for spare
 20:00 Sparker hydrophone inboard
 21:05 Airguns redeployed
 21:36 SOL 9
 23:59 Running Line 9

Total km of completed lines: 1284 Kms

	Today (hours)	Total (hours)
Mob/demob, setting up	0.0	3.4
On line	22.2	152.4
Turning	1.8	23.2
Steaming	0.0	48.9
Weather downtime	0.0	0.0
Equipment downtime	0.0	0.0
Vessel downtime	0.0	4.1
Port	0.0	0.0

Summary Daily Log

Date: 12 september J.D. 255

Time

00:00	Running Line 9
00:05	Magnetometer on again
06:00	Magnetometer power supply changed to 110V transformer
10:55	EOL 9 - turning tp next line
11:00	Increase speed for transit
12:12	SOL 10 - 4 guns, 6 sec firing
12:28	Nav error on bridge - 130m off-line, correcting slowly
14:40	Magnetics logging on - security log only for first aprt of line
17:40	EOL 10 - turning to next line
19:11	SOL 11 - 4 guns, 6 sec firing
19:30	Ongoing magnetometer investigations - data very noisy
23:59	Running Line 11

Total km of completed lines: 1451 Kms

	Today (hours)	Total (hours)
Mob/demob, setting up	0.0	3.4
On line	21.2	173.6
Turning	2.8	26.0
Steaming	0.0	48.9
Weather downtime	0.0	0.0
Equipment downtime	0.0	0.0
Vessel downtime	0.0	4.1
Port	0.0	0.0

Summary Daily Log

Date: 13 September J.D. 256

Time

00:00	Running Line 11
02:05	GPS off-track 30-40m
04:19	EOL 11 - turning to next line
04:30	Magnetometer sensors changed - still noisy - magnetometer off for repair
05:49	SOL 12
07:17	Magnetometer back on
08:00	EOL 12 - turning to next line
09:05	SOL 13
11:30	EOL 13 - turning to next line
13:00	SOL 14
15:10	EOL 14 - turning to next line
16:10	SOL 15
18:08	EOL 15 - turning to next line
19:45	SOL 16
22:25	EOL 16 - turning to next line
23:29	SOL 17
23:59	Running Line 17 - magnetometer very noisy

Total km of completed lines: 1622 Kms

	Today (hours)	Total (hours)
Mob/demob, setting up	0.0	3.4
On line	16.0	189.6
Turning	8.0	34.0
Steaming	0.0	48.9
Weather downtime	0.0	0.0
Equipment downtime	0.0	0.0
Vessel downtime	0.0	4.1
Port	0.0	0.0

Summary Daily Log

Date: 14 September J.D. 257

Time

00:00 Running Line 17 - magnetometer noisy
 01:40 Differential signal lost briefly
 02:01 EOL 17 - turning to next line
 02:15 Sparker recovered for trimming and redeployed
 03:30 Magnetometer sensor changed
 04:23 SOL 18
 07:00 Differential corrections respection poor
 07:12 EOL 18 - turning to next line
 08:23 SOL 19 - magnetometer noisy
 10:03 Magnetometer off for further investigation of noise
 10:24 Clock on pinger recorder approx. 1 minute fast - reset
 10:50 EOL 19 - turning to next line
 11:50 SOL 20
 12:12 Magnetometer back on after further repair in laboratory console
 14:50 EOL 20 - turning to next line
 15:40 Slowed on turnround to complete compressor maintenance
 16:20 Up to survey speed to approach turn onto line
 16:50 SOL 21
 19:38 EOL 21 - turning to next line
 21:58 SOL 22
 23:59 Running Line 22

Total km of completed lines: 1736 Kms

	Today (hours)	Total (hours)
Mob/demob, setting up	0.0	3.4
On line	15.1	204.7
Turning	8.4	42.4
Steaming	0.0	48.9
Weather downtime	0.0	0.0
Equipment downtime	0.5	0.5
Vessel downtime		4.1
Port	0.0	0.0

Summary Daily Log

Date: 15 september J.D. 258

Time

00:00 Running Line 22
 00:55 EOL 22 - turning to next line
 01:00 Sparker recovered for trimming and redeployed
 03:00 SOL 23
 03:15 Noise - interference observed on airgun
 04:10 TRAC C fail - restarted. Logging part of programme uninterrupted.
 06:15 Continuing interference on airgun hydrophone
 11:31 Sparker switched off - water depth too great
 11:44 Sparker and hydrophone recovered
 12:52 Air pressure down to 1600psi - one compressor cut out
 12:52 Airgun firing slowed to 8 secs while compressor problem investigated.
 13:00 Airgun signal HP filter increased to 40Hz
 13:30 Compressor back on - airgun firing back to 6 seconds
 18:05 E/S struggling in deep water - changed to hull transducer - much better surprisingly
 18:12 Air pressure down - compressor cut out - firing rate to 8 sec.
 18:15 Compressor reset - firing back to 6 sec.
 19:17 EOL 23 - turning to next line
 20:42 SOL 24
 23:59 Running Line 24
 Total km of completed lines: 1904 Kms

	Today (hours)	Total (hours)
Mob/demob, setting up	0.0	3.4
On line	20.5	225.2
Turning	3.5	45.9
Steaming	0.0	48.9
Weather downtime	0.0	0.0
Equipment downtime	0.0	0.5
Vessel downtime	0.0	4.1
Port	0.0	0.0

Summary Daily Log

Date: 16 september J.D. 259

Time

00:00	Running Line 24
01:15	EOL 24 - turning to next line
02:20	SOL 25
11:45	EOL 25 - turning to next line, guns off for compressor maintenance
11:50	Increase speed for transit
15:00	TRAC C stopped - restarted
16:10	SOL 26
21:50	EOL 26 - turning to next line
22:30	Magnetometer very noisy again - switched off for investigation
23:45	SOL 27
23:59	Running line 27

Total km of completed lines: 2069 Kms.

	Today (hours)	Total (hours)
Mob/demob, setting up	0.0	3.4
On line	16.5	241.7
Turning	7.5	53.4
Steaming	0.0	48.9
Weather downtime	0.0	0.0
Equipment downtime	0.0	0.5
Vessel downtime	0.0	4.1
Port	0.0	0.0

Summary Daily Log

Date: 17 September J.D. 260

Time

00:00	Running Line 27
04:18	EOL 27 - turning to next line
05:35	SOL 28
08:00	E/S struggling in deep water with vessel rolling
11:20	EOL 28 - turning to next line
12:25	SOL 29
14:15	TRAC C stopped - restarted
15:15	Emergency drill carried out
16:25	Magnetometer back on
18:24	EOL 29 - turning towards next line and increasing speed for transit
23:35	SOL 30
23:59	Running Line 30

Total km of completed lines: 2206 Kms

	Today (hours)	Total (hours)
Mob/demob, setting up	0.0	3.4
On line	16.6	258.3
Turning	7.4	60.8
Steaming	0.0	48.9
Weather downtime	0.0	0.0
Equipment downtime	0.0	0.5
Vessel downtime	0.0	4.1
Port	0.0	0.0

Summary Daily Log

Date: 18 September J.D. 261

Time

00:00	Running Line 30
06:10	Sparker deployed
06:35	Sparker on - firing rate reduced to 8 sec.
06:49	Changed to E/S towed fish - better than hull transducer with vessel rolling
14:50	EOL 30 - turning to next line
15:40	SOL 31
16:40	Magnetometer increasingly noisy again
17:22	Magnetometer off for investigation
18:53	EOL 31 - turning to next line
20:00	SOL 32
23:43	EOL 32 - turning to next line
23:50	Sparker inboard for trimming and redeployed
23:59	Heading towards Line 33

Total km of completed lines: 2392 Kms

	Today (hours)	Total (hours)
Mob/demob, setting up	0.0	3.4
On line	21.7	280.0
Turning	2.3	63.1
Steaming	0.0	48.9
Weather downtime	0.0	0.0
Equipment downtime	0.0	0.5
Vessel downtime	0.0	4.1
Port	0.0	0.0

Summary Daily Log

Date: 19 September J.D. 261

Time

00:00 Heading towards next line - magnetometer sensor changed for spare
 01:00 Magnetometer repair successful - now getting good data
 02:00 SOL 33
 06:15 EOL 33 - turning towards next line
 07:20 SOL 34
 17:29 Air pressure down - one gun leaking
 17:35 Leak traced to Gun 3, gun shut off
 17:40 Problems with starting Gun 5 - traced to inboard firing unit
 17:52 Gun 5 now operational - back to four guns
 20:00 TRAC C laptop frozen, master fine - laptop restarted
 22:37 EOL 34 - turning to next line
 22:50 Sparker recovered for trimming, airguns recovered for maintenance
 22:55 Sparker redeployed
 22:55 Air leak traced to chaffed air hose on the frame. Two hoses replaced
 23:59 Heading towards next line

Total km of completed lines: 2533 Kms

	Today (hours)	Total (hours)
Mob/demob, setting up	0.0	3.4
On line	19.5	299.5
Turning	4.5	67.6
Steaming	0.0	48.9
Weather downtime	0.0	0.0
Equipment downtime	0.0	0.5
Vessel downtime	0.0	4.1
Port	0.0	0.0

Summary Daily Log

Date: 20 September J.D. 263

Time

00:00	Heading for next line
01:00	Airguns redeployed after hose repairs
03:16	SOL 35
14:30	EOL 35 - end of survey operations, airguns, sparker and magnetometer off
14:37	Pinger and E/S switched off
15:02	All stern towed gear recovered
15:15	Pinger and E/S fish recovered - underway to Fairlie
23:59	On passage to Fairlie

Total km of completed lines: 2625 Kms

	Today (hours)	Total (hours)
Mob/demob, setting up	0.8	4.2
On line	11.2	310.7
Turning	3.3	70.9
Steaming	8.7	57.6
Weather downtime	0.0	0.0
Equipment downtime	0.0	0.5
Vessel downtime	0.0	4.1
Port	0.0	0.0

Summary Daily Log

Date: 21 September J.D. 264

Time

00:00 On passage to Fairlie
Equipment demobilising and packing all day
23:59 On passage to Fairlie

Total km of completed lines: 2625 Kms

	Today (hours)	Total (hours)
Mob/demob, setting up	0.0	4.2
On line		310.7
Turning	0.0	70.9
Steaming	24.0	81.6
Weather downtime	0.0	0.0
Equipment downtime	0.0	0.5
Vessel downtime	0.0	4.1
Port	0.0	0.0

Summary Daily Log

Date: 22 September J.D.265

Time

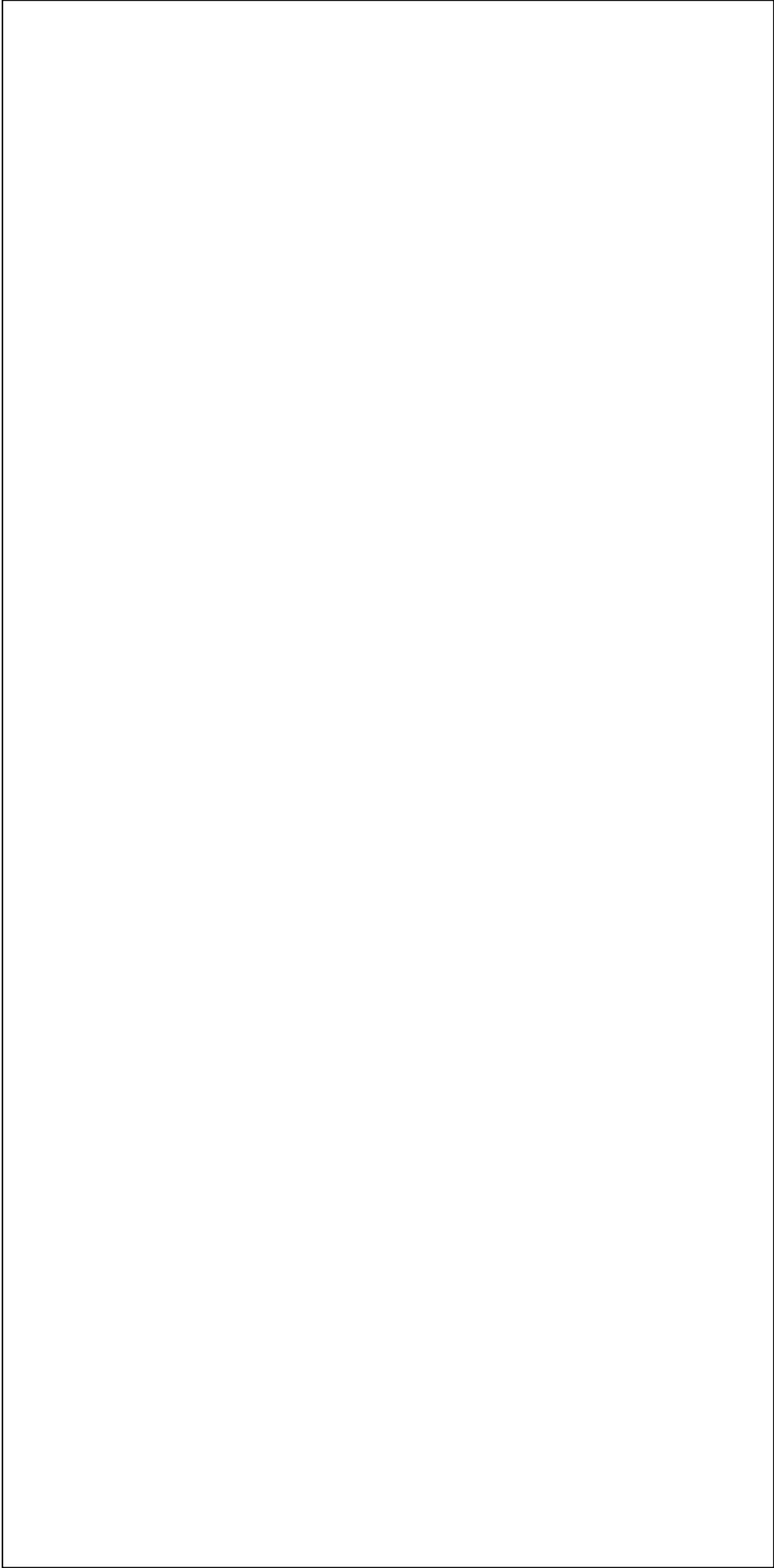
00:00 On passage to Fairlie

16:00 Alongside Fairlie

Total km of completed lines:

	Today (hours)	Total (hours)
Mob/demob, setting up	0.0	4.2
On line		310.7
Turning		70.9
Steaming	16.0	97.6
Weather downtime	0.0	0.0
Equipment downtime	0.0	0.5
Vessel downtime	0.0	4.1
Port	0.0	0.0

Appendix II Line Summary Log



British Geological Survey Marine Operations

Line Summary Log Sheet 2 of 2



PROJECT 02/01 NORTH OF 62N 2002 GEOPHYSICAL SURVEY Vessel: RRS Discovery Cruise D265

Line No.	Start			End			Length (km)	Total (km)	Equipment Run					Comments
	Date	J. Day	Time	Date	J. Day	Time			Airgun	Sparker	Gravity	Magnetics	Pinger	
25	16-Sep	259	2:20	16-Sep	259	11:45	84	2029	x	x	x	x	x	Too deep for sparker
26	16-Sep	259	16:10	16-Sep	259	21:50	40	2069	x	x	x	x	x	Too deep for sparker
27	16-Sep	259	23:45	17-Sep	260	4:18	42	2111	x	x	x	x	x	Too deep for sparker. Magnetometer under repair
28	17-Sep	260	5:35	17-Sep	260	11:20	45	2156	x	x	x	x	x	Too deep for sparker
29	17-Sep	260	12:25	17-Sep	260	18:24	50	2206	x	x	Part	x	x	Too deep for sparker
30	17-Sep	260	23:35	18-Sep	261	14:50	126	2332	x	Part	x	x	x	Too deep for sparker at start
31	18-Sep	261	15:40	18-Sep	261	18:53	30	2362	x	x	Part	x	x	Magnetometer noisy again
32	18-Sep	261	20:00	18-Sep	261	23:43	30	2392	x	x	x	x	x	
33	19-Sep	262	2:00	19-Sep	262	6:15	35	2427	x	x	x	x	x	Magnetometer good
34	19-Sep	262	7:20	19-Sep	262	22:37	106	2533	x	x	x	x	x	
35	20-Sep	263	3:16	20-Sep	263	14:30	92	2625	x	x	x	x	x	

Appendix III Gravity Base Ties

Date	Location	Corrected Ship Base	Corrected Meter Reading	Drift mgal
02/09/02	Fairlie	981581.20	12789.8	
23/09/02	Fairlie	981581.07	12790.9	+1.2