PGS Geophysical

M/V RAMFORM VICTORY

Project no 2005098

Woodside Energy Ltd

Aragorn 3D Survey
Bass Strait, Tasmania

25th March to 30th May 2006

version 1

PGS Geophysical – Marine Acquisition, SINGAPORE

AUTHORISATION

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Singapore
22nd June, 2006

DISTRIBUTION

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REVISED VERSIONS

NUMBER	CHANGES	AUTHOR	DATE
1	Final version	Leif-Inge Iversen	22nd June.2006

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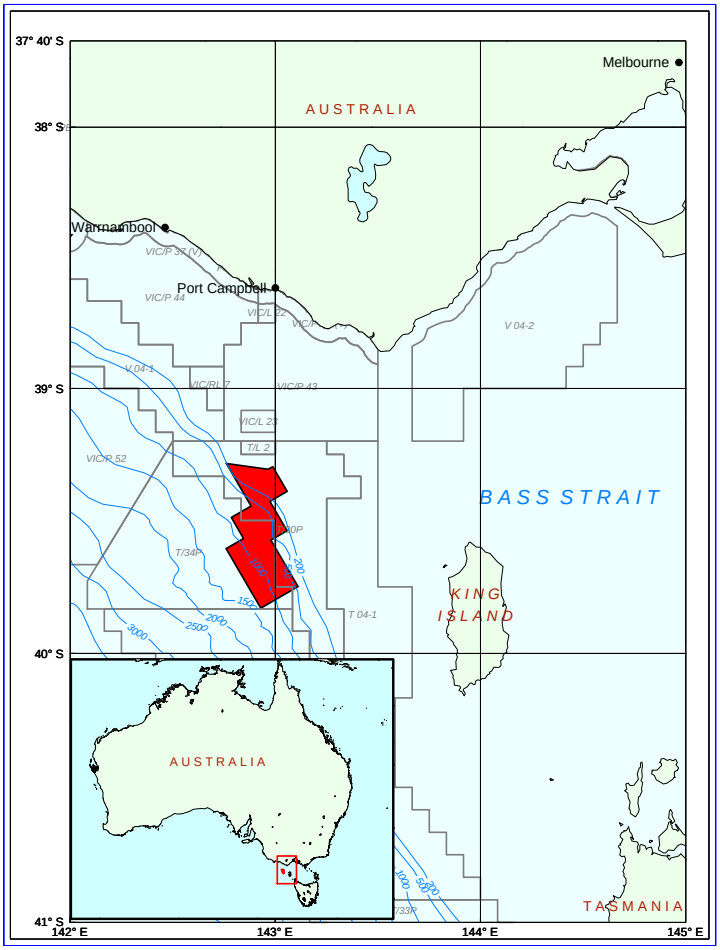
1 Introduction

1.1 Summary



Mobilisation took place during the transit from the Woodside Trim project in the Great Australian Bight to the Aragorn project in the Bass Strait in Victoria, Australia. This transit began on the 22nd March 2006, but part of the transit was put on the Trim survey. The Aragorn survey began on 25th March 2006. We were on the Aragorn prospect and began deployment of the streamers on 26th March 06.

During this transit, there was a crew change in Port Lincoln on 25th March. This also included a Woodside induction for the onsigning crew members and a PGS / Woodside kick off meeting to finalise the start up.

During the survey an extensive amount of bad weather was encountered. This added up to 52% of the survey time. This also resulted in the RAMFORM VICTORY crew having to retrieve and deploy the in water equipment 6 times. During these periods, the vessel was either in port or standing by behind King Island for safety.

Due to the bad weather, Woodside Energy Ltd changed the survey and shooting plan several times. They backed off the length of the lines in Area B from 63 km to 41 km. After completing the new Area B the weather window opened up (toward the end of the survey) and we went back and shot the rest of Area B except for 3 prime lines.

Area D was not shot and the survey was terminated after the completion of Area C on 30th May 2006.

All in water equipment was onboard at 21:00 on 30th May 2006 and demobilisation was completed that same day at 24:00.

1.2 Special techniques

No special techniques were used during this survey

1.3 Key parameters

Source	:	2 x 3090 in^3
Source depth	:	6 m
Streamers	:	10 x 4500 m
Streamer spacing	:	120 m
Streamer depth	:	9 m
Near trace offset	:	280 m

1.4 Systems

Source type	:	Bolt LLX 1900 Turbo guns
Streamer type	:	Reduced Diameter Hydrostreamer (RDH)
Recording system	:	PGS's gAS Recording w/Syntrak 960 Acquisition system
Navigation	:	SkyFix.XP / Multifix 4, StarFix.HP / StarFix Suite
Float positioning	:	Seatrack RGPS / StarFix Suite
Acoustic ranging	:	DigiRANGE

1.5 Production Statistics

efficiency	35.53%	
performance	97.39%	
infill % (prime ff / infill ff)	17.19%	
prime % complete	87.55%	
	total	**average**
prime traverse	1,768.05	26.39
prime run out traverse	94.5	1.41
infill traverse	303.92	4.54
infill run out traverse	18	0.27
u/shoot prime traverse	0	0
u/shoot infill traverse	0	0
total traverse	2,184.47	32.6
prime cdp km	35,361.00	527.78
prime run out cdp km	1,890.00	28.21
infill cdp km	6,078.38	90.72
infill run out cdp km	360	5.37
u/shoot prime cdp km	0	0
u/shoot infill cdp km	0	0
total CDP Km	43,689.38	652.08
prime sq km	1,060.83	15.83
prime run out sq km	56.7	0.85
infill sq km	182.35	2.72
infill run out sq km	10.8	0.16
u/shoot prime sq km	0	0
u/shoot infill sq km	0	0
total Sq Km	1,310.68	19.56

Note: the "prime % complete" is only at 87.55% as the survey was ended early due to weather and other commitments.

1.6 Operational Statistics

Activity	Total Hours	% of Total
Production		
Line Change	246.47	15.33%
Prime Production	227.87	14.17%
Line Change - Infill	45.38	2.82%
Infill	37.52	2.33%
Run Out (Prime)	11.95	0.74%
Run Out (Infill)	2.15	0.14%
Standby		
Weather	889.3	55.30%
Local Transit / Prospect Change	101	6.28%
Fishing	15.2	0.95%
Downtime		
Recording/QC Software	5.36	0.33%
Acoustics	5	0.31%
Active, Passive Modules	3.65	0.23%
Bolt Airgun Airleak	0.75	0.05%
Source Separation	0.22	0.01%
Software problems inc. Crash	0.18	0.01%
Streamer Interface Software	0.12	0.01%
General Demob	15.88	0.99%
Total Production	**571.34**	35.53%
Total Standby	**1,005.50**	62.53%
Total Downtime	**15.28**	0.95%
Total MOB/DEMOB	**15.88**	0.99%
Total Hours	**1,608.00**	
Total Days	**67d 0h 0m**	

During the survey there was a disagreement on standby time concerning crew change. The standby rate was cut in half to accommodate both parties during these times.

2 Sequence of Events

2.1 Daily Log

DATE	Location & Comments
25-Mar-06	Transit to survey area
26-Mar-06	Transit to survey area, commence streamer deployment
27-Mar-06	Deploying streamers
28-Mar-06	Deploying streamers
29-Mar-06	Deployment completed, commence production
30-Mar-06	Production, standby for weather recovering streamers
31-Mar-06	Standby for weather
01-Apr-06	Standby for weather
02-Apr-06	Standby for weather, deploying streamers
03-Apr-06	Deploying streamers, production
04-Apr-06	Production, standby for weather recovering streamers
05-Apr-06	Standby for weather, alongside at Portland
06-Apr-06	Standby for weather, alongside at Portland
07-Apr-06	Standby for weather, alongside at Portland
08-Apr-06	Standby for weather, heading back to the prospect
09-Apr-06	Standby for weather, redeploying the streamers
10-Apr-06	Standby for weather streamer deployemnt aborted weather window to small
11-Apr-06	Standby for weather, head to shelter by King Island & anchor
12-Apr-06	Standby for weather, at anchor by King Island
13-Apr-06	Standby for weather, at anchor by King Island
14-Apr-06	Standby for weather, at anchor by King Island
15-Apr-06	Standby for weather, heading back to the prospect
16-Apr-06	Standby for weather, redeploying the streamers
17-Apr-06	Standby for weather streamer deployment aborted & equipment recovered
18-Apr-06	Standby for weather, head to shelter by King Island & anchor
19-Apr-06	Standby for weather, sheltering behind King Island
20-Apr-06	Standby for weather, sheltering behind King Island. Looping streamers

21-Apr-06	Standing by for weather, heading to Geelong for Bunkers
22-Apr-06	Standing by for weather, alongside Geelong Bunkers cancelled
23-Apr-06	Standby for weather, depart Geeelong & head back to the prospect
24-Apr-06	Standby for weather, heading back to the prospect & start deploying
25-Apr-06	Complete deployment & commence production. Downtime for air leak
26-Apr-06	Production / infill
27-Apr-06	Production / infill
28-Apr-06	Production / infill
29-Apr-06	Production / infill. Suspend production for helicopter crew change
30-Apr-06	Helicopter crew change abandon, return to production
01-May-06	Production. Picked up gear for Cx and Wx.
02-May-06	Quayside in Melbourne at 8:40. Standing by for Wx. Completed Cx. Took on MGO and streamer sections.
03-May-06	Quayside in Melbourne. Standing by for Wx.
04-May-06	Departed Melbourne and arrived in Geelong. Took on HFO and Lube oil. Standing by for Wx.
05-May-06	Quayside in Geelong. Standing by for Wx.
06-May-06	Quayside in Geelong. Standing by for Wx.
07-May-06	Quayside in Geelong. Standing by for Wx.
08-May-06	Quayside in Geelong. Standing by for Wx.
09-May-06	Quayside in Geelong. Standing by for Wx.
10-May-06	Departed Geelong at 12:00 for prospect. Still on Wx downtime.
11-May-06	Deploying streamers after being down for Wx.
12-May-06	Wx downtime. Production.
13-May-06	Production.
14-May-06	Production.
15-May-06	Production.
16-May-06	Production.
17-May-06	Production.
18-May-06	Production.
19-May-06	Production.
20-May-06	Production.

21-May-06	Production.
22-May-06	Production.
23-May-06	Productiion
24-May-06	Production.
25-May-06	Production.
26-May-06	Production.
27-May-06	Production. Array 1 depth rope tangled.
28-May-06	Production. Fishing equipment.
29-May-06	Production.
30-May-06	Production. End Of Survey.

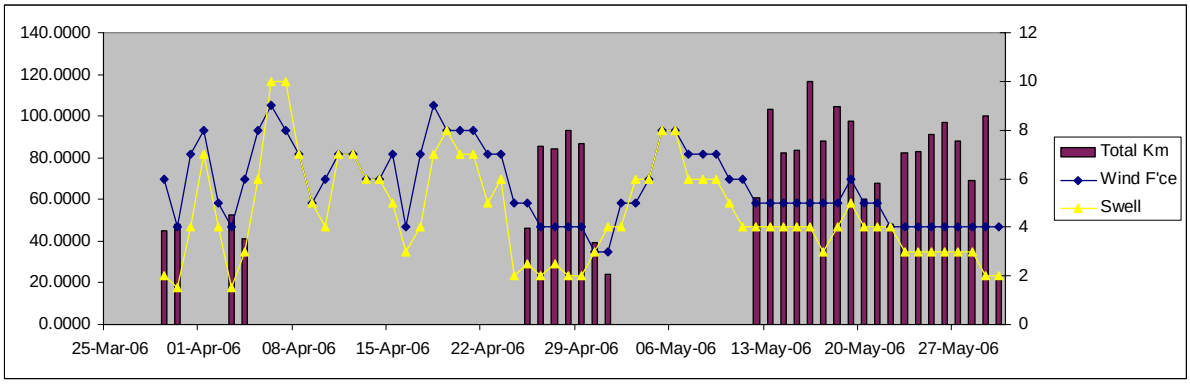
2.2 Daily production and sea state

DATE	Total Km	No Runout	Prime	Infill Km	F'ce	Swell
25-Mar-06						
26-Mar-06						
27-Mar-06						
28-Mar-06						
29-Mar-06	44.9813	42.7313	2.2500		6	2
30-Mar-06	48.3563	43.8563	4.5000		4	1.5
31-Mar-06					7	4
01-Apr-06					8	7
02-Apr-06					5	4
03-Apr-06	52.3687	50.1187	2.2500		4	1.5
04-Apr-06	41.0063	36.5063	4.5000		6	3
05-Apr-06					8	6
06-Apr-06					9	10
07-Apr-06					8	10
08-Apr-06					7	7
09-Apr-06					5	5
10-Apr-06					6	4
11-Apr-06					7	7
12-Apr-06					7	7
13-Apr-06					6	6
14-Apr-06					6	6
15-Apr-06					7	5
16-Apr-06					4	3
17-Apr-06					7	4
18-Apr-06					9	7
19-Apr-06					8	8
20-Apr-06					8	7

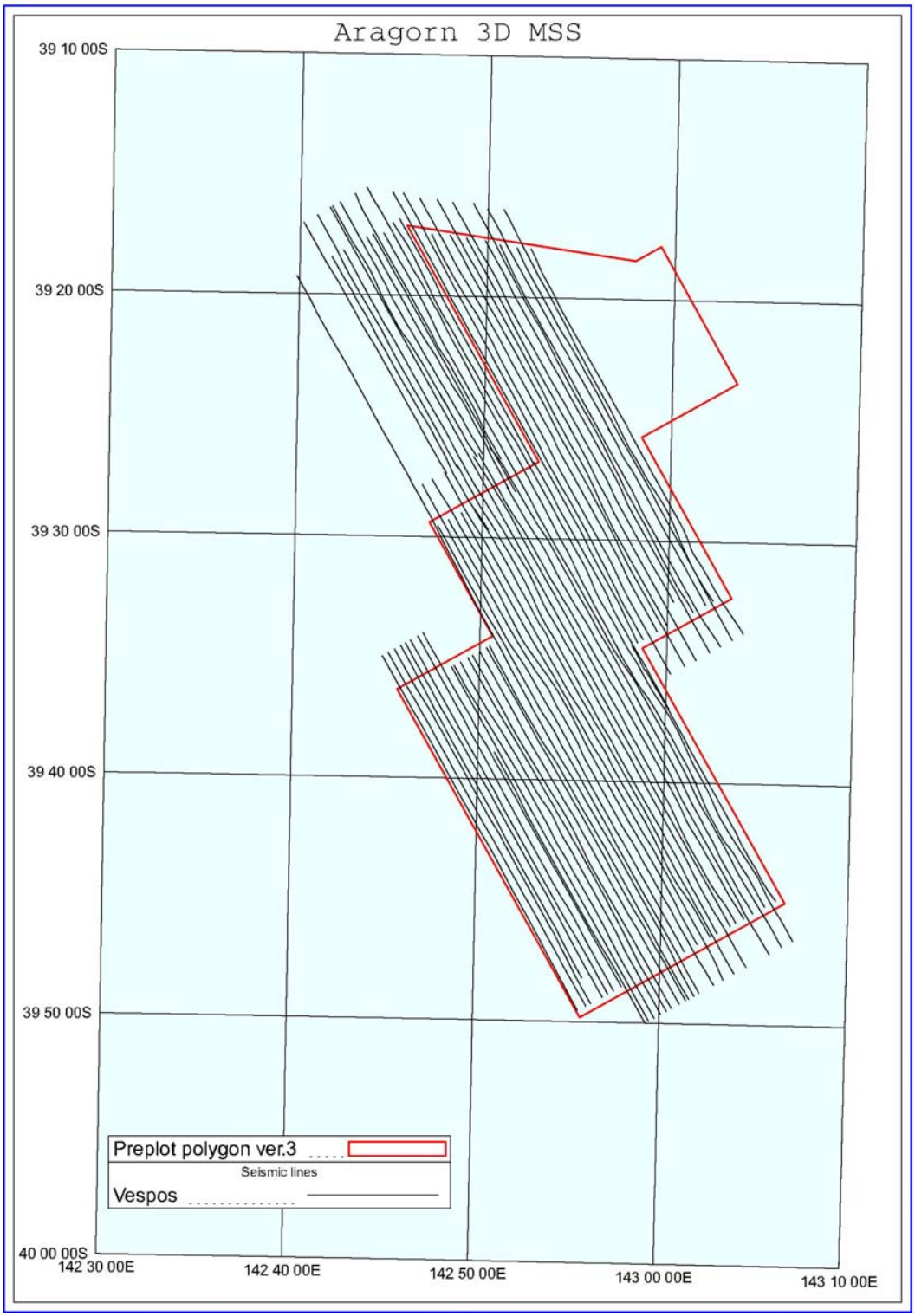
21-Apr-06					8	7
22-Apr-06					7	5
23-Apr-06					7	6
24-Apr-06					5	2
25-Apr-06	46.2750	44.0250	2.2500		5	2.5
26-Apr-06	85.6125	69.4315	6.7500	9.4310	4	2
27-Apr-06	83.9437	57.7499	4.5000	21.6938	4	2.5
28-Apr-06	93.3750	57.7500	4.5000	31.1250	4	2
29-Apr-06	86.9625	60.9000	2.2500	23.8125	4	2
30-Apr-06	39.3937	39.3937			3	3
01-May-06	23.7563	21.5063	2.2500		3	4
02-May-06						
03-May-06						
04-May-06						
05-May-06						
06-May-06						
07-May-06						
08-May-06					7	6
09-May-06					7	6
10-May-06					6	5
11-May-06					6	4
12-May-06	60.9562	58.7062	2.2500		5	4
13-May-06	103.5188	96.7688	6.7500		5	4
14-May-06	82.2375	38.8687	2.2500	41.1188	5	4
15-May-06	83.4937	78.9937	4.5000		5	4
16-May-06	116.2500	72.8812	2.2500	41.1188	5	4
17-May-06	88.0875	81.3375	6.7500		5	3
18-May-06	104.2687	99.7687	4.5000		5	4
19-May-06	97.8188	34.6688		63.1500	6	5
20-May-06	59.9812	59.9812			5	4

21-May-06	67.6688	67.6688			5	4
22-May-06	48.2813	25.6688		22.6125	4	4
23-May-06	82.3313	80.0813	2.2500		4	3
24-May-06	82.6875	80.4375	2.2500		4	3
25-May-06	91.1438	86.6438	4.5000		4	3
26-May-06	97.0688	90.3188	6.7500		4	3
27-May-06	88.1813	83.6813	4.5000		4	3
28-May-06	69.2813	64.7813	4.5000		4	3
29-May-06	99.9563	32.1000	2.2500	65.6063	4	2
30-May-06	21.4125	16.9125	2.2500	2.2500	4	2

Wind Force: Beufort Scale Swell: Meters



2.3 Post plotted vessel positions



3 Key personnel

	24th March to 02nd May 2006	02nd May to 03rd June 2006
Party Chief	Lea Farmer	John MacKay
Chief observer	Paal Halvorsen	Udo Bar
Chief navigator	Martin Link	Thorne Sutherland
Navigator Processor	Robert Millard	Richard Browne
Chief mechanic	Tore Garvik	Torgeir Krydsby
Chief geophysicist QC	Roger Elliff	Gijsbert Meesters
Chief geophysicist	Michael Illingworth	Ye Zai Bing
Client representative onboard	Paul Round	Paul Round
	Peter Chen	Benjamin Goodwin
MMO	Joshua Smith	Joshua Smith

4 HSE

4.1 Statistics

Exposure hours	Marine crew	30720
	Seismic crew	36000
	Third party crew	26376
	Total	**93096**
Workboat operations		28
Workboat exposure hours		85.33
Incident Reports		6
Near Misses		
Safety meetings		4
Audits		37
Tool box meeting		32
Drills		13
STOP cards		52

4.2 Incidents / Near Misses

Report no.	Date	Action by	Classification	Status	Comments
VIC0610	31-Mar-06	TSM / BSM	Near miss	Open	Focus no. 2350/06/MA – partial black out due to main engine shutdown. Under investigation
VIC0611	14-Apr-06	TSM / BSM	Equipment Failure	Closed	Focus no. 2743/06/MA – potential for an oil spill from hydraulic space drainage. This is now plugged and cannot go overboard. This is on the next yard list to be re-routed in mid-July.
VIC0612	17-Apr-06	PGS	Equipment damage	Closed	Focus no. 2966/06/MA – Rough weather damage & equipment failure on the Cassandra. Equipment fix.
VIC0613	24-Apr-06	TSM / BSM	Equipment failure	Closed	Focus no. 3242/06/MA – Failure of HFO / MGO change over valve causing diesel to be sprayed over exhaust boiler. This was modified with a plate so this could not happen.
VIC0614	30-Apr-06	PGS	Near Miss	Closed	Focus 3242/06/MA – Monitor fell during bad weather just missing Observer. Secured better.
VIC0615	11-May-06	TSM / BSM	Equipment failure	Closed	Focus 3770/06/MA - Failure of the new Westfalia Bilgemaster 3000 OWS valve after being cleaned. Valve was taken rebuilt. Close supervision during the operation of the valve when cleaning of the cell in the future.

During the survey the onboard client representative was given access to the PGS Focus Safety system so that he could monitor incident reports, near misses, STOP cards, etc.

5 Survey operations review

5.1 Survey area information

Oilfield installations

There is the MEARSK GUARDIAN Rig 9 km to the North of Area D. This did not affect our shooting as we did not shoot Area D.

Oilfield activity

A small amount of activity in the THYLACINE field to the MEARSK GUARDIAN, but as all vessels co-operated very well, we did not encounter any problems.

Shipping Activity

There was virtually no shipping activity within the vicinity of the prospect. A small quantity of coastal traffic was sighted, but here again, all vessels gave us their fully co-operation when we contacted them on the VHF radio.

Sea Conditions, Tides and Currents

The prevailing winds were from the south-west as was the swell, which averaged 2 to 9 metres during the early part of the survey.

Currents, either general or localised, did not have an affect on the survey operation; neither did the tides, which varied by approximate 1.4 m in the area.

In Sea Dangers

None present during the survey.

Time sharing

There was no other seismic activity within the area, and therefore time sharing was not required.

Fishing Activity

There were 2 lines that were terminated early due to fishing traps. These were Sequences 36 and 46. Most of the fishing boats that we encountered were very cooperative and moved out of the area.

Woodside did a very good job on communicating with the fishermen on the shoreside, which was the main reason for such good cooperation.

Weather

Bad weather periods were experienced from 30th March to 03rd April, 04th April to 25th April and 01st May to 12th May 2006. During these periods the vessel either went to port for safety or stood by behind King Island.

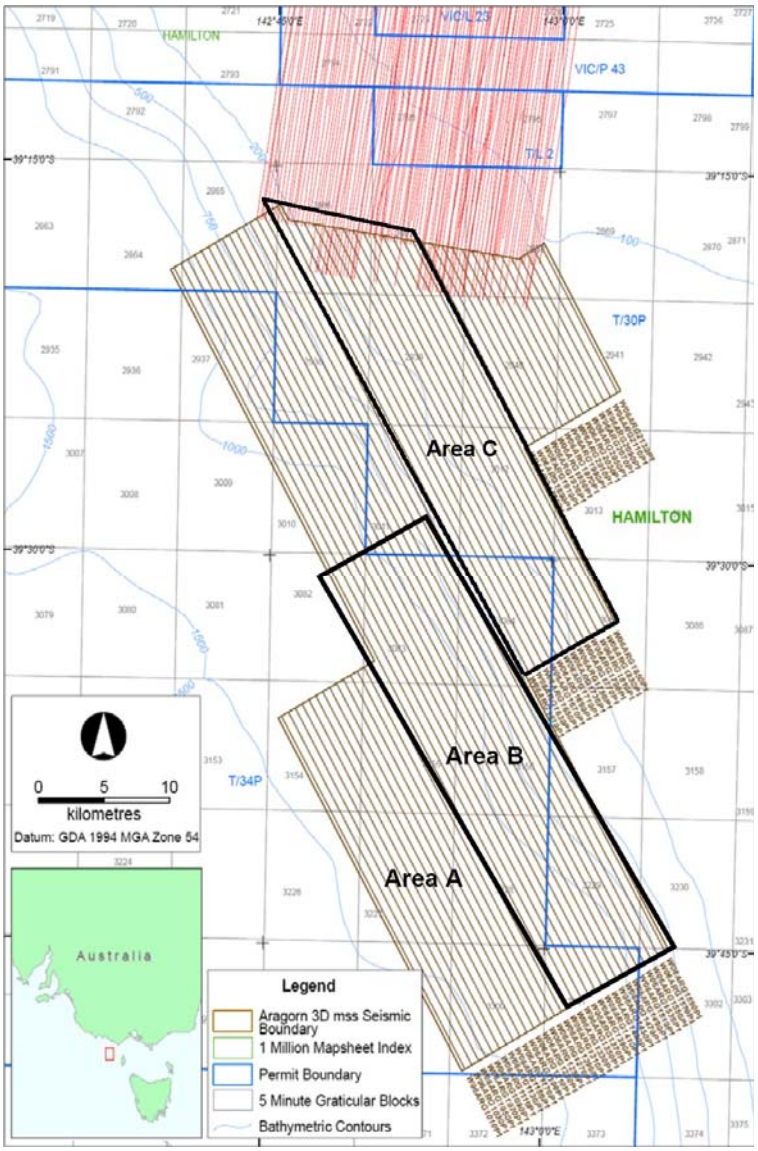
Cetaceans

There were zero cetaceans sighted during the survey. PGS / Woodside soft start procedure was enforced throughout the survey. An MMO rode the boat to help lookout for any whales.

Operational Planning

Due to the effect of the weather during the early stages of the survey, several changes were made to the area and to the method of acquisition. This was done to ensure continuous data across the greatest amount of area, as well as guarantee the target zone was covered during the available weather windows.

The major change to the area consisted of shortening the longest lines of the survey, shown as Area B in the diagram below. Woodside deemed that this was sufficient to cover the primary area of interest. Two sequences had been acquired in the normal 'race track' acquisition cycle prior to making this change, so it was decided to collect data between these two sequences in an alternating pattern, acquiring adjacent lines in opposite directions. Once the gap between the two original sail lines was closed, acquisition continued using the alternating method in the easterly direction.



As the vessel approached the completion of Area B, the weather forecast remained favourable, so Woodside then decided to re-implement the original line length for Area B sail lines 1390-1550 (the eastern half of Area B), acquiring them in the same direction as the southern segments.

Once these requirements in Area B were satisfied, the vessel continued, still using an alternating pattern, acquiring data in an easterly direction until the area consisting of sail lines 1610 – 1850 (Area C), was complete.

6 Seismic energy source

6.1 Source Performance

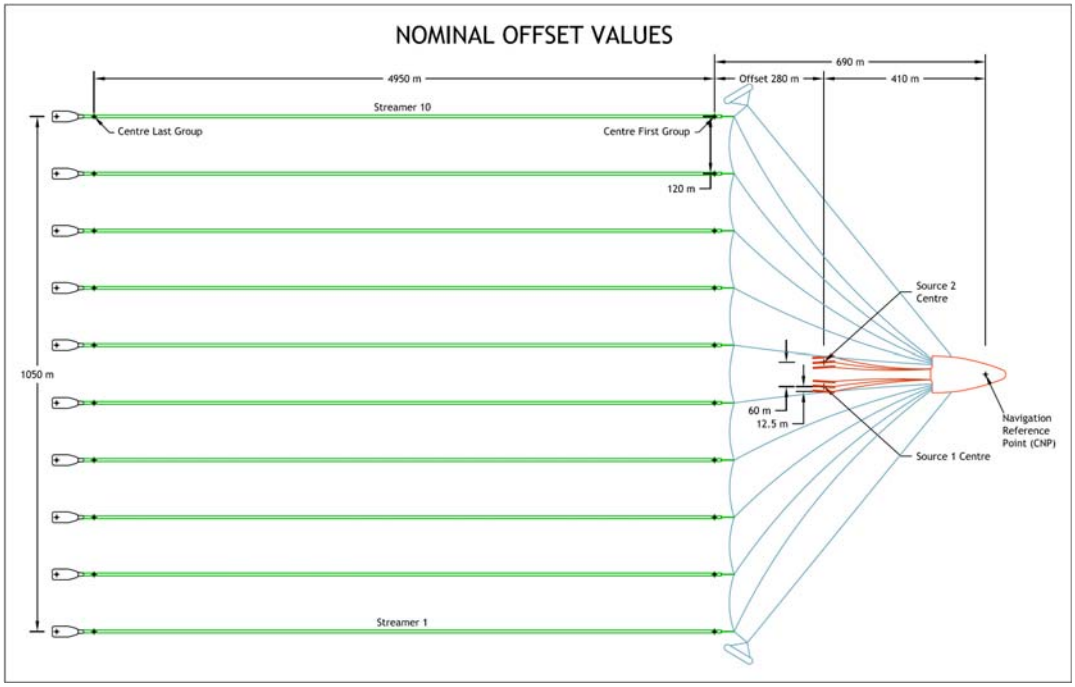
The source performed very well during the survey with only 0.97 hours of downtime during the project. There were two incidents that caused the downtime. One was for an airleak and the second was for towing and handling when the depth rope tangled up in the gun and the SOL was delayed.

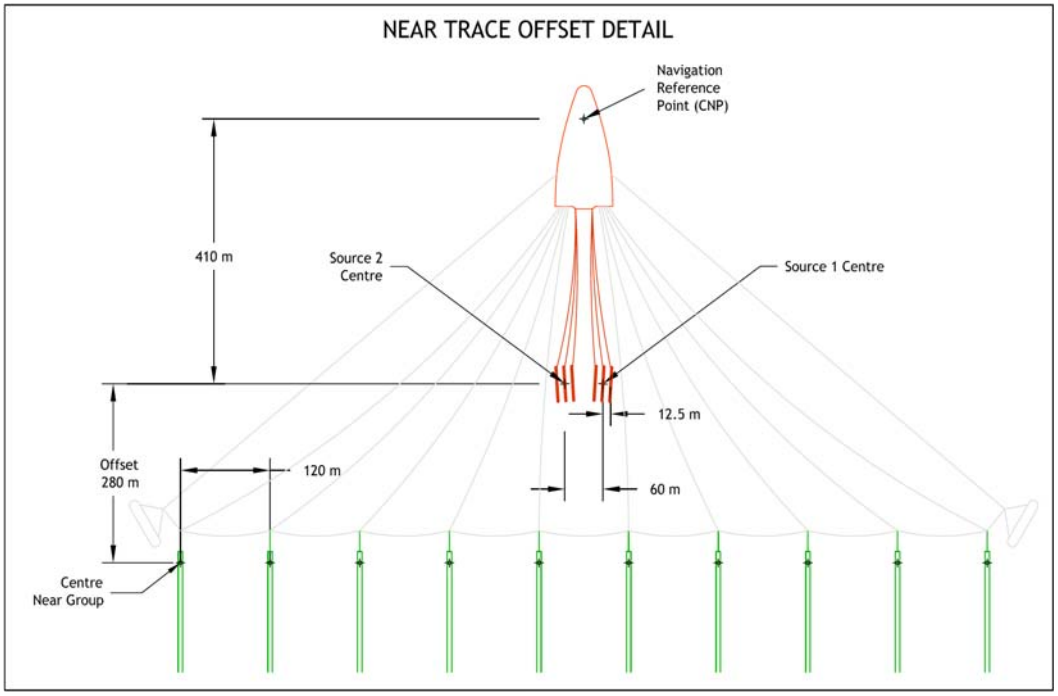
General maintenance was performed during line changes and did not cause any downtime.

6.2 Source details

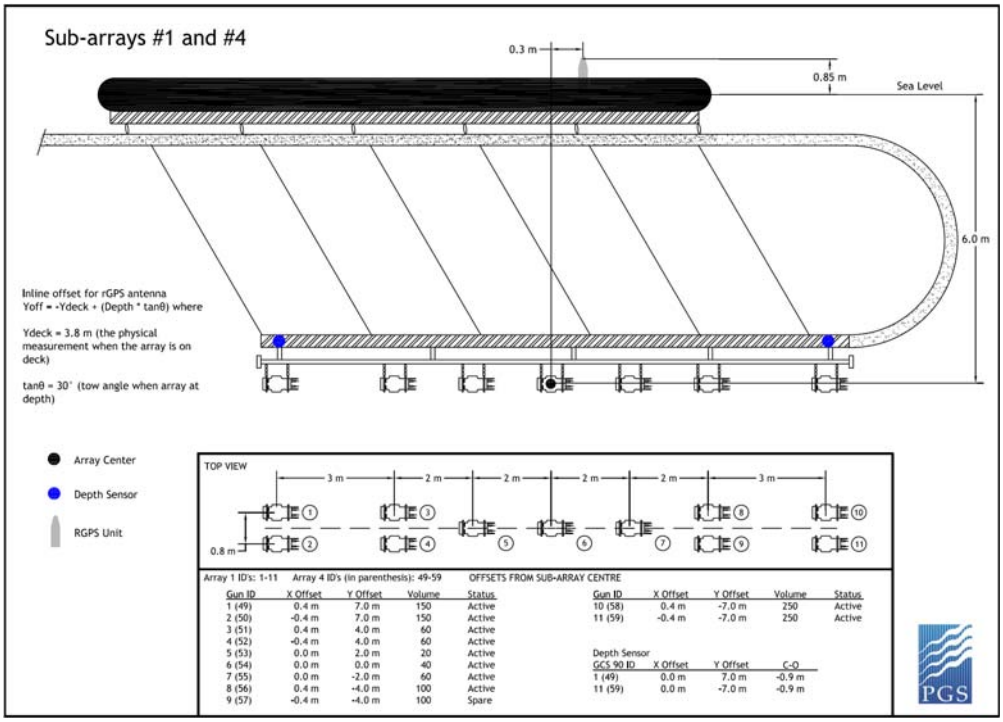
Source type	:	Bolt air guns
Air pressure	:	2000 psi
Volume	:	3090 in^3
Number of sources	:	2
Number of sub-arrays	:	3
Source separation	:	60 m
Sub-array separation	:	12 m
Source length	:	14 m
Gun synchronisation	:	± 1.0 ms
Shot interval	:	18.75 m Flip - Flop
Depth	:	6 m
Depth control	:	Fixed depth ropes
Depth monitoring	:	Syntron depth transducers, GCS-90
Spacing control	:	Spread-ropes on sliding collars
Near field signatures	:	7 phones per sub-array
Compressors	:	3 x LMF 47/138
Source controller	:	GCS-90
Modelled source signature	:	See Appendix 12.2 for further details

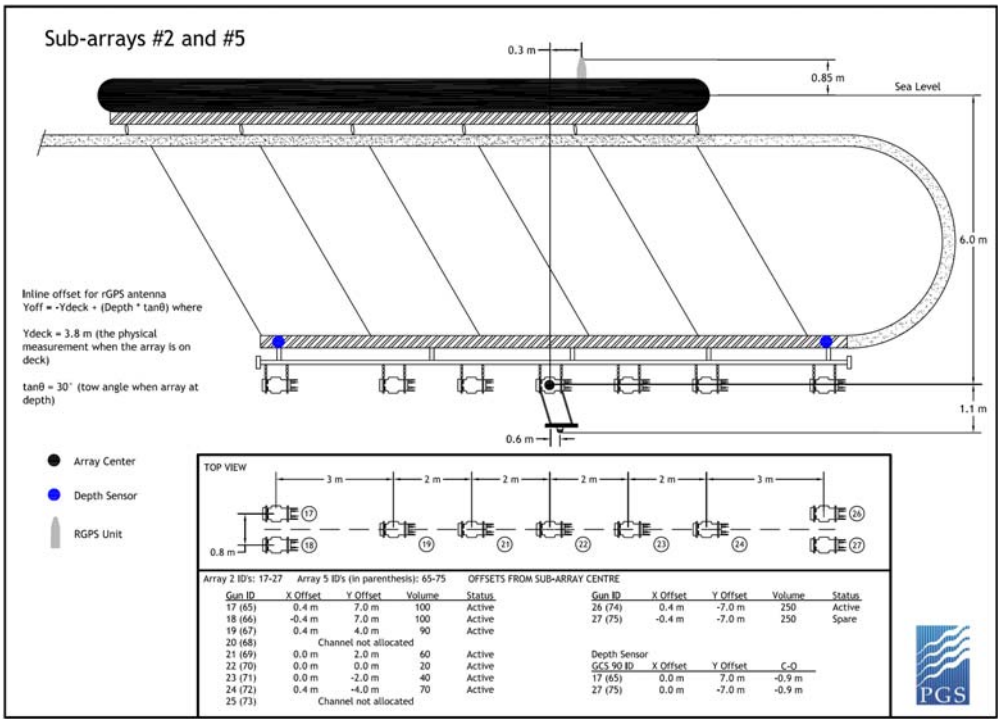
6.3 Offset diagrams

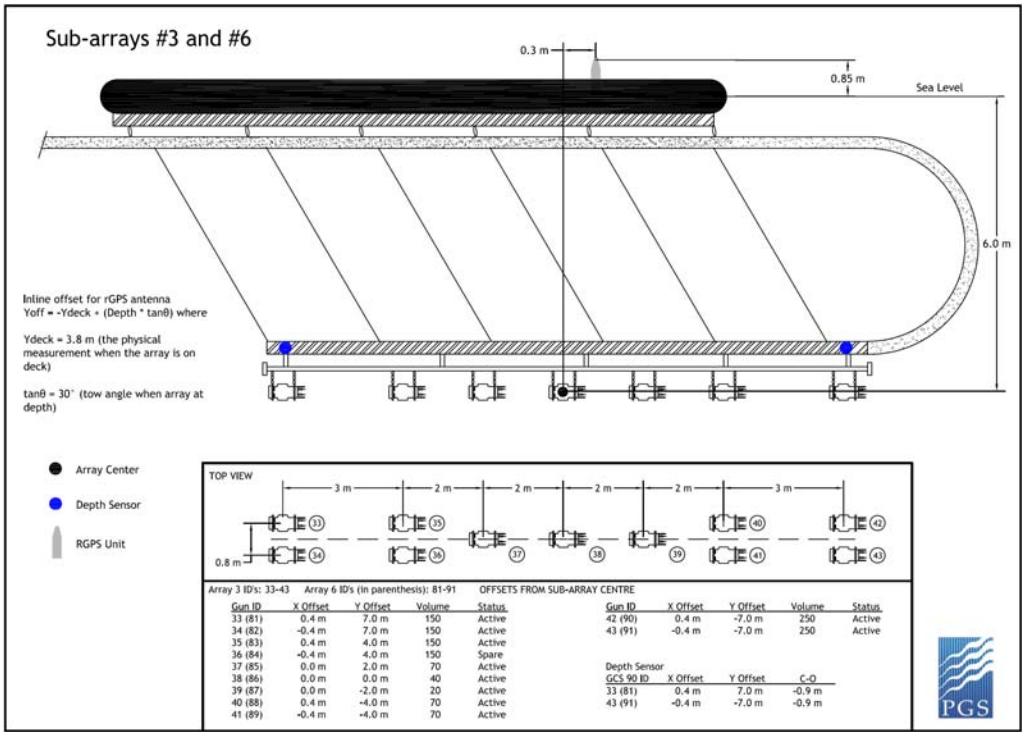




6.4 Gun array diagrams





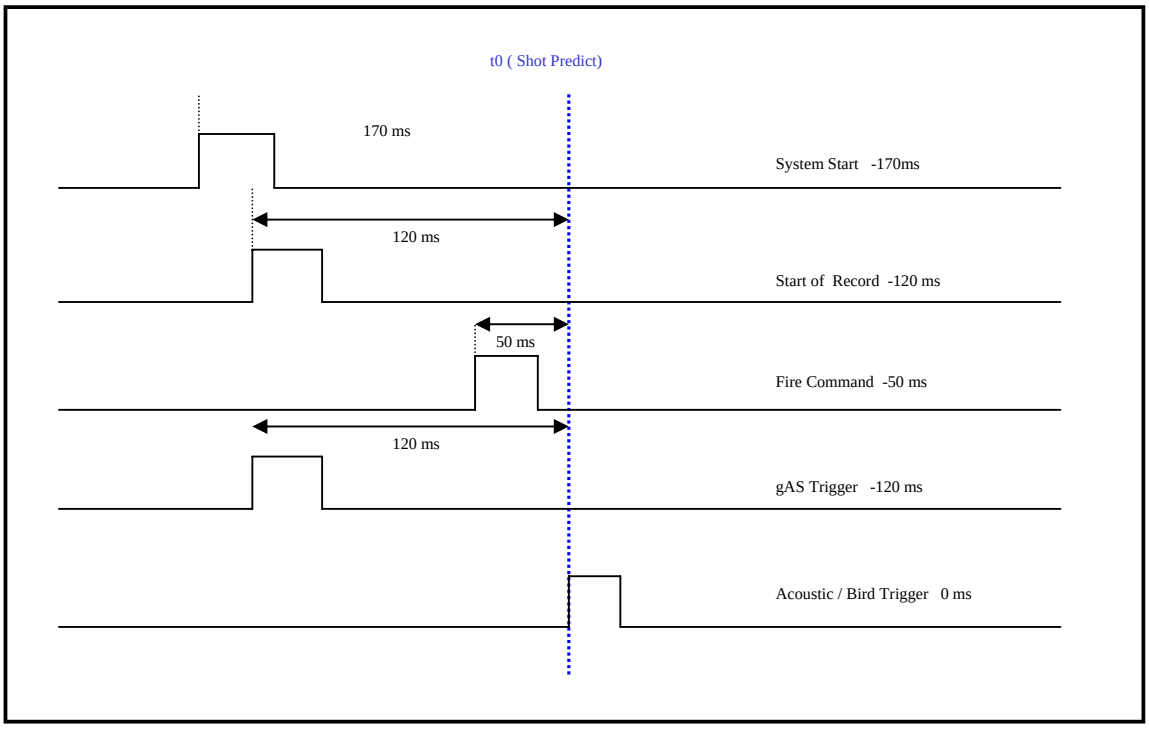

Sub-arrays #3 and #6
0.3 m
0.85 m
Sea Level
6.0 m
Inline offset for rGPS antenna
Yoff = -Ydeck + (Depth * tanθ) where
Ydeck = 3.8 m (the physical measurement when the array is on deck)
tanθ = 30° (tow angle when array at depth)
Array Center
Depth Sensor
RGPS Unit
TOP VIEW
3 m
2 m
2 m
2 m
2 m
3 m
0.8 m
33
34
35
36
37
38
39
40
41
42
43
Array 3 ID's: 33-43 Array 6 ID's (in parenthesis): 81-91 OFFSETS FROM SUB-ARRAY CENTRE
Gun ID X Offset Y Offset Volume Status
33 (81) 0.4 m 7.0 m 150 Active
34 (82) -0.4 m 7.0 m 150 Active
35 (83) 0.4 m 4.0 m 150 Active
36 (84) -0.4 m 4.0 m 150 Spare
37 (85) 0.0 m 2.0 m 70 Active
38 (86) 0.0 m 0.0 m 40 Active
39 (87) 0.0 m -2.0 m 20 Active
40 (88) 0.4 m -4.0 m 70 Active
41 (89) -0.4 m -4.0 m 70 Active
Gun ID X Offset Y Offset Volume Status
42 (90) 0.4 m -7.0 m 250 Active
43 (91) -0.4 m -7.0 m 250 Active
Depth Sensor
GCS 90 ID X Offset Y Offset C-O
33 (81) 0.4 m 7.0 m -0.9 m
43 (91) -0.4 m -7.0 m -0.9 m
PGS

7 Seismic acquisition system

7.1 System details

Recording System	:	gAS, with direct Ethernet link to Viper
Software Version	:	3.0.2-6
Amplitude resolution	:	24 bit
Data Channels	:	3600
Auxiliary Channels	:	48
Tape Transports	:	6 x IBM 3590 cartridge drives
Tape Format	:	SEG D, 8036
Recording Media	:	Imation, 3590
Record Length	:	9216ms
Deep water delay	:	0 ms
Sample Rate	:	2 ms
High Cut Filter	:	206 Hz / 276 dB/octave
Low Cut Filter	:	3 Hz / 12 dB/octave
Gain Setting	:	12 dB
Amplifier	:	Voltage Mode differential
Input Range	:	0-2048 mV
A/D Converter	:	Delta Sigma Architecture
Distortion	:	< 0.0005 % (-106 dB)
Cross-Feed Isolation	:	> 110 dB
Power Consumption	:	7.5 W per module
Polarity Convention	:	SEG, positive pressure gives negative number
SEG-D header description	:	see Appendix 12.3 for further details

7.2 System timing



7.3 Streamers

7.3.1 Streamer Performance

The Streamers had been pre-ballasted for this area prior to start of the survey. Some fine tuning was carried out during the beginning of the survey.

During the survey there was a down time of 3.65 hours for the streamers. This is broken down into active streamer module failures and telemetry failure.

The above problems were safely fixed from the workboat.

Other general maintenance and repairs of the in-water equipment was done during the line changes from the workboat. This did not cause any production downtime.

7.3.2 Streamer details

Type of streamer	:	PGS Reduced Diameter Hydro-streamer
Number of streamers	:	10
Streamer sensitivity	:	20 V/bar
Streamer length	:	4500 m
Number of groups	:	360
Group interval	:	12.5 m
Group length	:	12.5 m
Hydrophone type	:	T-2
Streamer depth control	:	Digibird 5011
Streamer depth	:	9 m
Number of compass-birds	:	See streamer layout Section 7.5

7.3.3 Trace Numbering

STREAMER	TRACE
Streamer 1	1 to 360
Streamer 2	361 to 720
Streamer 3	721 to 1080
Streamer 4	1081 to 1440
Streamer 5	1441 to 1800
Streamer 6	1801 to 2160
Streamer 7	2161 to 2520
Streamer 8	2521 to 2880
Streamer 9	2881 to 3240
Streamer 10	3241 to 3600
Auxiliaries	1 to 48

7.3.4 Component dimensions

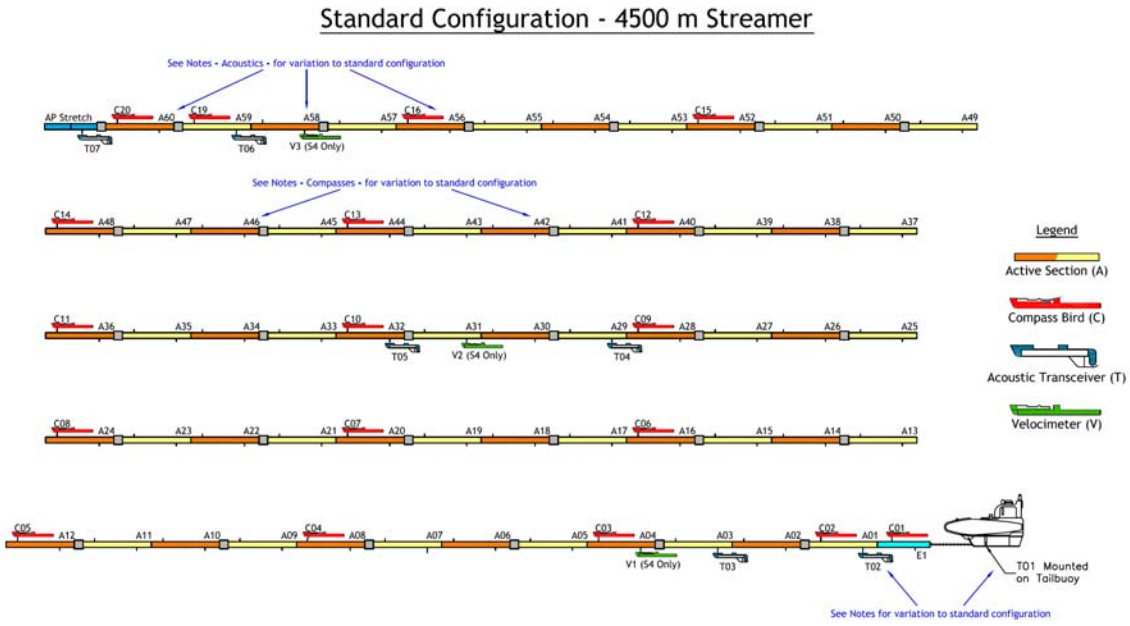
	No. per STREAMER (Streamers 1-2, 5-6 and 9-10)	No. per STREAMER (Streamers 3-4 and7-8)	NOMINAL LENGTH (m)
Lead-in	1	1	700 to 1100
Head Stretch Sections	1	1	3
Syntrak Module	24	24	0.358
RDH-S Live Sections	Active 57 to Active 66 (750 m)	Active 47 to Active 66 (1500 m)	74.54
RDH Live Sections	Active 01 to Active 56 (4200 m)	Active 01 to Active 46 (3450 m)	74.54
Tail Stretch Sections	1	1	50
Power Adapter Section	1	1	0.358

7.4 Recording System

7.4.1 Recording System performance

The gAS recording system and the Syntrak MSTP system perfomed well during the survey. There was a total of 5.66 hours downtime. This is broken down into 0.18 hours downtime for a gAS lock-up, 0.12 hours downtime for a Syntrak lock-up, and 5.37 hours downtime for the edit, which includes a line change to re-shoot the Syntrak lock-up.

7.5 Streamer layout



Notes - Variations From Standard Layout:
Compass and Depth Controllers
Streamers 1 and 10: Two extra birds added to assist depth keeping. Located on sections A42 and A46.
Acoustic Transceivers (also refer to Acoustic diagram)
Streamers 5 - 8: Front network comprised of three Acoustic transceivers:
Streamers 4 and 7 are as shown but have an extra unit mounted on section A57.
Streamers 5 and 6 units are mounted on sections A60, A58 and A56.
Tail bouys 2, 4, 7 and 9 have no acoustic unit mounted (T1), therefore numbering starts from 1st active section.

8 Navigation and Positioning

8.1 Navigation Performance

Overall data quality from the various navigation systems ranged between good to excellent. Data from the in-water sensors (compass headings and acoustic ranging) was degraded during periods of marginal weather, but was of sufficient quality that an adequate solution was provided for all sequences. Detailed discussions on each specific system may be found in the following sections.

The only downtime attributed to Navigation causes for this survey was one instance, in which one of tail buoys was improperly configured on deployment resulting in the loss of production of five hours to troubleshoot and rectify the problem.

8.2 Geodetic reference

8.2.1 Survey Datum

Survey datum	:	GDA94
Ellipsoid	:	GRS80
Semi Major Axis	:	6,378,137 m
1/Flattening	:	298.257222101 m
GPS Datum	:	WGS84
Ellipsoid	:	WGS84
Semi Major Axis	:	6,378,137 m
1/Flattening	:	298.257223563 m

Datum shift from WGS84 to GDA94

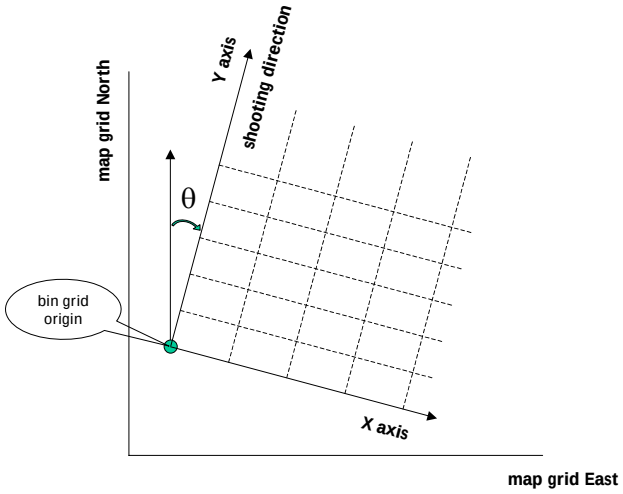
EPSG Transformation code	:	N/A*
X translation	:	-0.0046 m
Y translation	:	-0.0394 m
Z translation	:	-0.0687 m
X Rotation	:	-0.015486”
Y Rotation	:	-0.013723”
Z Rotation	:	-0.016079”
Scale (ppm)	:	0.004438
Geoid height (EGM96 model)	:	-5.5 m (for position 39º30’ S, 142º55’ E)

* These transformation values were supplied by Woodside prior to the start of the survey.

8.2.2 Map projection

Projection	:	Transverse Mercator
Projection System	:	MGA94 (UTM Zone 54)
Central Meridian	:	141º E
Scale Factor on Central Meridian	:	0.9996
Latitude of Origin	:	0º
False Northing	:	10,000,000 m
False Easting	:	500,000 m

8.2.3 Binning grid



Origin Easting (m)	:	665649.26869
Origin Northing (m)	:	5586138.9409
Rotation (deg)	:	331.003°

	X	Y
Origin bin number	967	841
Bin number increment	1	0.333…
Area size (m)	36,240.00	66,881.25
Bin interval (m)	30	6.25
Bin size minimum (m) at 0 m offset	30	6.25
Bin size maximum (m) at 4950 m offset	30	6.25

A Static bin flex was applied as follows (from near trace):

Segment	Offset Range	Max bin width
Near	0 – 1125	60 m
Near Mid	1125 – 2250	0 m
Far Mid	2250 – 3375	60 m
Far	3375 – 4500	90 m

8.3 Surface positioning

8.3.1 System I

Type	:	SkyFix.XP, Dual frequency DGPS
Differential Corrections via	:	Inmarsat IOR, OCSAT High Power
Reference stations	:	XP is a global orbit and clock correction solution; local reference stations are not used.
Software	:	Multifix 4, Version 1.09
Sub-Contractor	:	Fugro Survey

8.3.2 System II

Type	:	StarFix.HP, Dual Frequency phase based DGPS	
Differential Corrections via	:	Inmarsat POR, OCSAT High Power	
Reference stations	:	Melbourne	250 km distant
		Bathurst	900 km distant
		Cobar	925 km distant
		Ceduna	1175 km distant
		Brisbane	1625 km distant
Software	:	SPM2000, Version 4.15	
Sub-Contractor	:	Fugro Survey	

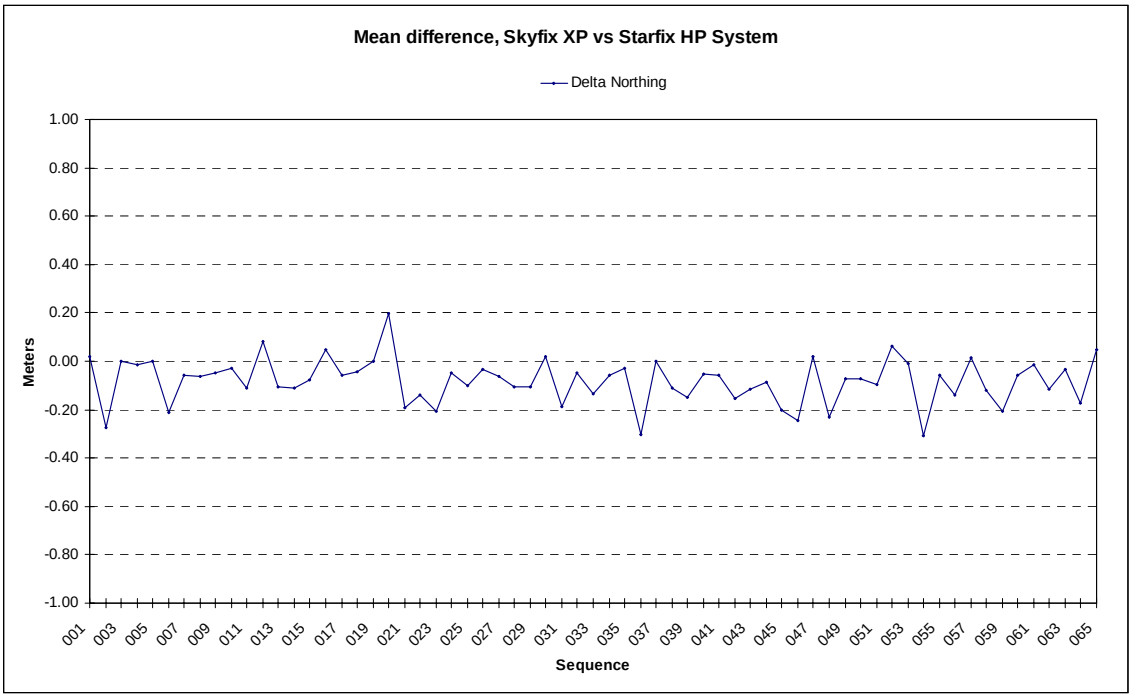
The StarFix.HP system was very problematic throughout the survey. It would suddenly reset the HP computation. After some correspondence with the contractor, Fugro, it was suggested to change the way in which the SPM2000 selects the source for the correction data. For the start of the survey, this was set to All Sources. This was changed so that the system used a dedicated correction source (the first port), and would only use the secondary if the connection was lost. It is Fugro's belief that there is a software problem when using the All Sources setting that is causing the HP position calculations to reset.

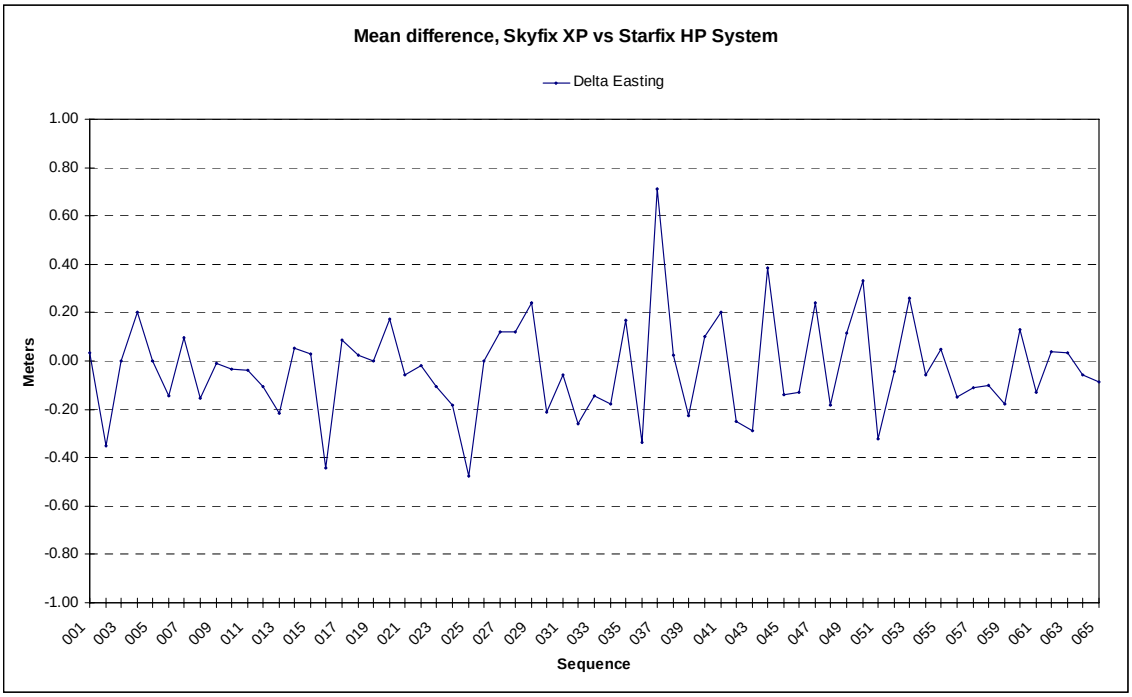
In post processing it was seen that StarFix.HP was unusable for the first 20 lines except for sequences 011, 014, & 015, but during these sequences there were data jumps requiring edits for a maximum of 550 shot points. From sequence 021 the HP system was stable and compared well enough with StarFix.XP to be used in the solution, however, for sequences 030, 032, 042 & 064 StarFix.HP required edits during these lines.

StarFix.XP performed well for all lines except sequence 037 were there were data spikes of no more than 20 shots required editing.

With the edits aside and poor data excepting, the two systems compared well throughout the survey as can be seen in the following comparisons. Comparisons between the systems, after processing, showed maximum mean differences in the order of 0.6 metre or less in Easting and Northing for all the sequences.

The following two graphs depict the mean differences in Northing and Easting respectively for complete sequences, between SkyFix.XP and StarFix.HP.





8.3.3 Float positioning

Relative GPS	:	Seatex 320/220
GPS receiver	:	Ashtech G 12-L
UHF communication	:	Wood & Douglas, frequency 450-470 MHz
Software version	:	StarFix Suite RGPS Vers.2.08.02

Data from the buoy-tracking system was very good, and only minimal gating and low-pass filtering were required to remove isolated spikes and noise. All 10 tail buoy units were operational for all sequences of the survey except for sequence 009 where TB1 required an 800 shot point edit and sequence 031 which required two edits of no more than 90 shot points. At no time were there less than 9 operational tail buoy units used in the solution.

For the source units, there were never less than five active gun units at any time. No down-time was attributed to the buoy-tracking system except as mentioned in section 7.1 during deployment.

8.3.4 Heading reference

GPS Heading / Attitude system	:	Seapath 200
Gyro	:	SG Brown Meridian Surveyor

Seapath was used as the default vessel-heading indicator, and the conventional SG Brown gyro served as a back-up. Seapath performed without interruption for all sequences except for sequence 030 where Seapath had a data loss for 52 shot points, in this instance the backup gyro was used in post processing. Seapath and gyro data were de-spiked but not filtered

8.3.5 Delivered P1/90 and P2/94

Raw navigation data were recorded in UKOOA P2/94 format during acquisition and written to 3590 tape and hard disk. At the conclusion of each sequence, the data format was checked and any necessary updates made to the header to produce a final, deliverable P2/94 file. Two sets of P2/94 data on 3590 tape were delivered to the client, and one additional set on 3590 tape was archived at PGS offices in Oslo, Norway. Also included in the delivery to the client was a DVD-ROM containing all the P2/94 files, individually compressed.

All final p294 data files were included with linefeed as per the client's request.

The following comments concerning the datum transformation were inserted into all P2/94 files after a request by the PGS office:-

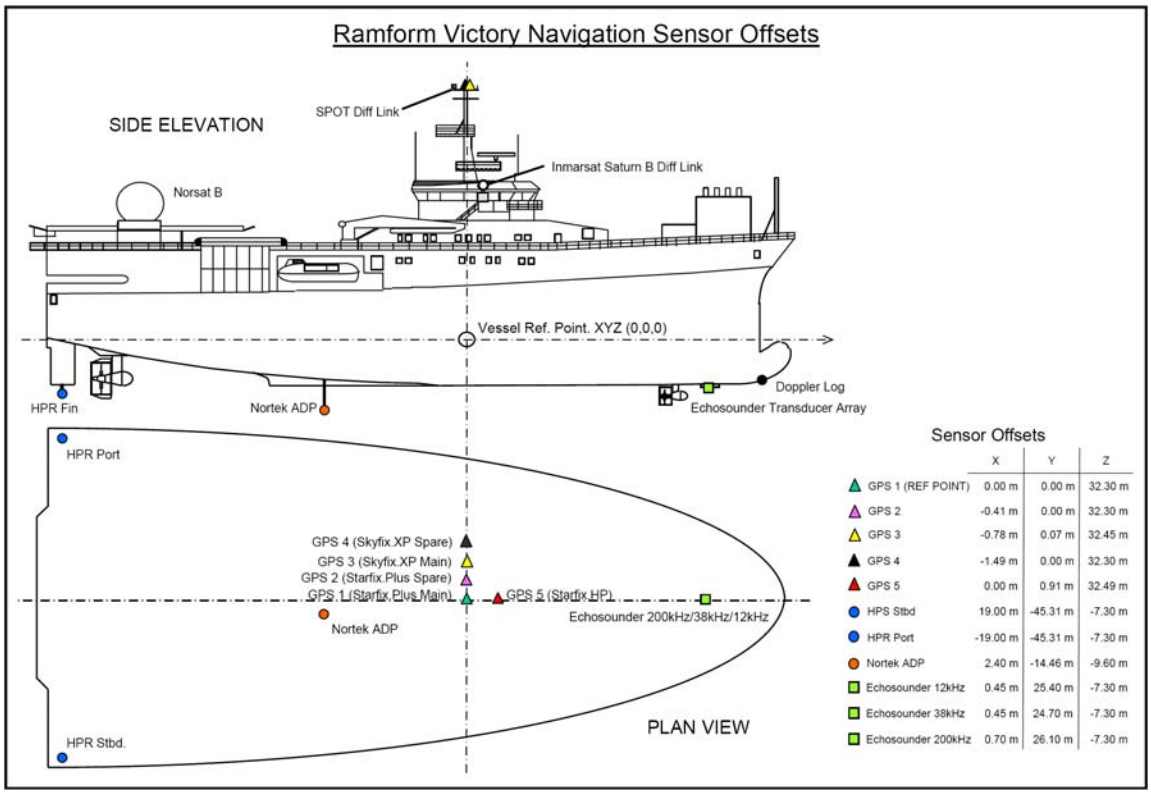
```
C0001 Due to format limitation in record H0120. Exact datum shift WGS84-GDA94:
C0001 dx= -0.0046, dy= -0.0394, dz= -0.0687, rx= -0.015486, ry= -0.013723,
C0001 rz= -0.016079, scale correction= 0.004438E-6
```

This same comment was also inserted into the P1/90 header as H2600 records.

Processed navigation data were provided in UKOOA P1/90 format. The P1/90 data were written to 3590 tape with individual sequence headers and included position records for vessel, sources, tail buoys, echo sounder, CMP positions, and all receiver groups. Two sets of P1/90 data on 3590 tape were delivered to the client, and one additional set on 3590 tape was archived at PGS offices in Oslo, Norway.

All final p190 data files were included with linefeed, the depth records in each file corrected for vessel draft, velocity of sound through the water column and tide corrected as per the client's request. Also included in the delivery to the client was a DVD-ROM containing all the P1/90 files, individually compressed.

8.3.6 Navigation Sensor Offsets

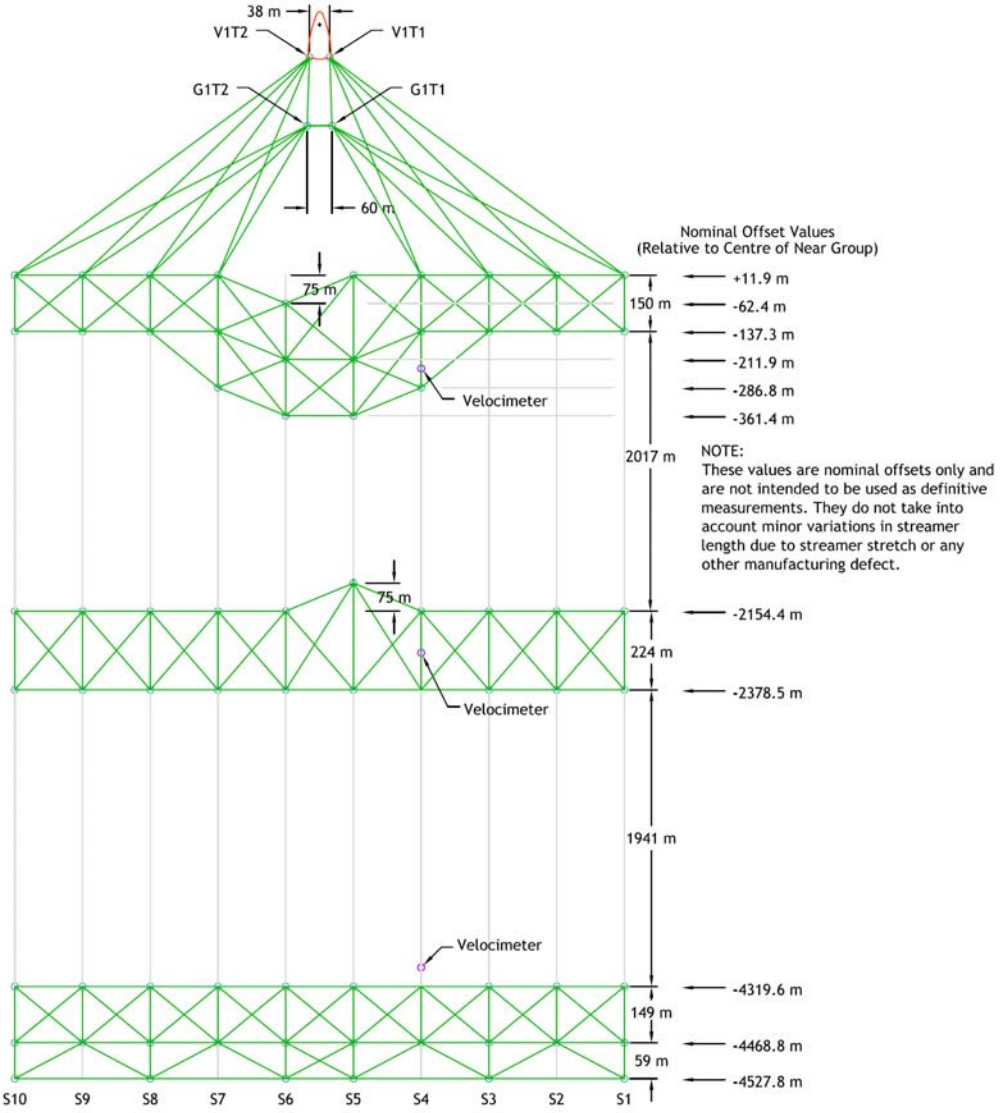


8.4 Underwater positioning

8.4.1 Acoustic ranging system

System name	:	DigiRange
Software version	:	System 3, Version 5.01
Frequency	:	50- 110 kHz

8.4.2 Acoustic network



It should be noted that two units on streamer 5 were deployed in non-standard locations; one was located in the mid-net and the other was at the head of the streamer. This did not degrade positioning quality so it was decided after discussions with the onboard client representative that these would not be relocated after the start of the survey.

Acoustic data was of good quality throughout the duration of the project. All ranges were set to two-way ranging. However, in areas where the acoustic environment is noisier or deteriorated, such as behind the vessel and gun arrays, one-way ranges were used in Sprint post-processing i.e., the vessel to streamer and gun to streamer observations, in preference to the two-way observations. Additionally, one-way ranges were used in instances where the two-way ranges were deteriorated on any given line, decided on a line by line basis.

During periods of marginal weather, ranging between the tail-buoys did not occur due to the equipment limitations, although one-way ranging to the streamers was present.

8.4.3 Magnetic compasses

Bird Compasses	:	Digicourse, 5011 Bird
Software version	:	System 3, version 5.01
Magnetic variation	:	2.57

Eighteen DigiCourse compasses were deployed on each of the inner eight streamers, with twenty placed on the two outer most streamers (to assist with depth keeping, not for additional redundancy in heading data).

The compass data was at best satisfactory and fairly free of noise at the streamer's target depth due to the continual & prevalent SW swell, for approximately 75% of the lines this required moderate processing with gating and low-pass filtering. For the remainder of the prospect weather conditions and sea state necessitated the use of strong processing and gating and filter values, during these lines, the *a priori* SD value for compasses was raised to a maximum of 1 degree in order to counteract these conditions. Compass data for all sequences were analysed for biases, stuck values and excessive noise. Unacceptable compasses were rejected from the post-processing solution and physically replaced when appropriate

8.4.4 Echosounder

Type and model	:	SIMRAD EA500
Transceiver frequency	:	12 kHz/ 38kHz / 200kHz
Heave compensated	:	Yes, MRU5

The water depth data was de-spiked, but not filtered.

No tide corrections were applied in Sprint and the depth as measured from the echo sounder was written to the raw P1/90. The propagation velocity used in the echo sounder was 1500 m/s. As mentioned above in section 8.3.4., velocity, tidal and draft corrections were applied to the final P1/90 before delivery to the client.

Data for the 12 kHz and 38 kHz transducers were recorded throughout the survey, and from Sequence 059 recording of the 200 kHz began. Final P1/90 depths were derived from the 38 kHz transducer, which performed generally well throughout the majority of the survey, up until Sequence 059 where it was deemed necessary to use the 200 kHz transducer for derived depths.

However on Sequence 03, the bow thruster was left on at the start of line and therefore no depth data for first 180 shot points was present. Client requests for data in this section necessitated the merging of the depths derived from the seismic data. Loss of depth data also happened for Sequence 036 when the bow thruster had to be used online due to marginal weather, this created three gaps no larger than 130 shot points where echo sounder data was absent, again this was rectified by having the seismic depth derived data merged into the final p190.

Depth ranged from approximately 100 meters - 1970 meters

After the survey was completed, one special P1/90 tape **W06ARGE011** containing echo sounder positions and water depths was created.

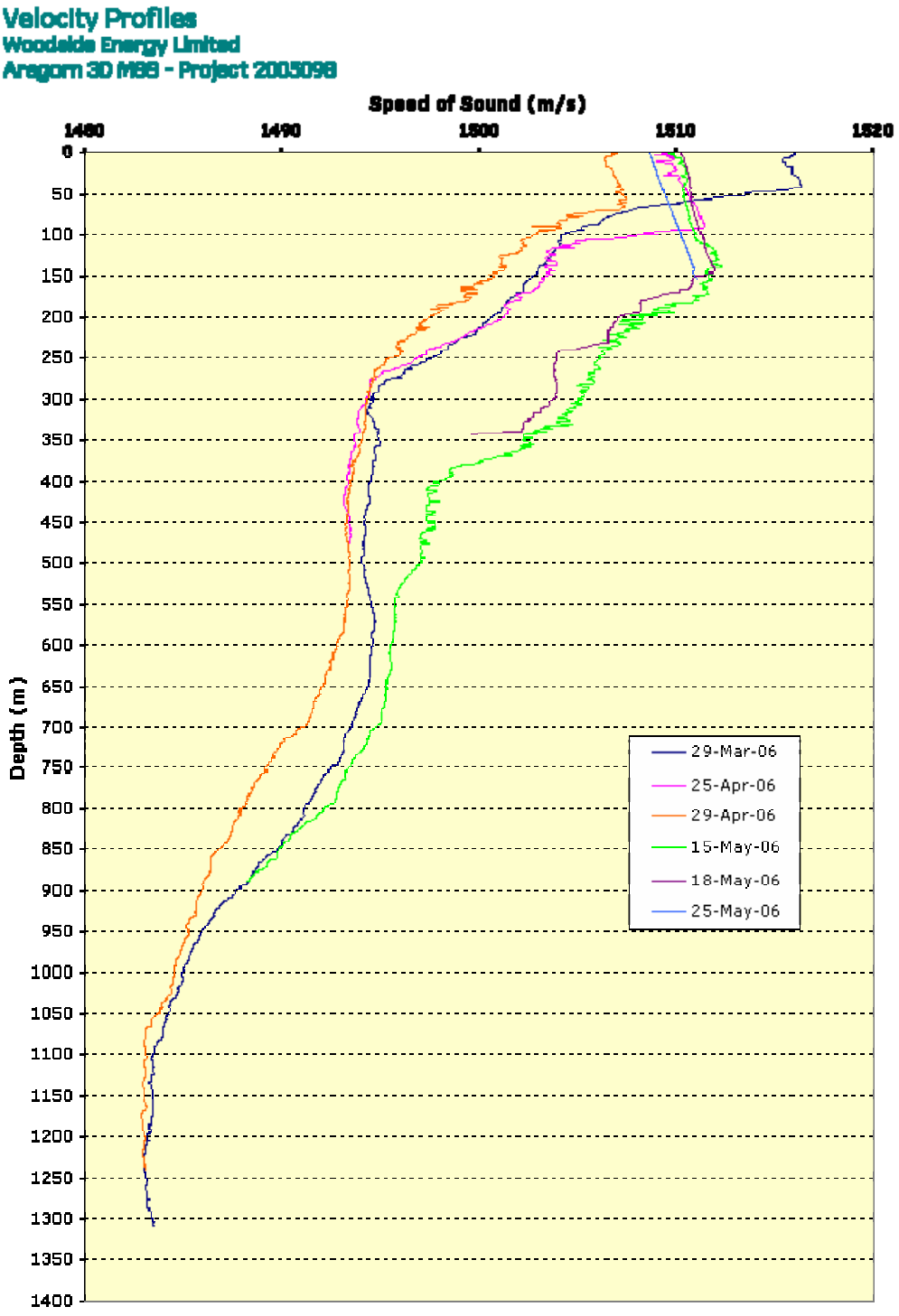
Below is shown an extraction from the P1/90 tape **W06ARGE011.** This shows what the water depth data has been corrected for.

```
H2600 THE ECHO SOUNDER DEPTH DATA HAS BEEN CORRECTED FOR PITCH. ROLL AND HEAVE
H2600 IN THE ECHO SOUNDER PRIOR TO BEING PASSED TO SPECTRA.
H2600
H2600 THE WATER DEPTH DATA HAS BEEN DESPIKED.
H2600
H2600 THE WATER DEPTHS HAVE BEEN CORRECTED FOR DRAFT (7.3 METERS),
H2600 SOUND VELOCITY AND TIDAL CHANGES.
H2600
H2600 THE SOUND VELOCITY SET IN THE ECHO SOUNDER WAS 1500 M/S.
H2600
H2600 SOUND VELOCITY PROFILES USED TO CORRECT THE DEPTHS FOR VELOCITY CHANGE
H2600 IN THE WATER COLUMN.
H2600
H2600 PROFILE:                    DATE:                POSITION:
H2600    1                     29.03.06          39 44 16S  142 55 13E
H2600    2                     25.04.06          39 49 46S  142 02 23E
H2600    3                     29.04.06          39 47 17S  142 57 00E
H2600    4                     15.05.06          39 36 24S  142 53 18E
H2600    5                     18.05.06          39 29 54S  142 55 00E
H2600    6                     25.05.06          39 24 03S  142 53 29E
H2600
H2600
H2600 TIDAL CORRECTIONS WAS APPLIED USING TIDAL DATA SUPPLIED BY THE CLIENT.
H2600 THE DATA WAS BASED ON TIDES AT THE LOCATION 39 30 S  142 55 E.
H2600
H2600 VERTICAL DATUM: MSL
```

8.4.5 Sound velocity

CDT probe	:	Valeport 604-CTD
Real time sensors	:	3 x Digicourse Velocimeter - 7000

The chart on the following page was produced with data from the Valeport. A total of six profiles were collected during the survey.


Velocity Profiles
Woodside Energy Limited
Aragorn 3D MSS - Project 2005098
Speed of Sound (m/s)
1480
1490
1500
1510
1520
Depth (m)
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
800
850
900
950
1000
1050
1100
1150
1200
1250
1300
1350
1400
29-Mar-06
25-Apr-06
29-Apr-06
15-May-06
18-May-06
25-May-06

Three real time sensors were used to provide dynamic sound velocities for all acoustic range calculations, both in real-time and for network adjustment in post processing. These were located on streamer 4; one at the front, one in the mid-net and one near the tail (see acoustic network diagram). Range data from each of the acoustic units was then associated with the closest probe.

8.5 Navigation and binning systems

8.5.1 Integrated navigation system

Type	:	SPECTRA
Supplier	:	Concept Systems Ltd.
Software version	:	10.09.01
Real Time Interface	:	PowerRTNU v
Machine type	:	Server IBM x235
X-terminals	:	IBM Netstation
Tape storage	:	DAT Tapes
External disks	:	Raid 5 System

8.5.2 Binning system

Type	:	CENSUS
Supplier	:	I/O Inc
Software Version	:	4.4.1
Machine type	:	IBM RS/6000 H50
Tape storage	:	IBM 3950
External disks	:	RAID5 SSA Serial Storage Architecture, 76GB.

9 Navigation processing

9.1 Introduction

Data were processed using SPRINT. The processing was comprised of the following steps:

- Data import
- Data pre-processing
- Network adjustments
- Data export
- Final quality control

Each of these steps is covered in more detail below.

9.2 Data import

Raw data were recorded to tape and disk in P2/94 format. After the end of the line these data were checked, and if necessary, corrections were made to the header to produce a final archived version.

These data were then imported into Sprint, and a QC report generated. Included in this report were:

- P2/94 format errors or inconsistencies
- differences in configuration between successive files
- changes in gun sequence
- time between shots not within specified limit
- jump in shot numbers
- number of headers

9.3 Pre-processing

All data were pre-processed to ensure consistent results in the adjustment phase.

During pre-processing, observations were grouped by sensor type. Predefined spike rejection gates and noise suppression filters were applied to the raw data. Configuration files were used to save all gating and filter values. After analysis, the final values were applied in a batch mode.

Where circumstances dictated, the values were changed interactively before the data were batched.

After pre-processing of all the observations, a quality report was generated containing the following information:

Nobs	:	Number of raw observations.
Nrej	:	Number of data observations missing after processing.
Bad block	:	Maximum block of missing raw data (in seconds).
Nominal	:	Nominal values computed from the logged offsets, or user assigned.
Mean	:	Mean value of the observation.
Max. Delta	:	The maximum shot to shot increment.
Units	:	In which unit data is recorded.

9.4 Network adjustments

The network adjustment stage consisted of a least squares adjustment of the processed observations for each shot point. The software allows the observations to be treated as either a complete net, or a series of sub nets (e.g.: vessel antenna, front net, tail net, etc.). Sub nets were used for analysis of problem lines. A complete net was used for final adjustment after the individual sub nets were solved.

The streamer-shaping algorithm in use was an arc of curve fit through the pre-processed compasses. The streamer shape is adjusted through network computed node positions.

At the end of the net adjustment, a quality report was generated. Items included were:

- Network configuration
- Statistics on node covariance's
- All observations scale/correction/SD in use
- Statistics on node shot point intervals
- Statistics on observation residuals
- Statistics on network variance factor and degrees of freedom
- The error ellipse (semi-major axis/skew) of all defined nodes
- Streamer rotation

9.5 Data analysis

Data analysis were performed for all lines and allowed all data from the Ingres database to be displayed. There were two main uses for this facility. The first was to produce a standard set of QC plots for each line, and the second was to act as an investigation tool for problems seen at any stage of processing.

Configuration files were defined to create a standard set of QC plots for every line.

Configuration files were defined to create a standard set of QC plots for every line.

The following plots were included:

- Inline streamer misclosures.
- Streamer rotations.
- Streamer feather angles.
- Streamer separations.
- Source and source sub-array separations.
- Offsets for vessel to sources and sources to near hydrophone groups.
- Shot point intervals (distance and time) of vessel position.
- Gyro and course-made-good of vessel.
- Vessel position comparison (Field position vs. Post-processed position).
- Network variance factor and degrees of freedom.
- Speed of sound in water.
- Water depth.

9.6 Data export, P1/90 output

During the export process the receiver positions were computed and a P1/90-file was generated. The in-line misclosures error was accounted for by applying a linear distribution of the error to computed receiver positions. A header was added to the data during export.

The data were written to 3590 tape cartridges.

9.7 Data quality control procedures

The first line was sent to the office for QC. Both the P1 and P2 headers were checked. The line was processed and the solution was compared with the P190 file from the vessel. This procedure was repeated after each crew change to make sure there were no errors introduced.

The final P2/94 tapes were checked using PGS internal software **p2list**. This program checked and returned the following information:

- Which files were on a tape and if each file had a complete header.
- Number of end-of-file markers and if the last record had an EOF mark.
- The filename, the sequence, the media label identifier (H0003), the number of shots, the number of shot inconsistencies (missing or double shots) and the number of records.
- A checksum, which were used to verify that data on tape were identical to data on disk.
- For every file the first and last E1000 record was printed.
- If there were shot inconsistencies, the E1000 records surrounding the inconsistency were printed.

Final quality control performed on the data included a number of streamer comparisons, both inline and streamer-to-streamer.

- Vessel, source and receiver positions were checked for internal consistency.
- The applied streamer rotations and the inline misclosures were checked.
- Latitude/longitude and grid coordinates were checked against the datum/projection defined in the header.

The final P1/90 files were also checked using a Sprint QC tool, which checked:

- Contents of the first and last vessel record.
- Source id of the first and last source record.
- Number of even and odd shot points with different source id.
- Number of header records found.
- Number of vessel, source, tail buoy and receiver records expected and how many were found.
- Number of new line characters found.

The final P1/90 files were checked using a PGS internal software **p1check**. This program checked and returned the following information:

- Tape name and date of issue.
- Datum/projection information from the header.
- For every line in the file: start/end shot and start/end co-ordinates.
- Standard comment record (H2600) concerning lines and shots in the file.
- Linefeeds in the file.
- All records 80 bytes long.
- Number of end-of-file markers and if the last record had an EOF mark.
- Grid co-ordinates correspond to the latitude and longitude with the given datum and projection.
- A checksum, which were used to verify that data on tape were identical to data on disk.

The final P1/90 tapes were checked using PGS internal software **p1list**. This program checked and returned the following information:

- Which files were on a tape and if each file had a complete header.
- Number of end-of-file markers and if the last record had an EOF mark.
- The filename, the tape version identifier (H0202) and the number of records.
- A checksum, which were used to verify that data on tape were identical to data on disk.
- For every line in the file the line name, FSP, LSP and the position of SOL and EOL was given.

Results of the P2list, P1list and p1plot were saved and copies are archived in the Oslo office.

All tape labels were created using PGS internal software **mklab**. All information on the labels was extracted from the files on the tapes.

9.8 Computer systems

Computer	:	Dell Poweredge 2850
Operating System	:	Redhat Enterprise Linux 3 WS
Tape storage	:	2x IBM Magstar 3590 B1A
External disks	:	RAID 10, 219 GByte
Type	:	SPRINT
Software version	:	4.3.3
Supplier	:	Concept Systems Ltd.
Printer / Plotter	:	HP laserJet 5M / DesignJet 755CM

10 Seismic data quality

In the following sub chapters, 11.1 to 11.4, several different kinds of (external) noise that were encountered are described and their consequent effect on the seismic data quality discussed. In sub chapters 11.5 to 11.8, we describe how and with what methods the seismic data were QC'd to ensure the quality of the final product.

10.1 Seismic interference

Seismic interference was not a problem during the acquisition of this survey. Sometimes, however, a single shot showed SI from unknown origin. For shots where this occurred, a warning or edit was put in the Observer's log, depending on the amplitude of the SI.

10.2 Swell noise

During the acquisition of this survey (March-May 2006) swell noise was experienced during several lines. This swell noise was generally coming from low pressure systems at the SW of the survey area. Because the lines were orientated from North West to South East, and the swell was coming from the SW, the swell caused relatively less noise in the data.

To attenuate the swell noise, SINK (Seismic Interference Noise Killer) was applied to the data.

Where used, the SINK program parameterisation for QC testing was similar to that being employed by PGS Data Processing who was processing the data onboard.

See sub chapter 11.8 for the effect of swell noise on the Brute Stack. Also can be seen the stack after applying SINK to the data.

10.3 Ship noise

Ship noise from passing vessels was not a problem during the acquisition of these data.

10.4 Bad channels

Noisy traces: Some traces became noisy due to different causes, like damaged streamer compartments, debris caught on streamer, etc. If the noise of a trace became above acceptable levels, the trace was edited.

Spiking traces: Some traces went spiking due to various causes such as seawater in the cable. As a result, the affected channels were edited.

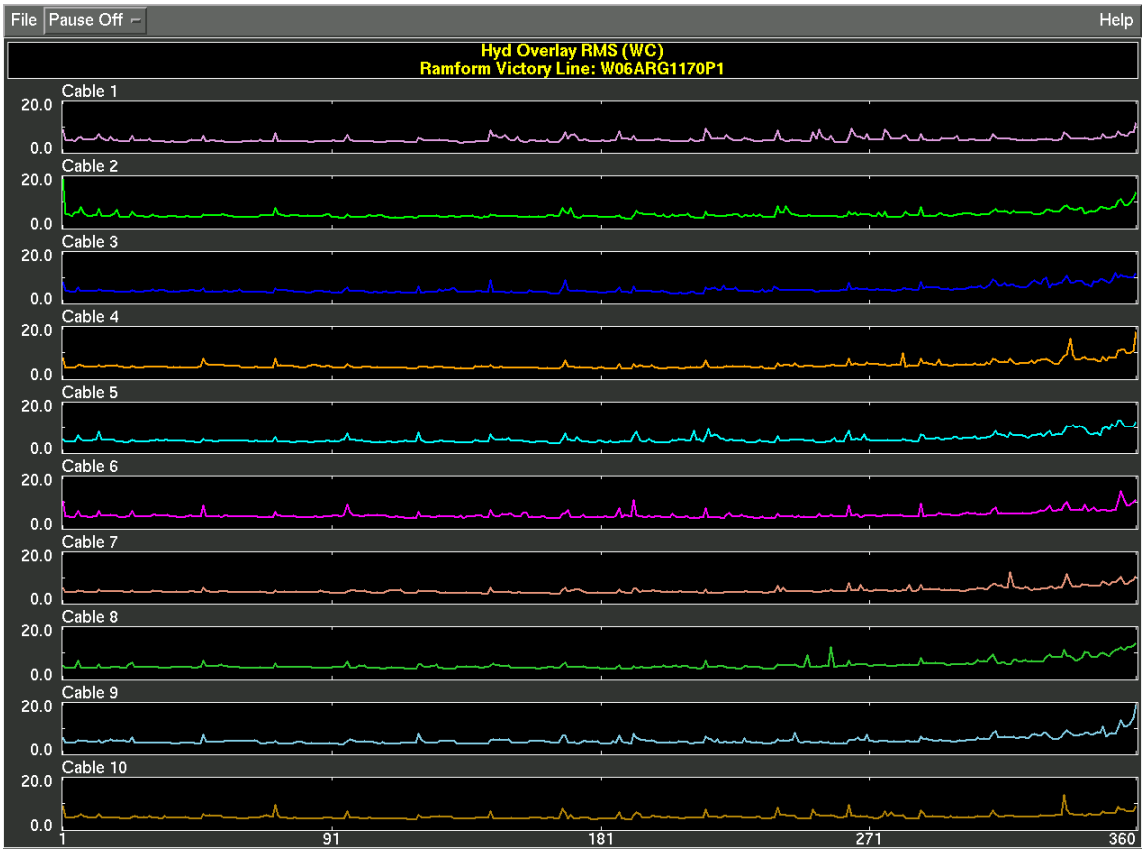
Dead/Weak traces: Some traces didn't show any response at all, and some only a very weak response. These traces were also edited.

Channels failing hydrophone leakage test: In cases where particular channels failed the hydrophone leakage tests, the affected sections were swapped out at the earliest opportunity.

10.5 RMS and noise analysis

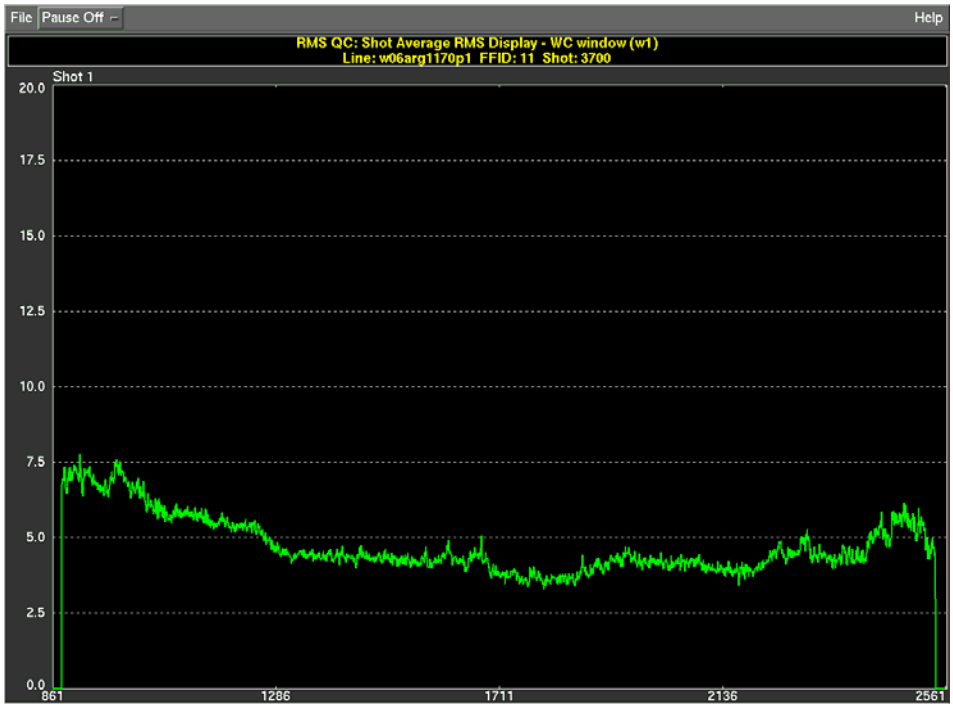
The RMS graphs with all streamer and channel values for the Water Column and End of Record noise windows were a useful tool to identify the different types of noise encountered. In conjunction with the raw shot plots, the shot point and channel edits were confirmed / established on a line-by-line basis. The channel average RMS plots and signal window RMS plots are also checked for bad channels and gun anomalies as a back up to the observers QC.

Examples of the available plots are given below:

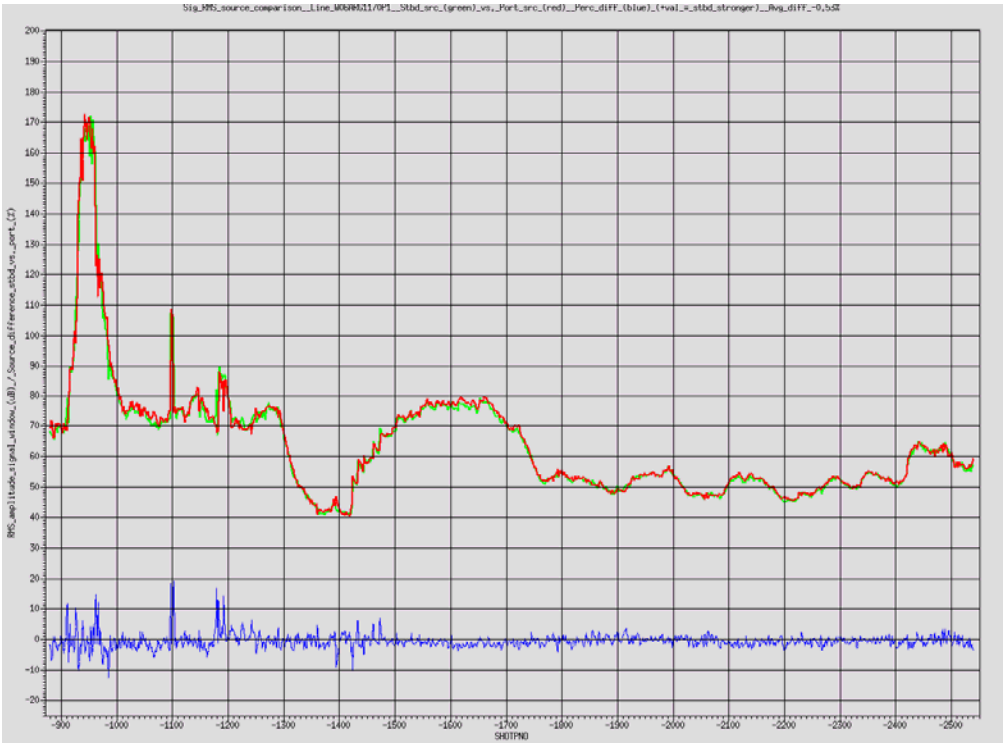


Channel average RMS noise (Water Column window 130-250ms) display for all streamers.

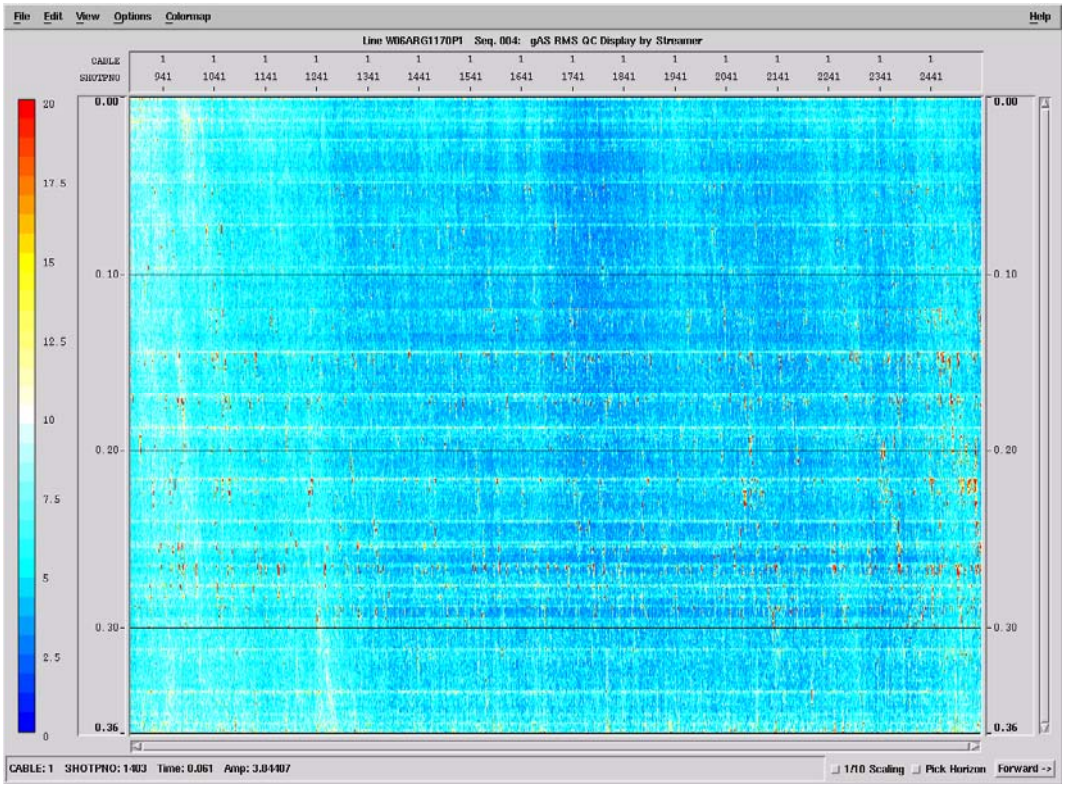
This display is used to help select bad/noisy channels for subsequent editing. This example was taken from line W06ARG1170P1



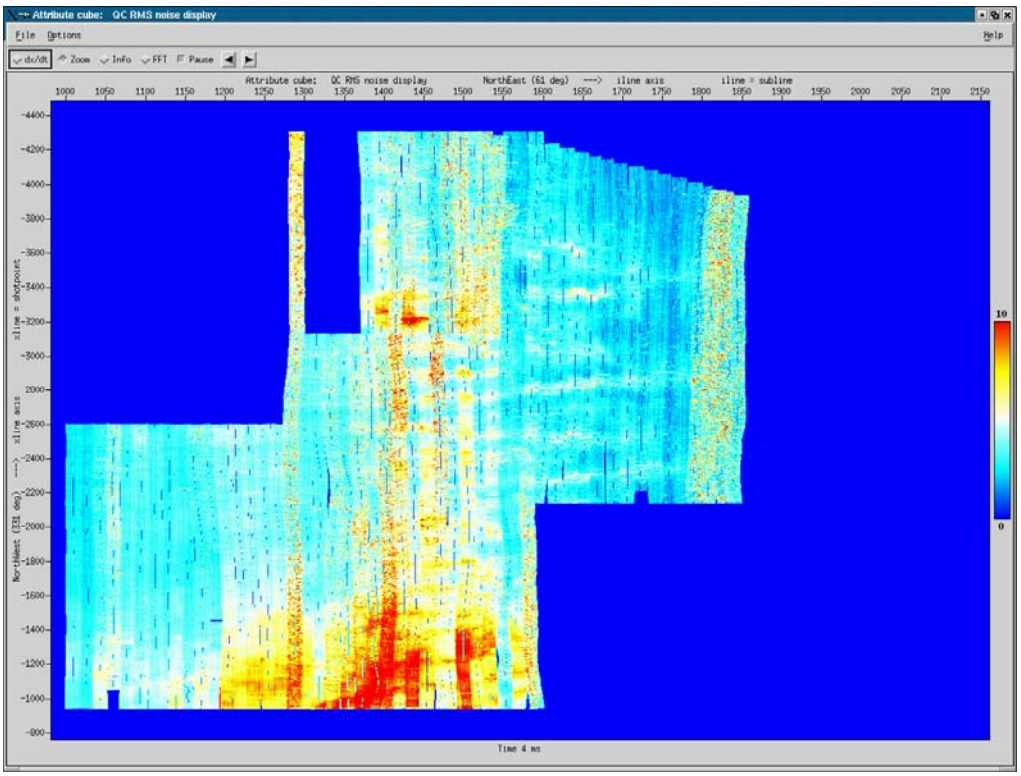
Shot point average noise display of the Water Column window (130-250ms), an average of all channels for each shot in a window at the beginning of the record. This is one of the most important displays for geophysical QC as it gives information on the sea state and any external noise source. In this example from line W06ARG1170P1, a reasonably quiet line.



Source Comparison QC display, used to check for source anomalies. This display is an average of the RMS for all channels of each shot in the Signal window (500-1000ms below the water bottom), with the port and starboard shots plotted in red and green respectively. The blue line at the bottom shows the percentage difference in RMS between these shots, with the average of these values being displayed at the top of the display as an average difference for the whole line. In this case the average difference between the sources for the whole line is only 0.53%. This example was from line W06ARG1170P1



RMS Noise (Water column window 130-250ms) Display - this display is produced from the raw data for all streamers and is used to QC bad channels and to identify external noise which may affect the data. This example was from line W06ARG1170P1, streamer 1, which shows some light swell noise evidenced by the red/yellow speckling affecting the middle third of the cable. Note that noisy channels can be identified as yellow/red, horizontal lines running across the display.

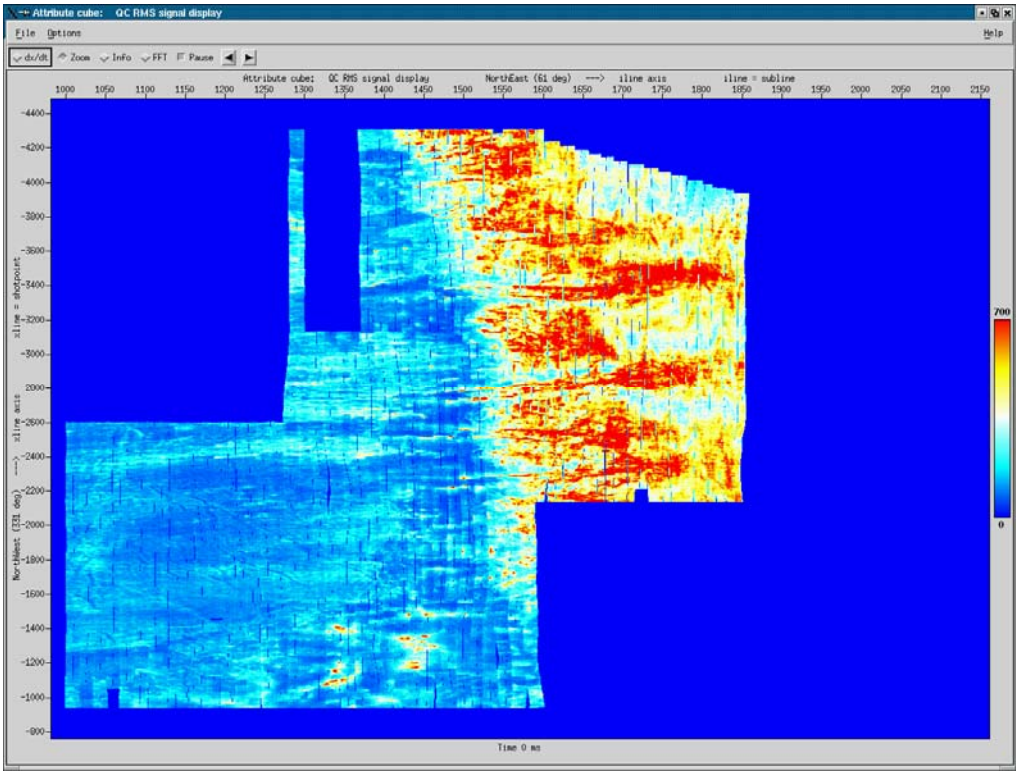


Areal RMS Noise Display Colour bar range 0-10µbar

Water Column noise window (250-750ms, channels 175-186}.

The water column noise window displays the ambient background noise levels. The average ambient background noise level for this survey was around 3-6µB. In this display we can see several dotted lines. The noise visible on these lines was caused by swell noise. The noise levels of the lines for this survey were within acceptable levels.

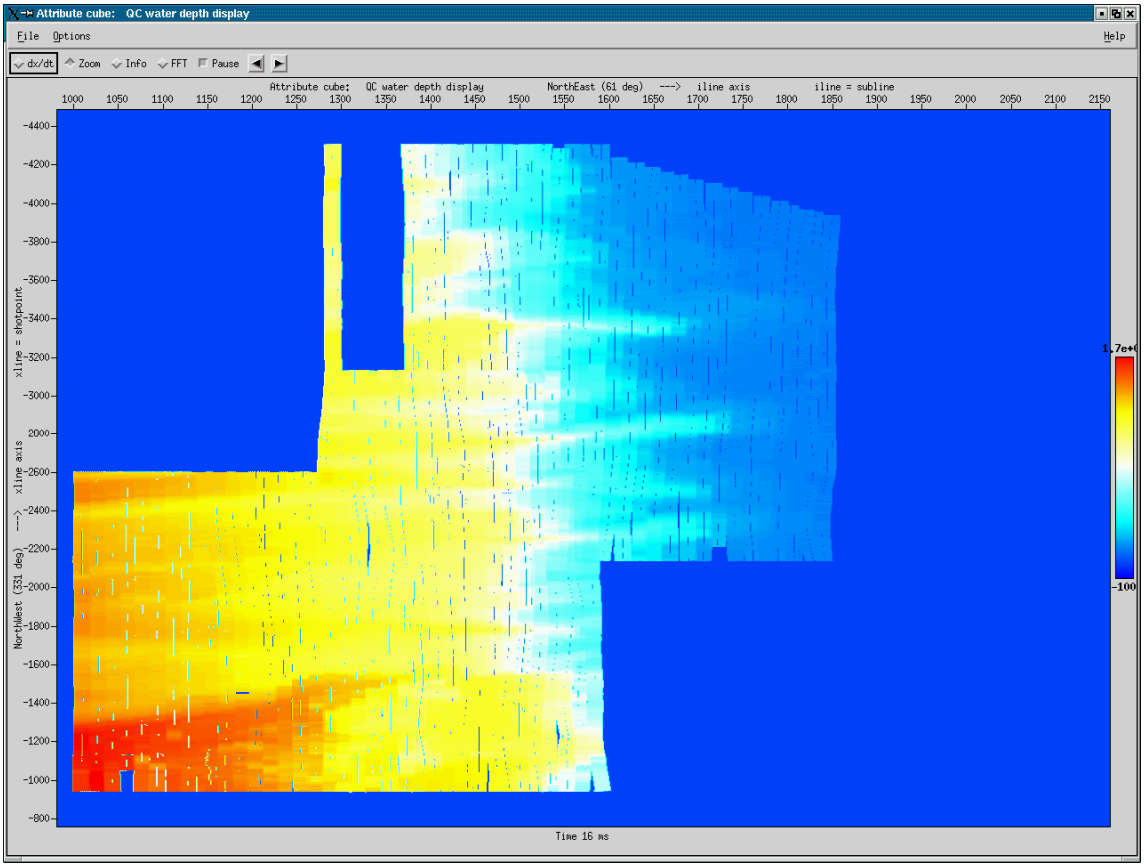
Some lines show areas with higher noise levels (yellow and red). On the places where there is a sudden jump to a higher/lower noise level for a certain line, the bottom speed of the vessel changed rapidly, resulting in more/less residual energy from the previous shot. On places where we see red/yellow areas that extend over several lines, the higher energy levels are caused by higher returned energy from the previous shot (caused by changes in geology).



Areal RMS Signal Display Colour bar range 0-700µbar

Signal Window (500-1000ms below the water bottom, channels 175-186, moveout 1700m/s).

This RMS signal window display shows the strength of the reflection energy at a desired target window. As we can see, the signal level was good in general for this survey.

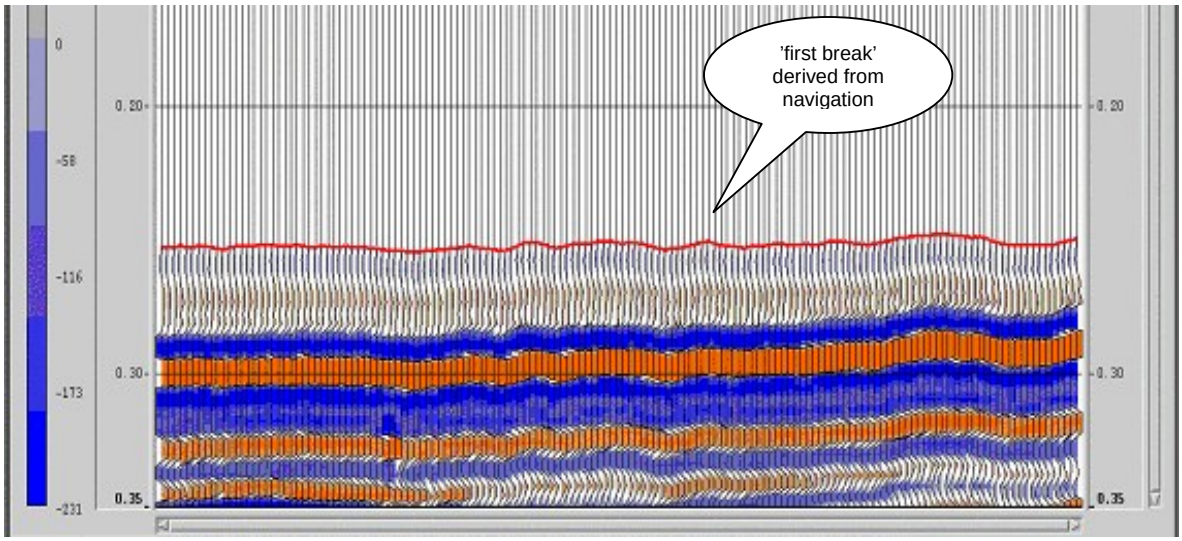


Average Water Depth (source P190) Colour bar range -100-1700m

Note that for display reasons the color bar starts with (minus) -100This picture shows that the prospect deepens to the South West.

10.6 First break / P1/90 offset check

Direct arrivals from the near traces were merged with the P1/90, and the navigation derived first break time was overlaid on the seismic data and checked on-screen. At some places the direct arrival was contaminated by refraction energy. There was a good match between the P1/90 and the seismic data.



10.7 Common offset cube

Following the navigation merge, a single trace was selected for each bin which had a source-receiver offset closest to 660m for loading to the common offset cube. The data were pre-processed and partial NMO applied (to offset 660m) prior to loading. Once loaded to the cube, inline, cross-line and time-slices displays were viewed to check for potential navigation merge errors.

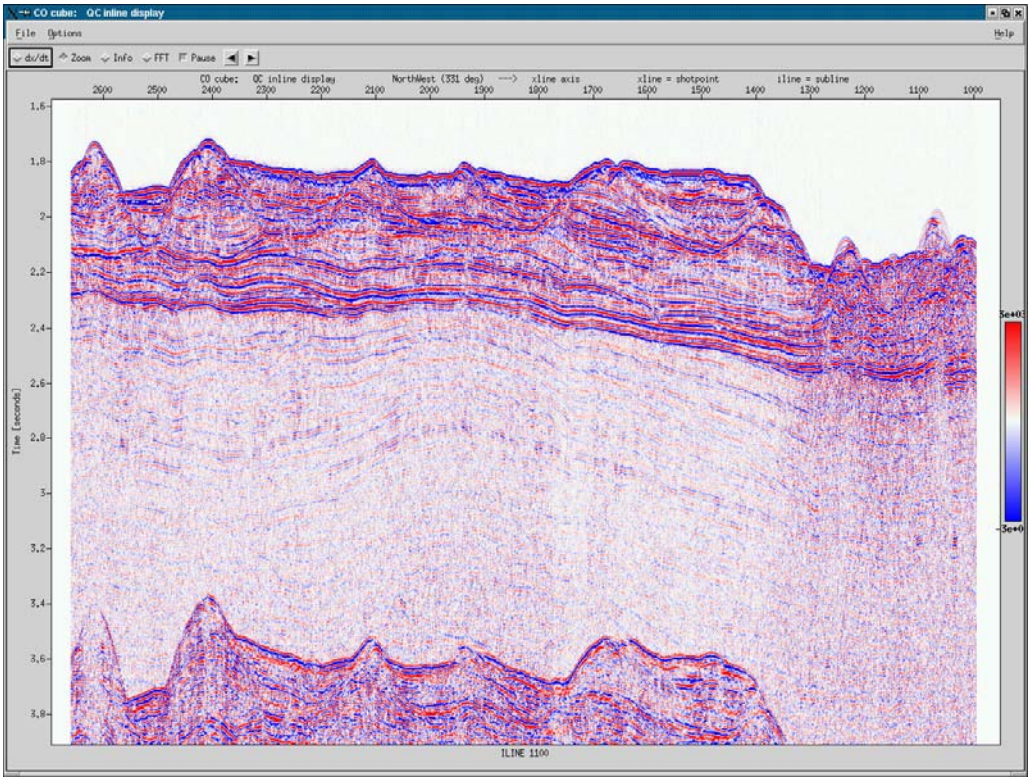
The cube as a whole performed a positive QC of the P190 data.

On the following pages are some representative inline, crosslines and timeslices from the final common offset cube, viz:

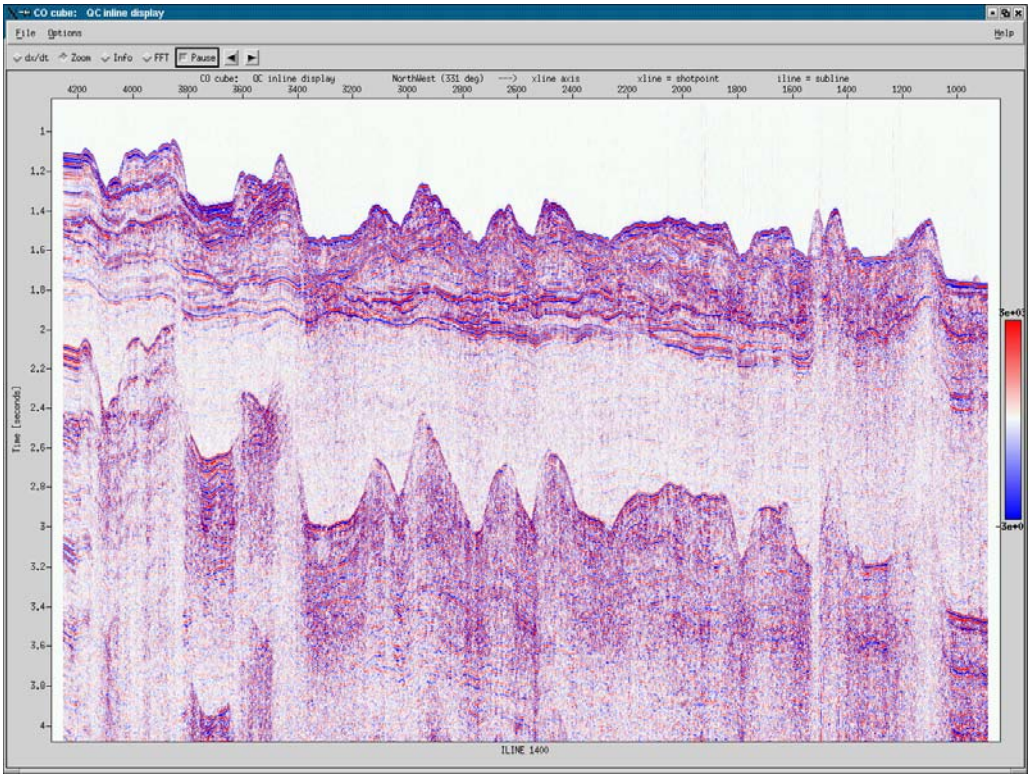
inline*	1100, 1400 and 1700
crosslines*	1800, 2400. 3000 and 3800
timeslices	700, 1900 and 2400

* - For clarity only the upper part of these displays is shown.,

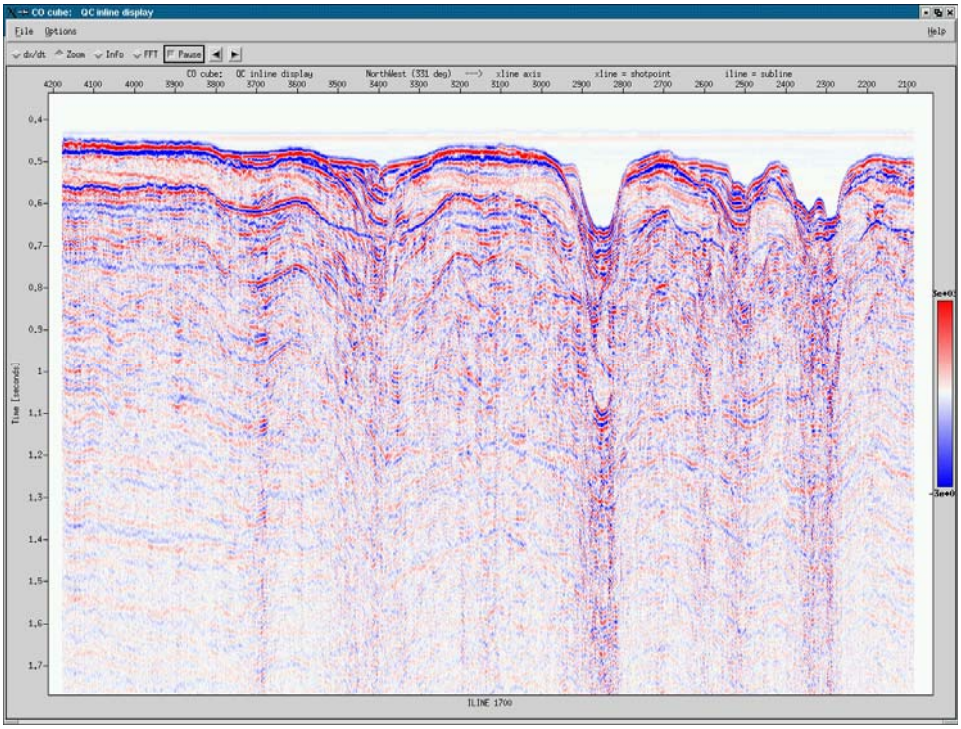
Iline 1100



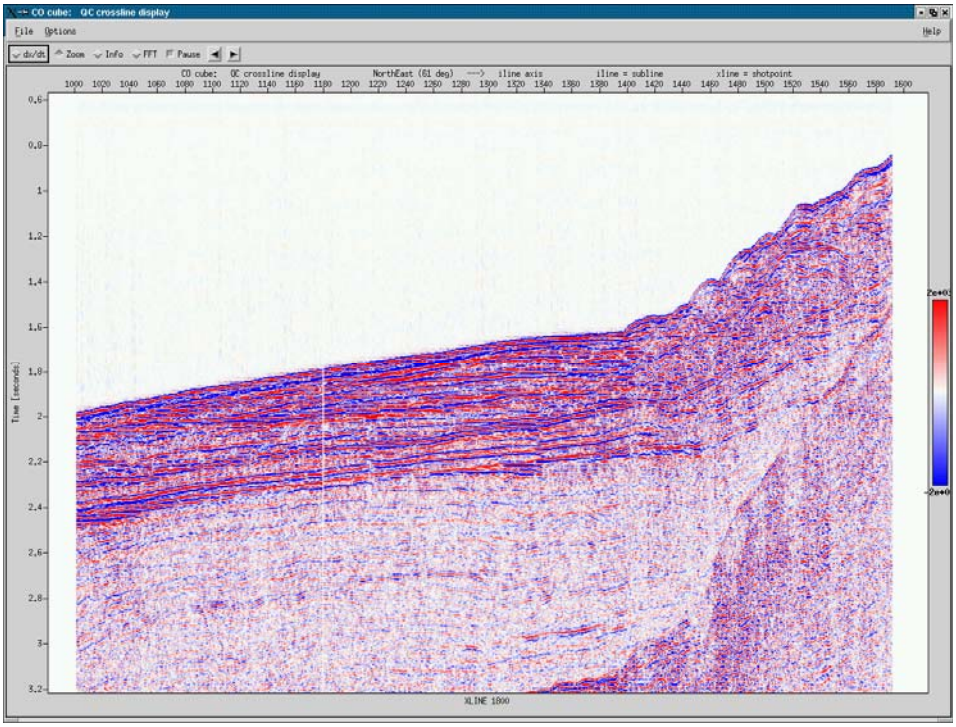
Iline 1400



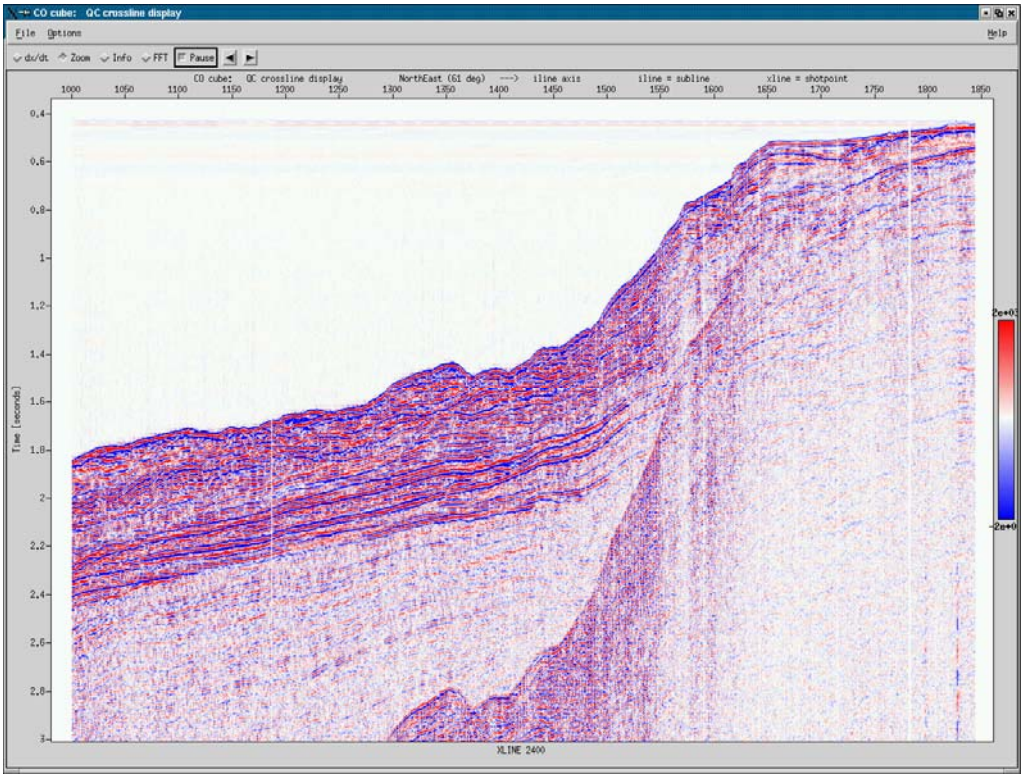
Iline 1700



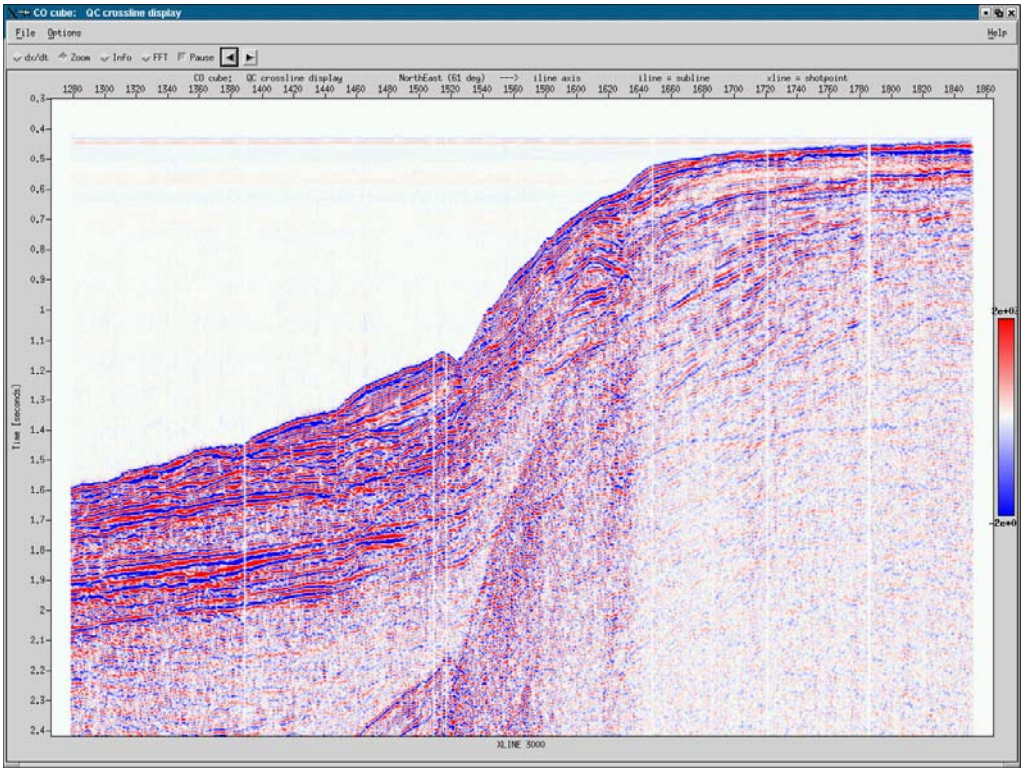
Xline 1800



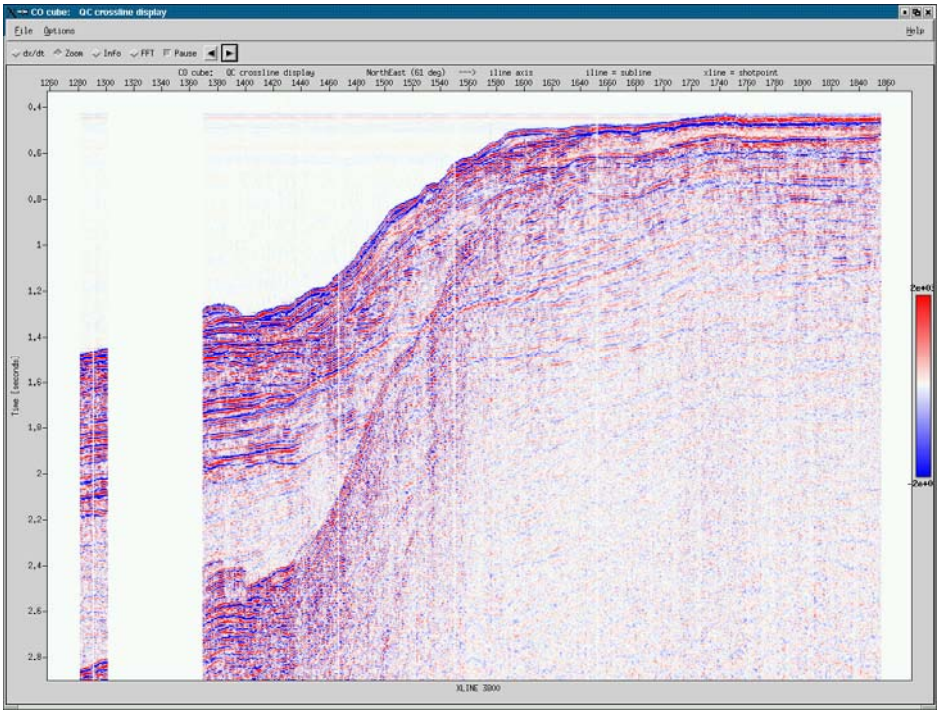
Xline 2400



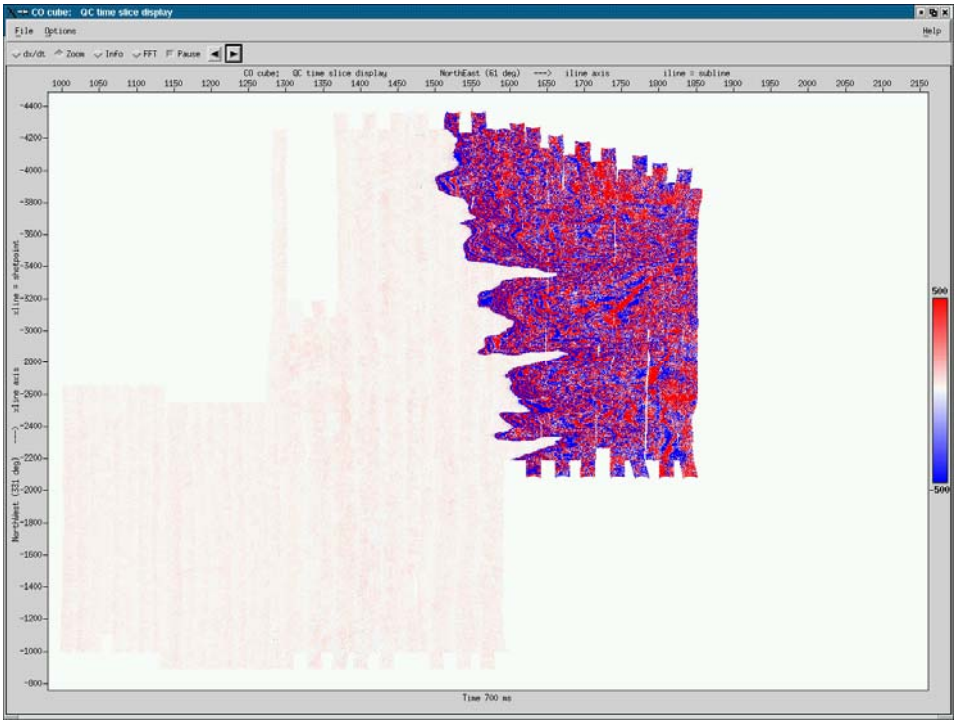
Xline 3000



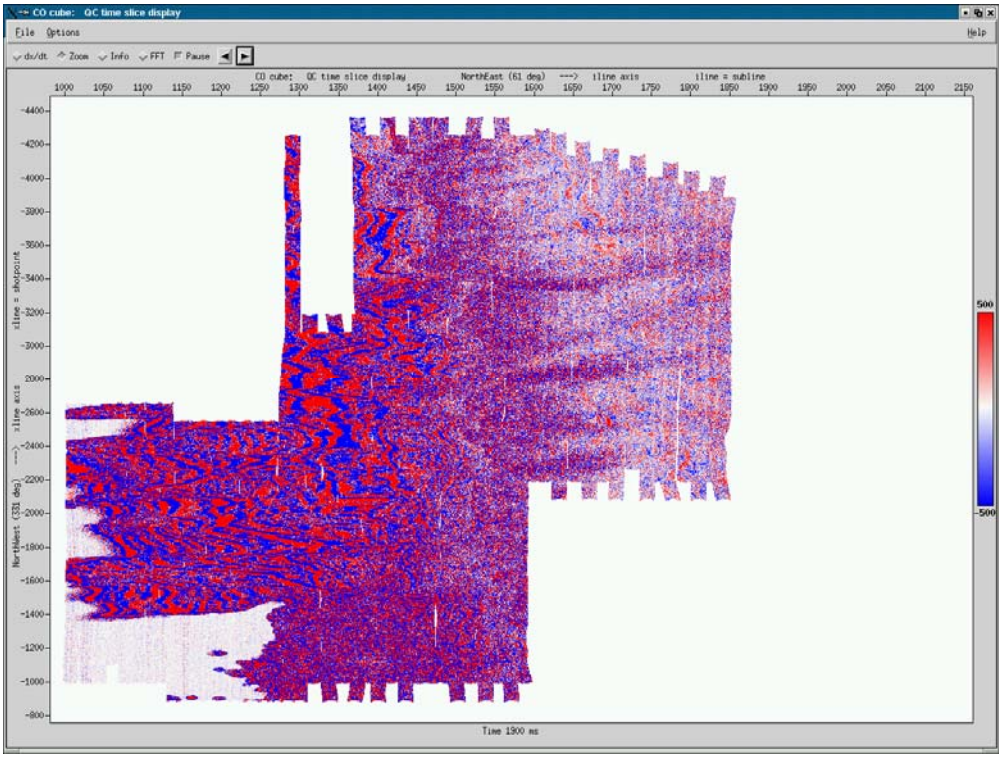
Xline3800



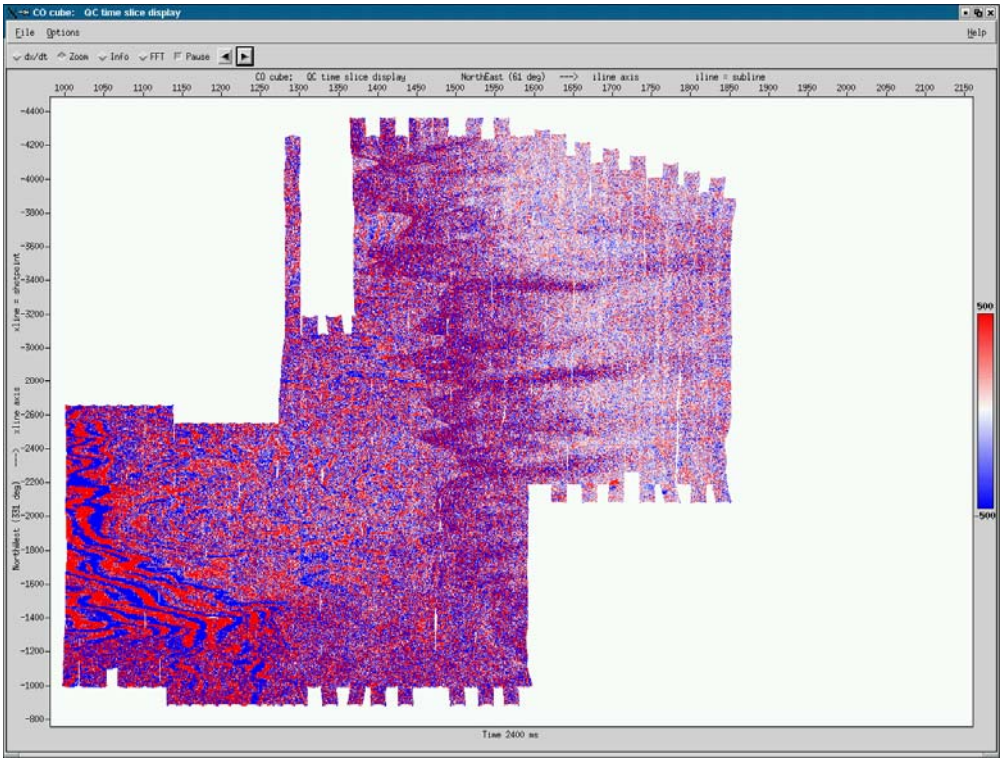
Timeslice 700ms



Timeslice 1900ms



Timeslice 2400



10.8 Brute stack QC

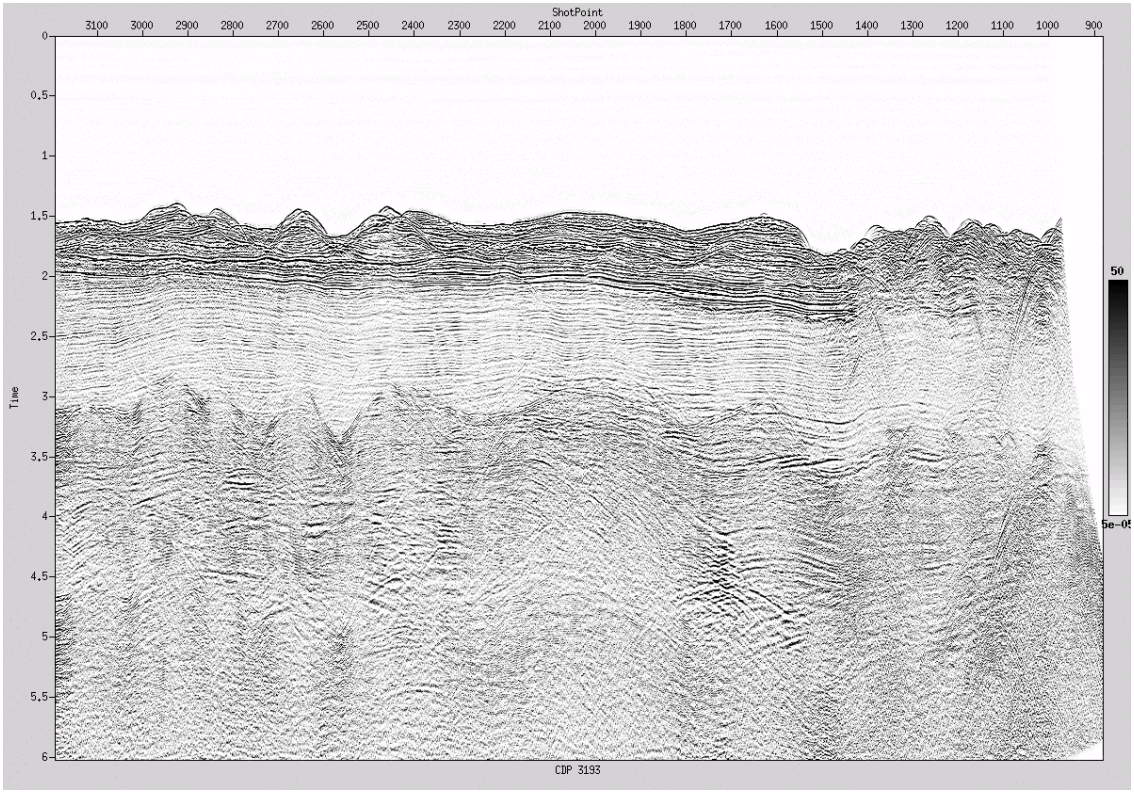
As a minimum, one sub surface CMP line was stacked for each sail line pass. The captured CMP line was rotated through the streamers from line to line. This enabled all streamers to be monitored on a regular basis. Additional processing was minimised so as not to suppress the effects of noise on the stack. Velocities were supplied by Woodside. Following NMO correction, a mute was applied to remove NMO stretch, and the data was stacked. A plot of the raw brute stack was then produced for each sequence, which was closely scrutinised for the effects of noise.

To eliminate the swell noise that was present in the data of several lines and visible in several brute stacks, a SINK stack was also produced, where SINK (Seismic Interference Noise Killer) was applied to the data to take out the swell noise. The SINK parameters were taken from PGS Data Processing as agreed with Woodside. This SINK was a 2 pass SINK.

SINK was able to take out most swell noise from the data of lines where swell noise occurred. However, in cases where the swell noise exceeded certain levels, some swell noise was still visible in the stack after applying SINK.

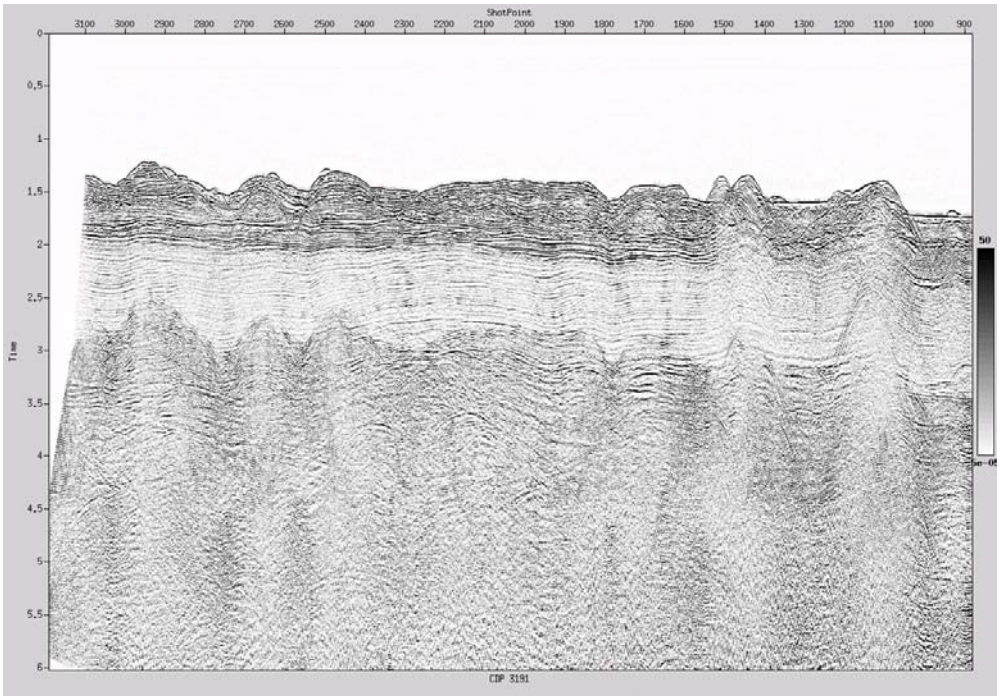
The following plot shows a brute stack for line W06ARG1310P1. This was a quiet line where no swell noise was visible in the stack.

Brute stack line W06ARG1310P1

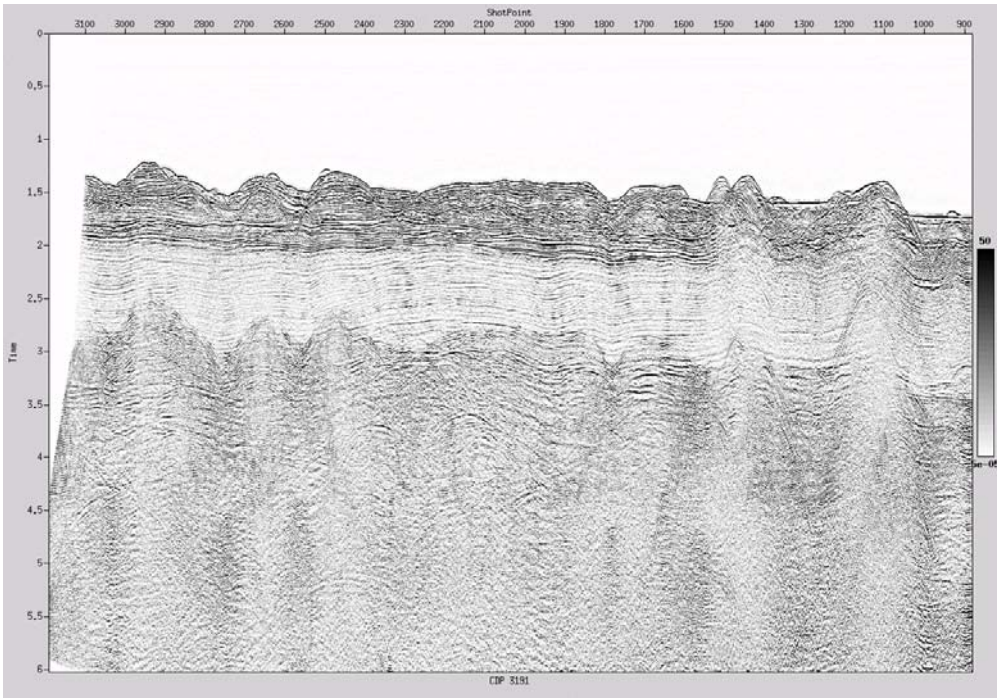


The next plot is an example of a brute stack from a noisy line, line W06ARG1390P1, where the swell noise is visible in the brute stack. Also the SINK stack of this line is shown. It can be seen that most swell noise has been taken out by SINK.

Brute Stack line W06ARG1390P1



SINK Stack line W06ARG1390P1



11 QC Processing

The acquisition QC involved several different aspects including:

- Real-time monitoring of acquisition via gAS functionality
- QC of RMS windows, auxiliary channels, near traces, and raw shots
- Production of a 2D brute stack for selected streamer (rotated each line)
- Seismic and navigation merge and navigation QC
- Production of a common offset cube
- Production of an Attribute cube (RMS)
- Investigation of problems as necessary

The gAS acquisition system was used to monitor and record data in real-time. The VIPER processing system was then utilised for the subsequent offline QC processing. Problems that occurred during production were investigated using all means available.

11.1 Online QC

The PGS gAS acquisition system was used to provide real time online QC displays that included:

- raw shot gathers, rotated through each streamer for every shot
- The EOR RMS window was displayed for all 10 streamers. This enabled ambient noise estimates to be made, and swell noise etc. to be quantified
- A display notifying streamer depth variations, source errors (misfires/autofires), and Syntrak recording problems
- Problems (parity/extraction errors) were shown on the instrument QC display
- Shot to shot comparison for noise analysis
- Auxiliary trace display to monitor for any source variations
- Windowed (130-250ms) auxiliary trace display for airleak detection
- Display with stacked auxiliary traces for autofire detection

gAS real-time RMS calculations were performed for all 3600 channels of each shot in four different time windows:

wc (water column)	130-250ms.	Used as the primary noise window
sig 1 (signal)	WB+500 – WB+1000ms	Used as signal window
sig 2 (signal)	WB+2000 – WB+2500ms.	Used as signal window
eor (end of record)	5500-6000ms.	Used as the secondary noise window

11.2 Offline QA/QC sequence

All the data was captured online using ‘snooper cards’ for QC and analysis:

11.2.1 2D QC stack

For each sail-line, a 2D QC brute stack and associated QC products were generated using the following sequence:

Reformat	SEG-D to internal format
Static Correction	Digital filter delay –120 ms (60 samples)
Geometry Assignment	Assign 2D geometry: 360 channels
Filter	Zero phase filter - 3-6-90-120Hz
Resample	2 ms to 4 ms
Edit	Bad shot and trace edit
Trace sum	Adjacent trace sum with partial NMO
*(SINK)	
Gain	T**2
dBGain	2.0dB/sec applied 0-6sec
Display	**Near traces for single streamer**
Display	**Single shot – all streamers**
Display	**Select shots every 250th – single streamer**
NMO	using Woodside supplied velocity field
Mute	Post NMO top mute
Display	**NMO corrected CDP Gathers**
Stack	nominal fold: 60
Static	+10ms, gun and cable static
Display	**Brute 2D stack**

* Also a SINK stack was produced for lines where swell noise was a problem. The SINK parameterisation was the same as being used by PGS Data Processing for the onboard production processing.

The following displays were produced for each CDP line processed:

- **Near trace Display** from selected stacking streamer
- **Single Shot Display - all streamers** 1 shot, all 10 streamers
- **Shot records Display (single streamer)** shots selected every 210 shots
- **NMO-corrected CDP gathers display** for every line
- **Brute 2D Stack Display**
- *** SINK 2D Stack Display**
- *** SINK 2D Difference Stack** – difference display to assess effectiveness of SINK process

11.2.2 Navigation / seismic merge QC

A near trace/common offset dataset was merged with the final P1/90 data. The direct arrivals from the near traces were then displayed on screen with the navigation derived first break time* overlaid on the seismic data. There was a good match between the P1/90 and the seismic data.

- The navigation derived first break time was derived using the near surface water velocity, which was taken from TS Dip measurements.

11.2.3 Common offset cube

A second P1/90 QC step was to build a common offset cube in VIPER to check for anomalies and miss-ties between sail lines on cross-line sections and time slices. After merging with the P1/90 navigation data, the trace with the nearest offset to 660m was selected for each inline/xline combination and loaded to the common offset cube. The data were pre-processed and partial NMO applied prior to loading. Once loaded to the cube, inline, cross-line, and time-slice displays were viewed to check for potential navigation merge errors.

11.2.4 RMS Attribute Cube

An attribute cube was also built using attributes derived from the middle twelve traces from each streamer for each shot. A five sample trace was output for each shot location with the following attributes assigned to samples one through five.

- Average RMS for the Signal window
- Average RMS for the Noise window
- RMS Signal/Noise ratio
- Max. RMS Noise
- Average Water Depth

11.2.5 Other QC Products

A near trace display was generated for every line to monitor bad and missing shots, especially auto-fires, and to ensure that a complete sequence was captured to disk.

From all the data several RMS windows were calculated. These windows were used to qc the data for different aspects, like noisy channels, gun performance QC, etc.

The output of the near field hydrophones mounted on the gun strings was recorded on the auxiliary channels, together with the system time-break in order to identify gun-timing errors. The auxiliaries of all gun strings were stacked together and displayed online as a real-time auto-fire QC display.

A post-line display of the auxiliary traces stacked by the common gun-string was also generated as an additional QC for autofires. Further a display was produced with each of the auxiliary traces truncated from 130 to 250 ms and spliced together into a single trace per shot/array which was useful for the identification of airleaks.

Raw shots for the stacked streamer were plotted for every 210th shot. These were used to determine the impact of external noise sources e.g. seismic interference, swell noise and ship noise on the raw data. In addition a single shot (all streamers) was plotted for each line as a guide to identifying and classifying bad channels.

11.3 Computer systems

A five node Linux cluster has been installed onboard the M/V RAMFORM VICTORY to perform seismic QC tasks using PGS' own Viper and gAS software.

The gAS QC system is used for online acquisition QC and acts as the primary recording system replacing the Syntrak recording system. It has been set up with special snooper cards to capture all the data in real time which is passed on to the Viper system.

The Viper system, with a full suite of pre-processing and QC tools, is used for QC processing and together with its parallel processing capability offers great scope and fast results for both on-line and off-line QC processing and investigation.

The Viper Linux cluster consists of five nodes designated for Viper QC.

Five IBM x335 nodes
Dual 2.4Ghz Intel Xeon processors per node.
1.5Gb RAM per node.
Two 146Gb 10k-rpm SCSI hot swap disks in nodes 1-3.
Two 300Gb 10k-rpm SCSI hot swap disks in nodes 4 and 5.
Dual 10/100/1000 Mbps Ethernet network adapters per node.
xSeries Cable Chain Technology.
LSI U40 HVD PCI Ultra Wide Differential SCSI adapter per node
Three nodes have 3590 tape drive connections with the third one spare.

Two HP ProCurve network switches - each switch has 8x1000baseT Ethernet ports with 16Gbps backplane.

This onboard processing system runs Viper V3.0.3-3 which is managed by Xcat software running under RedHat Linux V7.3.

12 Appendix

12.1 Data shipments

Date	Proforma	Content	Boxes	Wt	Shipping address	Comment
2nd June. 06	VIC23002654A	2 x P190 3590 tapes 2 x P294 3590 tapes 1 x P190 DVD 1 x P294 DVD Originals Project 2005098	1	2 kg	Access Information Management, 80 Pilbara Street, Welshpool, WA, 6106, Australia. Phone : +61 (0)8 9356-3766 Email : orders@accessim.com.au Attention : Bruce Sharman	Via NT Shipping Agencies PO Box 443 East Arm Wharf 0828 BERRIMAH NT Australia Tel +61 8 8947 2570 Fax +61 8 8947 2640
TBSO When 1st Data Tapes has arrived at des-tination.	VIC23002655A	4 x P190 3590 tapes 4 x P294 3590 tapes Copies Project 2005098	1	2 kg	Access Information Management, 80 Pilbara Street, Welshpool, WA, 6106, Australia. Phone : +61 (0)8 9356-3766 Email : orders@accessim.com.au Attention : Bruce Sharman	Via NT Shipping Agencies PO Box 443 East Arm Wharf 0828 BERRIMAH NT Australia Tel +61 8 8947 2570 Fax +61 8 8947 2640
2nd June. 06	VIC23002653A	2 x P190 3590 tapes 2 x P294 3590 tapes 2 x P190 3590 raw tapes 1 VEG backup tape 2 Sprint db 3590 backup tape 2 EOJ cd's 3 Census backup tapes Project 2005098	1	2 kg	PGS Geophysical AS (EXANO) Strandveien 4 P.O.Box 290 N-1326 Lysaker Norway Attn :Torfinn Brusegard Phone : (47) 67 52 64 00 Fax: (47) 67 52 64 64	Via NT Shipping Agencies PO Box 443 East Arm Wharf 0828 BERRIMAH NT Australia Tel +61 8 8947 2570 Fax +61 8 8947 2640
3 June 06	VIC23002664A	Boxes 1-16 474 x 3590 SEG D DataTapes Set C.	16	120 kg	Access Information Management, 80 Pilbara Street, Welshpool, WA, 6106, Australia. Phone : +61 (0)8 9356-3766 Email : orders@accessim.com.au Attention : Bruce Sharman	Via NT Shipping Agencies PO Box 443 East Arm Wharf 0828 BERRIMAH NT Australia Tel +61 8 8947 2570 Fax +61 8 8947 2640

TBSO When 1st SEG D Data Tapes has arrived at des-tination.	VIC23002672A	BOX 1- 16 474 x 3590 SEG D DataTapes Set F			Access Information Management, 80 Pilbara Street, Welshpool, WA, 6106, Australia. Phone : +61 (0)8 9356-3766 Email : orders@accessim.com.au Attention : Bruce Sharman	Via NT Shipping Agencies PO Box 443 East Arm Wharf 0828 BERRIMAH NT Australia Tel +61 8 8947 2570 Fax +61 8 8947 2640

12.2 Additional navigation deliverables

The following deliverables were issued from PGS offices in Oslo after the survey was completed.

- Vessel position tape, **W06ARG011**
- Water depth tape **W06ARGE011**, with water depths corrected for draft and sound velocity
- Vessel position plot on paper.
- Contour plot on paper.
- Coverage plots no flex on paper
- CD-ROM containing all the plots in cgm format
- P6/98 binning grid UKOOA format on tape **W06ARG-P698**

12.3 Source modelling

SIGNATURES FROM MARINE AIRGUN SOURCE LIBRARY

NUCLEUS - Marine Source Modeling 4.2.1

Modeling by Ping Zhao, PGS Technology/Geophysical Support, September 2004

Survey name	:	Aragorn 3D Survey
PGS project No	:	2005098 (Aragorn)
Survey area	:	Bass Straight, Victoria (Aragorn)
Vessel	:	M/V RAMFORM VICTORY
Array	:	3090T__60_2000_125
Source type	:	Bolt 1900LLXT
Source volume	:	3090 cu.in.
Air pressure	:	2000 psi
Source depth	:	6.0 m
Subarray separation	:	12.5 m
Recording filter	:	Syntrak-24bit system, 3(12) – 206(276) Hz (dB/oct.)
Receiver depth	:	9.0 m
Hydrophone group length	:	12.5 m
Compensating p-plugs	:	out
Full system response* filter name	:	S-24 g-12.5
Sea temperature	:	17 ° C

Enclosed are:

Figure 1: Array configuration top view, i.e. positive Y denotes starboard.
Figure 2: Modeled far-field signature and amplitude spectrum with 24bit recording filter (without receiver ghost).
Figure 3: Modeled far-field signature and amplitude spectrum with DFS-V recording filter (without receiver ghost).
Figure 4: Modeled far-field signature and amplitude spectrum with recording and hydrophone filter effect applied (without receiver ghost).
Figure 5: Far-field signature listing with 2 ms sampling interval (without receiver ghost).
Figure 6: Modeled far-field signature and amplitude spectrum with recording and hydrophone filter effect applied (with receiver ghost).
Figure 7: Far-field signature listing with 2 ms sampling interval (with receiver ghost).
Figure 8: Directivity plot for constant azimuth of 0° and 90°.
Figure 9: Single (on diagonal) and two gun drop-out diagram. Illegal combinations denoted in red.

* Full system response contains the effect of the recording filter including the effects due to the hydrophone capacitors connected in parallel.

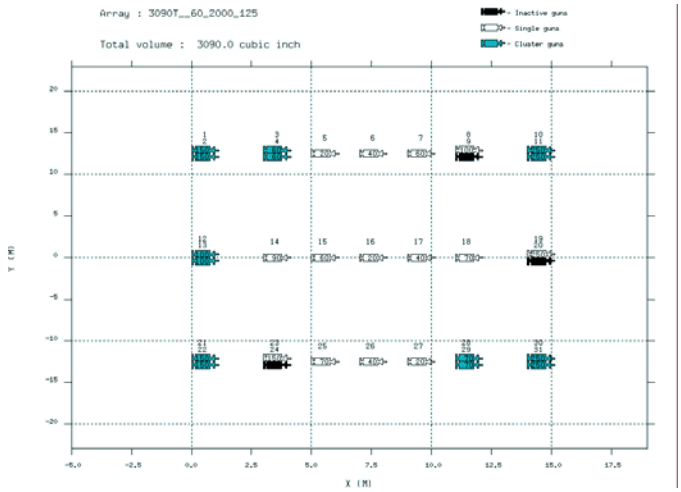


Figure 1: Array configuration top view, i.e. positive Y denotes starboard.

ARRAY LISTING

ARRAY NAME : 3090T__60_2000_125
NUMBER OF ACTIVE GUNS: 28
TOTAL ACTIVE VOLUME : 3090 CU.IN.
NUMBER OF SPARE GUNS : 3

GUN #	GUN TYPE	X (m)	Y (m)	Z (m)	VOLUME (cu.in)	PRESSURE (psi)	DELAY (ms)	CLUSTER NUMBER
1	18	0.00	12.90	6.00	150	2000	0.00	1
2	18	0.00	12.10	6.00	150	2000	0.00	1
3	18	3.00	12.90	6.00	60	2000	0.00	2
4	18	3.00	12.10	6.00	60	2000	0.00	2
5	18	5.00	12.50	6.00	20	2000	0.00	0
6	18	7.00	12.50	6.00	40	2000	0.00	0
7	18	9.00	12.50	6.00	60	2000	0.00	0
8	18	11.00	12.90	6.00	100	2000	0.00	0
9	18	11.00	12.10	6.00	100	SPARE	0.00	0
10	18	14.00	12.90	6.00	250	2000	0.00	3
11	18	14.00	12.10	6.00	250	2000	0.00	3
12	18	0.00	0.40	6.00	100	2000	0.00	4
13	18	0.00	-0.40	6.00	100	2000	0.00	4
14	18	3.00	0.00	6.00	90	2000	0.00	0
15	18	5.00	0.00	6.00	60	2000	0.00	0
16	18	7.00	0.00	6.00	20	2000	0.00	0
17	18	9.00	0.00	6.00	40	2000	0.00	0
18	18	11.00	0.00	6.00	70	2000	0.00	0
19	18	14.00	0.40	6.00	250	2000	0.00	0
20	18	14.00	-0.40	6.00	250	SPARE	0.00	0
21	18	0.00	-12.10	6.00	150	2000	0.00	5
22	18	0.00	-12.90	6.00	150	2000	0.00	5
23	18	3.00	-12.10	6.00	150	2000	0.00	0
24	18	3.00	-12.90	6.00	150	SPARE	0.00	0
25	18	5.00	-12.50	6.00	70	2000	0.00	0
26	18	7.00	-12.50	6.00	40	2000	0.00	0
27	18	9.00	-12.50	6.00	20	2000	0.00	0
28	18	11.00	-12.10	6.00	70	2000	0.00	6
29	18	11.00	-12.90	6.00	70	2000	0.00	6
30	18	14.00	-12.10	6.00	250	2000	0.00	7
31	18	14.00	-12.90	6.00	250	2000	0.00	7

THE GUN TYPES ARE: 18: BOLT 1900 LLXT

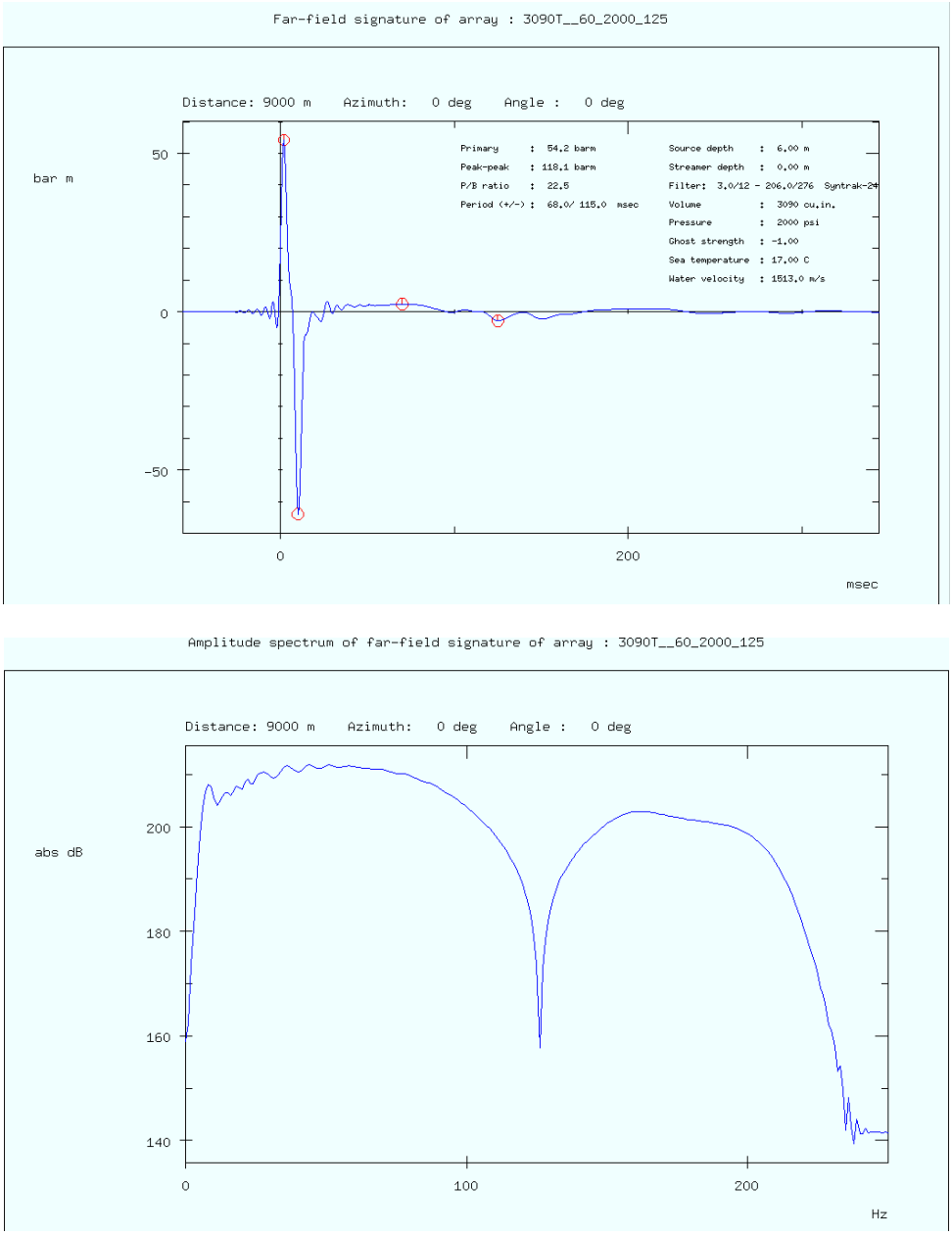


Figure 2: Modeled far-field signature and amplitude spectrum with 24bit recording filter (without receiver ghost).

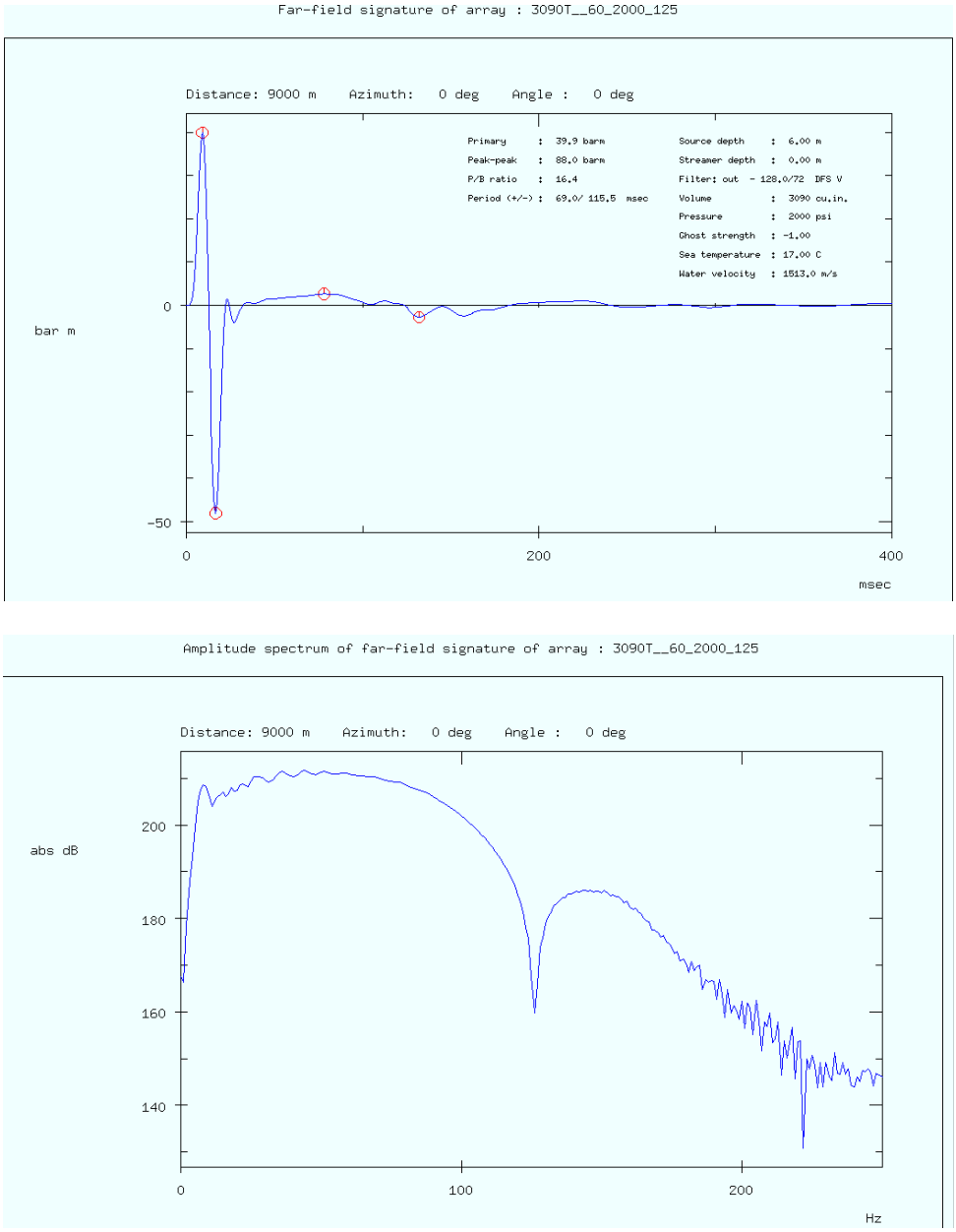


Figure 3: Modeled far-field signature and amplitude spectrum with DFS-V recording filter (without receiver ghost).

Full system response with source ghost only

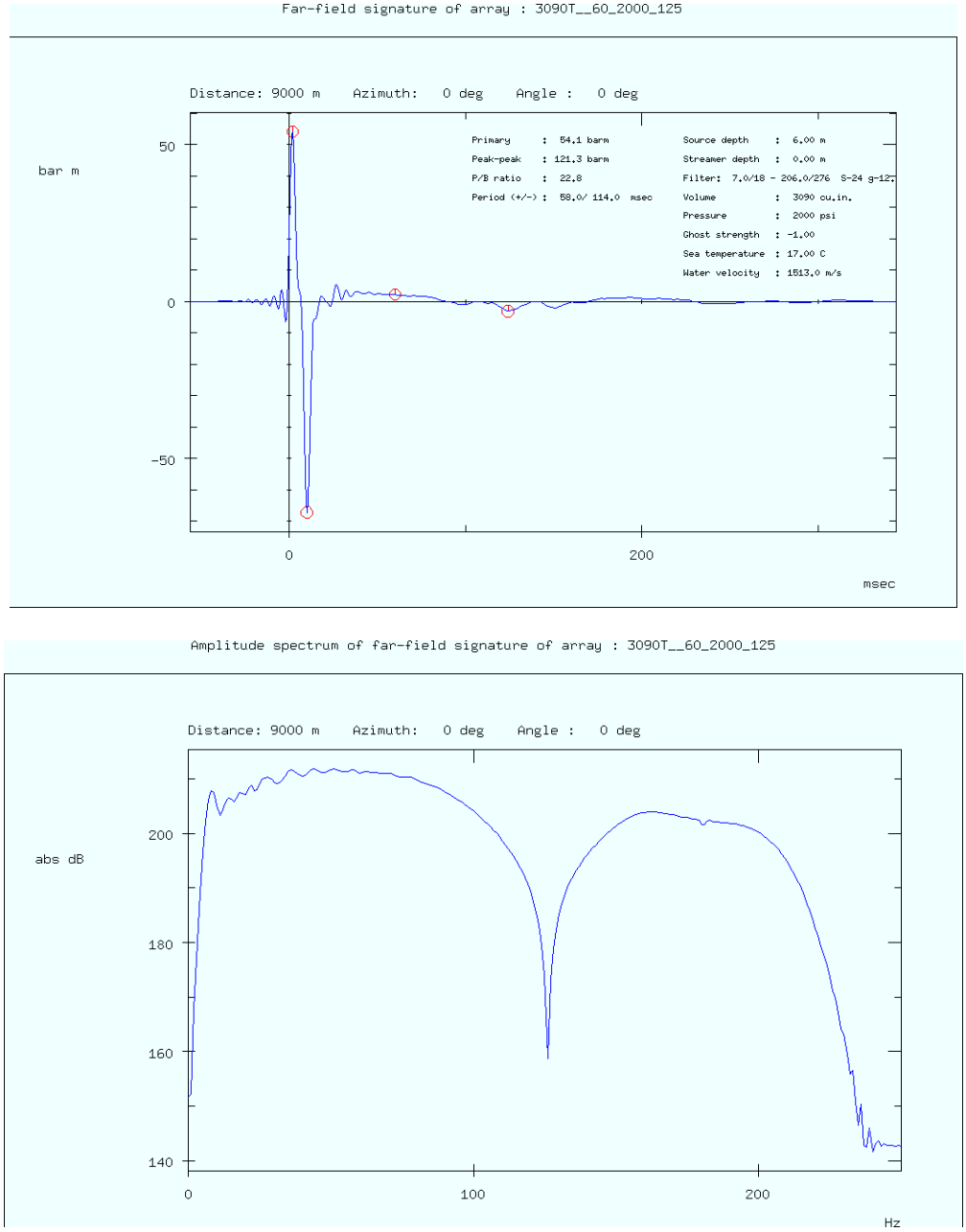


Figure 4: Modeled far-field signature and amplitude spectrum with recording and hydrophone filter effect applied (without receiver ghost).

Full system response with source ghost only

```
FAR-FIELD SIGNATURE LISTING

Array name          :  3090T__60_2000_125
Total volume        :    3090 cu.in.
Source depth        :    6.00 m
Streamer depth      :    0.00 m
Group length        :   12.50 m
Average pressure    :    2000 psi
Ghost strength      :   -1.00
Primary amplitude   :   54.06 bar m
Peak-peak amplitude :  121.32 bar m
P/B-ratio           :   22.82
Bubble period (+)   :   58.00 msec
Bubble period (-)   :  114.00 msec
Seawater temperature:   17.00 C
Seawater velocity   :  1513.0 m/s
Filter              :
  Low-cut frequency :    7.00 Hz
  Low-cut slope     :   18.00 dB/oct
  High-cut frequency:  206.00 Hz
  High-cut slope    :  276.00 dB/oct
  Instrument        :  S-24 g-12.5
  Time of 1st sample:  -56.00 msec i.e. index of time zero =  29.0
Sample interval     :    2.00 msec
Far-field position  :
  Distance          : 9000.00 m
  Azimuth           :    0.00 deg
  Angle of vertical :    0.00 deg

Amplitudes are in bar m
Time is increasing horizontally

     0.000     0.000     0.000    -0.010    -0.047    -0.025    -0.039
    -0.064     0.061     0.091     0.068     0.181     0.017    -0.066
     0.291    -0.112     0.397     0.250    -0.228     0.584    -0.995
     0.587    -0.745    -0.028     0.867    -2.040     3.619    -6.471
    20.826    54.058    16.992     3.024   -27.813   -67.261   -30.270
    -5.788    -4.220     1.618     0.568    -0.671    -0.945     4.745
     3.116     0.815     3.556     2.034     1.913     3.155     2.928
     2.412     2.792     2.793     2.281     2.496     2.390     2.219
     2.198     2.254     2.183     1.907     1.947     1.812     1.616
     1.788     1.778     1.644     1.741     1.564     1.283     1.129
     0.642     0.309     0.182    -0.109    -0.232    -0.516    -0.923
    -0.955    -0.951    -0.699    -0.139    -0.029    -0.103    -0.217
    -0.555    -0.518    -0.596    -1.261    -1.876    -2.635    -3.132
    -2.847    -2.550    -2.068    -1.376    -1.006    -0.481    -0.060
    -0.077    -0.126    -0.615    -1.344    -1.723    -2.035    -1.948
    -1.407    -1.028    -0.566    -0.225    -0.323    -0.298    -0.327
    -0.349     0.080     0.369     0.560     0.892     0.904     0.970
     1.133     0.996     1.062     1.172     1.091     1.270     1.295
     1.150     1.179     0.956     0.807     0.897     0.808     0.908
     0.993     0.819     0.852     0.748     0.565     0.679     0.568
     0.457     0.473     0.131    -0.106    -0.280    -0.660    -0.689
```

```
-0.683    -0.798    -0.627    -0.640    -0.717    -0.605    -0.729
-0.702    -0.495    -0.484    -0.270    -0.123    -0.212    -0.088
-0.115    -0.166     0.069     0.066     0.092     0.211     0.023
-0.015    -0.067    -0.328    -0.313    -0.353    -0.443    -0.283
-0.286    -0.266    -0.117    -0.145    -0.006     0.197     0.224
 0.389     0.443     0.357     0.416     0.319     0.228     0.302
 0.230     0.229     0.252     0.104     0.067     0.002    -0.131
-0.091    -0.098    -0.138    -0.100    -0.170
```

Figure 5: Far-field signature listing with 2 ms sampling interval (without receiver ghost).

Full system response with source and receiver ghost

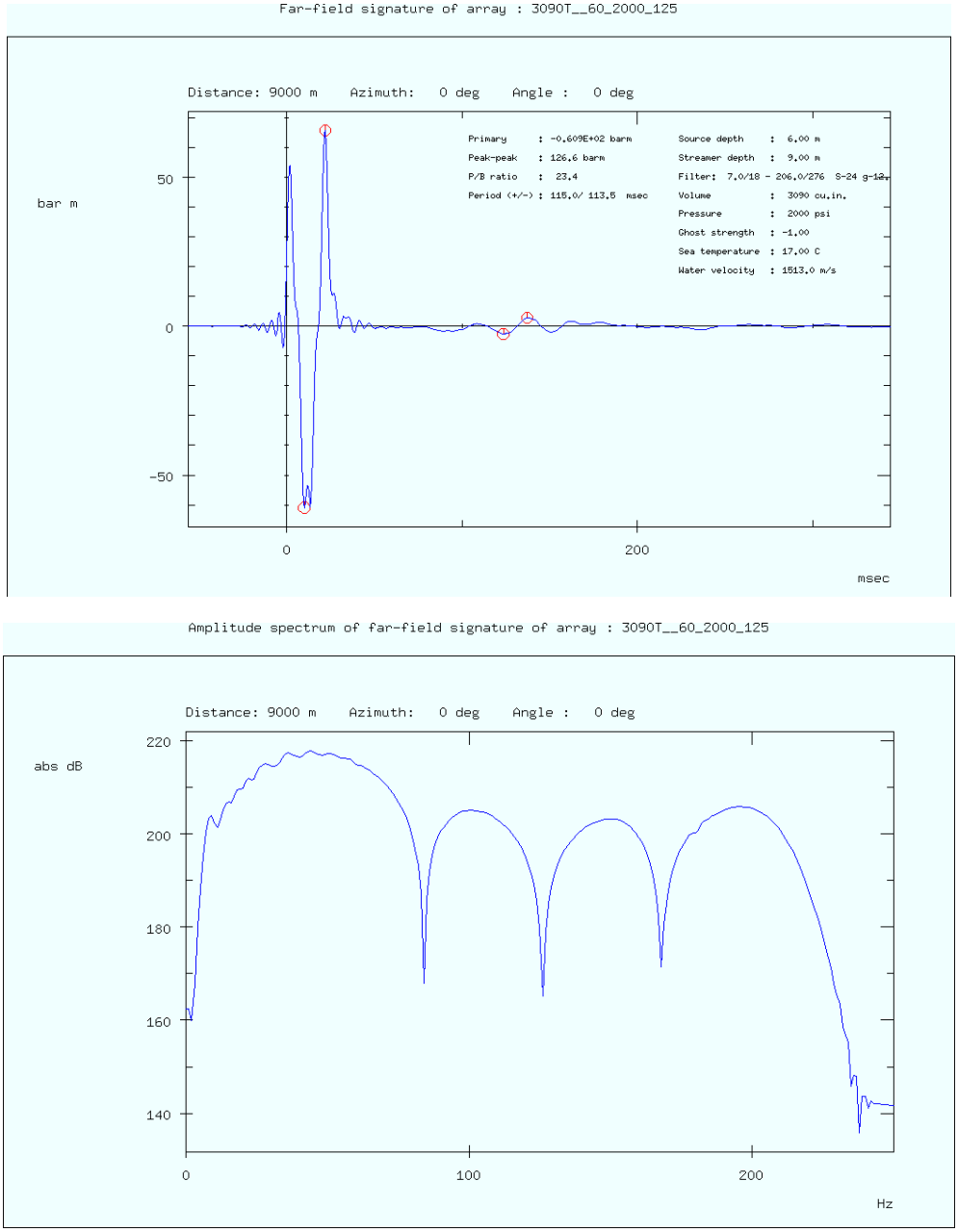


Figure 6: Modeled far-field signature and amplitude spectrum with recording and hydrophone filter effect applied (with receiver ghost).

Full system response with source and receiver ghost

FAR-FIELD SIGNATURE LISTING

```
Array name          :  3090T__60_2000_125
Total volume        :    3090 cu.in.
Source depth        :    6.00 m
Streamer depth      :    9.00 m
Group length        :   12.50 m
Average pressure    :    2000 psi
Ghost strength      :   -1.00
Primary amplitude   :  -60.93 bar m
Peak-peak amplitude :  126.64 bar m
P/B-ratio           :   23.75
Bubble period (+)   :  116.00 msec
Bubble period (-)   :  114.00 msec
Seawater temperature:   17.00 C
Seawater velocity   :  1513.0 m/s
Filter              :
  Low-cut frequency :    7.00 Hz
  Low-cut slope     :   18.00 dB/oct
  High-cut frequency:  206.00 Hz
  High-cut slope    :  276.00 dB/oct
  Instrument        :  S-24 g-12.5
  Time of 1st sample:  -56.00 msec i.e. index of time zero =  29.0
Sample interval     :    2.00 msec
Far-field position  :
  Distance          : 9000.00 m
  Azimuth           :    0.00 deg
  Angle of vertical :    0.00 deg

Amplitudes are in bar m
Time is increasing horizontally

     0.000     0.000     0.000    -0.010    -0.047    -0.025    -0.039
    -0.064     0.061     0.103     0.115     0.205     0.059    -0.007
     0.225    -0.200     0.325     0.069    -0.229     0.630    -1.276
     0.702    -1.178    -0.215     1.034    -2.561     4.601    -7.104
    21.679    53.867    16.418     4.751   -31.127   -60.934   -53.835
   -58.706   -19.560    -0.984    31.340    65.709    27.061    10.482
     6.974    -0.831     3.050     2.804     2.618    -1.715     0.083
     1.453    -0.754     0.845     0.293    -0.666    -0.497    -0.191
    -0.611    -0.500    -0.095    -0.590    -0.425    -0.401    -0.578
    -0.465    -0.386    -0.257    -0.203    -0.229    -0.334    -0.662
    -1.122    -1.334    -1.555    -1.651    -1.507    -1.624    -1.538
    -1.258    -1.119    -0.580     0.099     0.510     0.826     0.735
     0.391     0.150    -0.474    -1.226    -1.773    -2.401    -2.571
    -2.338    -1.928    -0.775     0.530     1.663     2.641     2.762
     2.453     1.900     0.735    -0.360    -1.274    -1.978    -1.870
    -1.269    -0.374     0.801     1.511     1.716     1.621     1.054
     0.657     0.619     0.593     0.885     1.186     1.238     1.303
     1.030     0.622     0.485     0.274     0.191     0.290     0.168
     0.160     0.109    -0.210    -0.285    -0.379    -0.475    -0.240
    -0.179    -0.120     0.042    -0.145    -0.240    -0.237    -0.415
    -0.357    -0.379    -0.601    -0.672    -0.959    -1.215    -1.149
    -1.144    -0.910    -0.518    -0.341    -0.048     0.077    -0.039
     0.090     0.124     0.163     0.439     0.483     0.523     0.600
     0.377     0.312     0.324     0.193     0.301     0.294     0.146
     0.141    -0.142    -0.390    -0.414    -0.558    -0.458    -0.272
    -0.205     0.067     0.192     0.216     0.430     0.475     0.512
     0.646     0.559     0.500     0.409     0.120     0.000    -0.095
    -0.207    -0.129    -0.163    -0.205    -0.163    -0.298    -0.357
    -0.324    -0.344    -0.237    -0.168    -0.164
```

Figure 7: Far-field signature listing with 2 ms sampling interval (with receiver ghost).

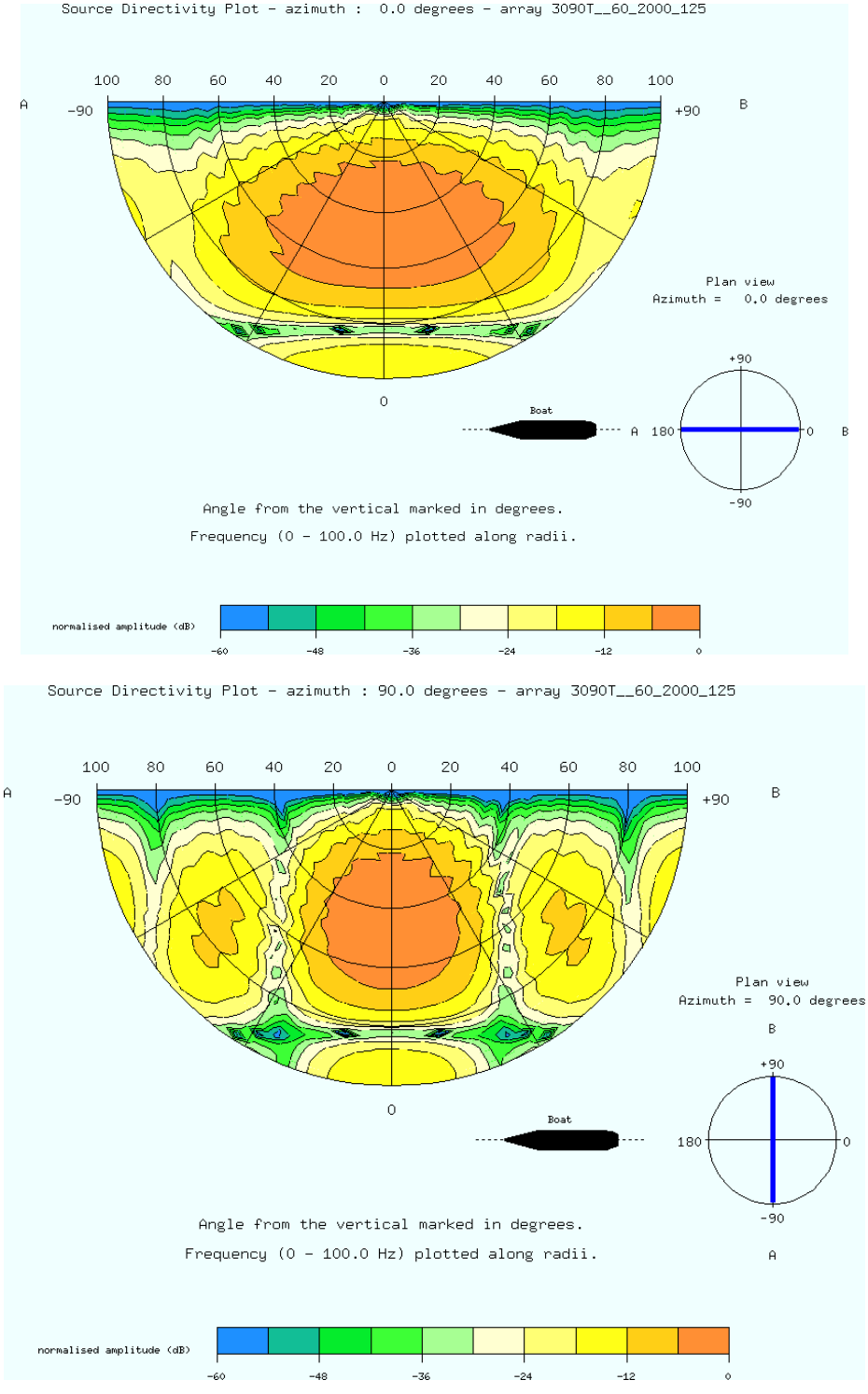


Figure 8: Directivity plot for constant azimuth of 0° and 90°.

12.4 Example SEG-D header

```
------------------------------------------------------------------------------
GENERAL HEADER #1                       Starting byte 0
Bytes     Description                   Value
------------------------------------------------------------------------------
01-02     File Number                   1843
03-04     SEGD Format                   8036
          Bits Per Sample               24
05-10     General Constants
11        Year                          2006
12        Additional Header Blocks      2
12-13     Day                           146
14        Hour                          21
15        Minute                        13
16        Second                        6
17        Manufacturer's Code           41
18-19     Manufacturer's Serial Number  0
20-22     Not Used
23        Base Scan Interval (ms)       2.0
24        Polarity
25        Scan/Block Exponent
26        Record Type                   Normal Record
27        Record Length (ms)            6144
28        Scan-types / Record           1
29        Channel Sets/Scan Type        11
30        Skew Blocks                   0
31        Extended-Header Blocks        0xFF
32        External-Header Blocks        0xFF

------------------------------------------------------------------------------
GENERAL HEADER #2                       Starting byte 32
Bytes     Description                   Value
------------------------------------------------------------------------------
01-03     Expanded File Number          0
04-05     Extended Channel Sets         0
06-07     Extended Header Blocks        1290
08-09     External Header Blocks        140
10        Reserved
11-12     SEG-D Revision Number         Rev. 0.0
13-14     General Trailer
15-17     Extended Record Length        200
18-19     General Header Block Number   2
20-31     Reserved
32        Extended Record Length        6
```

GENERAL HEADER #3		Starting Byte 64
Bytes	Description	Value
01-03	Reserved	
04-06	Source Line Number (int)	0
07-09	Source Line Number (fract)	0
10-12	Source Point Number (int)	4032
13-15	Source Point Number (fract)	0
14	Source Point Index	Not Used
15	Phase Control	Not Used
16	Type Vibrator	Not Used
17-18	Phase Angle	Not Used
19	General Header Block Number	3
20	Source Set Number	0
21-32	Reserved	

CHANNEL SET HEADER #1		Starting Byte 96
Bytes	Description	Value
01	Scan Type Number	1
02	Channel Set Number	1
03-04	Channel Set Start Time (ms)	0
05-06	Channel Set End Time (ms)	6144
07-08	Pre-Amp Gain (dB)	12
09-10	Number of Channels	360
11	Channel Set Type	Seismic Data
12	Scans per Base Scan	1
13-14	Alias Filter Frequency	206
15-16	Alias Filter Slope	276
17-18	Low Cut Filter	3
19-20	Low Cut Filter Slope	12
21-22	First Notch Filter	0
23-24	Second Notch Filter	0
25-26	Third Notch Filter	0
27-28	Extended Channel Set Number	0
29	Extended Header Flag	0
30	Vertical Stack	0
31	Cable Number	0
32	Array Forming	0

CHANNEL SET HEADER #2		Starting Byte 128
Bytes	Description	Value
01	Scan Type Number	1
02	Channel Set Number	2
03-04	Channel Set Start Time (ms)	0
05-06	Channel Set End Time (ms)	6144
07-08	Pre-Amp Gain (dB)	12
09-10	Number of Channels	360
11	Channel Set Type	Seismic Data
12	Scans per Base Scan	1
13-14	Alias Filter Frequency	206
15-16	Alias Filter Slope	276
17-18	Low Cut Filter	3
19-20	Low Cut Filter Slope	12
21-22	First Notch Filter	0
23-24	Second Notch Filter	0
25-26	Third Notch Filter	0
27-28	Extended Channel Set Number	0
29	Extended Header Flag	0
30	Vertical Stack	0
31	Cable Number	0
32	Array Forming	0

CHANNEL SET HEADER #3		Starting Byte 160
Bytes	Description	Value
01	Scan Type Number	1
02	Channel Set Number	3
03-04	Channel Set Start Time (ms)	0
05-06	Channel Set End Time (ms)	6144
07-08	Pre-Amp Gain (dB)	12
09-10	Number of Channels	360
11	Channel Set Type	Seismic Data
12	Scans per Base Scan	1
13-14	Alias Filter Frequency	206
15-16	Alias Filter Slope	276
17-18	Low Cut Filter	3
19-20	Low Cut Filter Slope	12
21-22	First Notch Filter	0
23-24	Second Notch Filter	0
25-26	Third Notch Filter	0
27-28	Extended Channel Set Number	0
29	Extended Header Flag	0
30	Vertical Stack	0
31	Cable Number	0
32	Array Forming	0

CHANNEL SET HEADER #4		Starting Byte 192
Bytes	Description	Value
01	Scan Type Number	1
02	Channel Set Number	4
03-04	Channel Set Start Time (ms)	0
05-06	Channel Set End Time (ms)	6144
07-08	Pre-Amp Gain (dB)	12
09-10	Number of Channels	360
11	Channel Set Type	Seismic Data
12	Scans per Base Scan	1
13-14	Alias Filter Frequency	206
15-16	Alias Filter Slope	276
17-18	Low Cut Filter	3
19-20	Low Cut Filter Slope	12
21-22	First Notch Filter	0
23-24	Second Notch Filter	0
25-26	Third Notch Filter	0
27-28	Extended Channel Set Number	0
29	Extended Header Flag	0
30	Vertical Stack	0
31	Cable Number	0
32	Array Forming	0

CHANNEL SET HEADER #5		Starting Byte 224
Bytes	Description	Value
01	Scan Type Number	1
02	Channel Set Number	5
03-04	Channel Set Start Time (ms)	0
05-06	Channel Set End Time (ms)	6144
07-08	Pre-Amp Gain (dB)	12
09-10	Number of Channels	360
11	Channel Set Type	Seismic Data
12	Scans per Base Scan	1
13-14	Alias Filter Frequency	206
15-16	Alias Filter Slope	276
17-18	Low Cut Filter	3
19-20	Low Cut Filter Slope	12
21-22	First Notch Filter	0
23-24	Second Notch Filter	0
25-26	Third Notch Filter	0
27-28	Extended Channel Set Number	0
29	Extended Header Flag	0
30	Vertical Stack	0
31	Cable Number	0
32	Array Forming	0

CHANNEL SET HEADER #6		Starting Byte 256
Bytes	Description	Value
01	Scan Type Number	1
02	Channel Set Number	6
03-04	Channel Set Start Time (ms)	0
05-06	Channel Set End Time (ms)	6144
07-08	Pre-Amp Gain (dB)	12
09-10	Number of Channels	360
11	Channel Set Type	Seismic Data
12	Scans per Base Scan	1
13-14	Alias Filter Frequency	206
15-16	Alias Filter Slope	276
17-18	Low Cut Filter	3
19-20	Low Cut Filter Slope	12
21-22	First Notch Filter	0
23-24	Second Notch Filter	0
25-26	Third Notch Filter	0
27-28	Extended Channel Set Number	0
29	Extended Header Flag	0
30	Vertical Stack	0
31	Cable Number	0
32	Array Forming	0

CHANNEL SET HEADER #7		Starting Byte 288
Bytes	Description	Value
01	Scan Type Number	1
02	Channel Set Number	7
03-04	Channel Set Start Time (ms)	0
05-06	Channel Set End Time (ms)	6144
07-08	Pre-Amp Gain (dB)	12
09-10	Number of Channels	48
11	Channel Set Type	AUX Data
12	Scans per Base Scan	1
13-14	Alias Filter Frequency	206
15-16	Alias Filter Slope	276
17-18	Low Cut Filter	3
19-20	Low Cut Filter Slope	12
21-22	First Notch Filter	0
23-24	Second Notch Filter	0
25-26	Third Notch Filter	0
27-28	Extended Channel Set Number	0
29	Extended Header Flag	0
30	Vertical Stack	0
31	Cable Number	0
32	Array Forming	0

CHANNEL SET HEADER #8		Starting Byte 320
Bytes	Description	Value
01	Scan Type Number	1
02	Channel Set Number	8
03-04	Channel Set Start Time (ms)	0
05-06	Channel Set End Time (ms)	6144
07-08	Pre-Amp Gain (dB)	12
09-10	Number of Channels	360
11	Channel Set Type	Seismic Data
12	Scans per Base Scan	1
13-14	Alias Filter Frequency	206
15-16	Alias Filter Slope	276
17-18	Low Cut Filter	3
19-20	Low Cut Filter Slope	12
21-22	First Notch Filter	0
23-24	Second Notch Filter	0
25-26	Third Notch Filter	0
27-28	Extended Channel Set Number	0
29	Extended Header Flag	0
30	Vertical Stack	0
31	Cable Number	0
32	Array Forming	0

CHANNEL SET HEADER #9		Starting Byte 352
Bytes	Description	Value
01	Scan Type Number	1
02	Channel Set Number	9
03-04	Channel Set Start Time (ms)	0
05-06	Channel Set End Time (ms)	6144
07-08	Pre-Amp Gain (dB)	12
09-10	Number of Channels	360
11	Channel Set Type	Seismic Data
12	Scans per Base Scan	1
13-14	Alias Filter Frequency	206
15-16	Alias Filter Slope	276
17-18	Low Cut Filter	3
19-20	Low Cut Filter Slope	12
21-22	First Notch Filter	0
23-24	Second Notch Filter	0
25-26	Third Notch Filter	0
27-28	Extended Channel Set Number	0
29	Extended Header Flag	0
30	Vertical Stack	0
31	Cable Number	0
32	Array Forming	0

CHANNEL SET HEADER #10		Starting Byte 384
Bytes	Description	Value
01	Scan Type Number	1
02	Channel Set Number	10
03-04	Channel Set Start Time (ms)	0
05-06	Channel Set End Time (ms)	6144
07-08	Pre-Amp Gain (dB)	12
09-10	Number of Channels	360
11	Channel Set Type	Seismic Data
12	Scans per Base Scan	1
13-14	Alias Filter Frequency	206
15-16	Alias Filter Slope	276
17-18	Low Cut Filter	3
19-20	Low Cut Filter Slope	12
21-22	First Notch Filter	0
23-24	Second Notch Filter	0
25-26	Third Notch Filter	0
27-28	Extended Channel Set Number	0
29	Extended Header Flag	0
30	Vertical Stack	0
31	Cable Number	0
32	Array Forming	0

CHANNEL SET HEADER #11		Starting Byte 416
Bytes	Description	Value
01	Scan Type Number	1
02	Channel Set Number	11
03-04	Channel Set Start Time (ms)	0
05-06	Channel Set End Time (ms)	6144
07-08	Pre-Amp Gain (dB)	12
09-10	Number of Channels	360
11	Channel Set Type	Seismic Data
12	Scans per Base Scan	1
13-14	Alias Filter Frequency	206
15-16	Alias Filter Slope	276
17-18	Low Cut Filter	3
19-20	Low Cut Filter Slope	12
21-22	First Notch Filter	0
23-24	Second Notch Filter	0
25-26	Third Notch Filter	0
27-28	Extended Channel Set Number	0
29	Extended Header Flag	0
30	Vertical Stack	0
31	Cable Number	0
32	Array Forming	0

HOST RECORDING SYSTEM STATUS BLOCK #1		Starting Byte 448
Bytes	Description	Value
01	External Header Status	OK
02	Tape Unit for Writing	0
02	Buffer Used	0
03-04	Number of Channels (Cable 1)	360
05-06	Number of Channels (Cable 2)	360
07-08	Number of Channels (Cable 3)	360
09-10	Number of Channels (Cable 4)	360
11-12	Number of Channels (Cable 5)	360
13-14	Number of Channels (Cable 6)	360
15-16	Number of Channels (Cable 7)	360
17-18	Number of Channels (Cable 8)	360
19-20	Reserved	
21	Transient Removal	Yes
22	Filter Samples Removed	28
23	Additional Host Blocks	1
23	Module Type	24-bit
24	Number of Physical Cables	15
24	MSRS Chassis	Single Chassis Used
25	Number of Receiver Lines	0
26	System Type	Non-Receiver Line
27	Record Status	Production Record
28	Header Revision	1
29	Software Revision	1
30-31	Blocks after SEG-D Area	1430
32	Number of Cables	10

HOST RECORDING SYSTEM STATUS BLOCK #2		Starting Byte 480
Bytes	Description	Value
01-02	Number of Channels (Cable 9)	360
03-04	Number of Channels (Cable 10)	360
05-06	Number of Channels (Cable 11)	0
07-08	Number of Channels (Cable 12)	0
09-10	Number of Channels (Cable 13)	0
11-12	Number of Channels (Cable 14)	0
13-14	Number of Channels (Cable 15)	0
15-16	Number of Channels (Cable 16)	0
17-31	Reserved	
32	Number of Physical Cables	125

LINE ID BLOCK #1		Starting Byte 512
Bytes	Description	Value
01-08	Cable 1 Line ID	
09-08	Cable 2 Line ID	
17-24	Cable 3 Line ID	
25-32	Cable 4 Line ID	

LINE ID BLOCK #2		Starting Byte 544
Bytes	Description	Value
01-08	Cable 5 Line ID	
09-08	Cable 6 Line ID	
17-24	Cable 7 Line ID	
25-32	Cable 8 Line ID	

LINE ID BLOCK #3		Starting Byte 576
Bytes	Description	Value
01-08	Cable 9 Line ID	
09-08	Cable 10 Line ID	
17-24	Cable 11 Line ID	
25-32	Cable 12 Line ID	

REEL NUMBER HEADER		Starting Byte 608
Bytes	Description	Value
01-02	Shot Time: Day	146
03	Shot Time: Hour	21
04	Shot Time: Minute	13
05	Shot Time: Second	6
06-08	Shot Time: Microseconds	852799
09	Acquisition Hardware	Syntrak System
10-12	Not Used	
13	External Header 1	Nav & GCS90 Combined
14	External Header 2	Digicourse Header
15	External Header 3	Not Defined
16	External Header 4	Not Defined
17-32	Reel Number	63064

CLIENT NAME	Starting Byte 640	
Bytes	Description	Value
01-32	Client Name	Woodside Energy Ltd

CONTRACTOR NAME	Starting Byte 672	
Bytes	Description	Value
01-32	Contractor Name	PGS Geophysical

SURVEY NAME	Starting Byte 704	
Bytes	Description	Value
01-32	Survey Name	Aragorn 3D

PROJECT CODE	Starting Byte 736	
Bytes	Description	Value
01-16	Project Code	2005098
17-18	Line Type	Off Line
19-24	Swath Number	0000.0
25-32	Sequence Number	57

CABLE #1	STATUS BLOCK 1	Starting Byte 768
Bytes	Description	Value
01-03	Transmitted Scan Count	0
04-06	Received Scan Count	0
07-09	Transmitted Extraction Count	92160
10-12	Received Extraction Count	92160
13	Scan/Extraction Count Status	No Error
14	Time Break Status	No Error
15	Logical Cable	0
16	Telemetry Processor Status	No Error
17	DSP Programs	0
18	First Channel Set	0
19	Last Channel Set	0
20-21	MSTS Software Revision	00.00
22-23	GPS Timebreak Decimal	.0000(00)
24	Physical Cable Number	0
24	Port Number	0
25-26	Time Break (ms)	0
27	QC Test	0
27	AUX Box Parameters	Not present in system
28-31	Test Oscillator Frequency	000.00000 Hz
32	Test Oscillator Amplitude	0.0 (-dB)

CABLE #1	STATUS BLOCK 2	Starting Byte 800
Bytes	Description	Value
01-32	Not Used	

CABLE #1	STATUS BLOCK 3	Starting Byte 832
Bytes	Description	Value
01-32	Not Used	

CABLE #2 Bytes	STATUS BLOCK 1 Description	Starting Byte 864 Value
01-03	Transmitted Scan Count	0
04-06	Received Scan Count	0
07-09	Transmitted Extraction Count	92160
10-12	Received Extraction Count	92160
13	Scan/Extraction Count Status	No Error
14	Time Break Status	No Error
15	Logical Cable	0
16	Telemetry Processor Status	No Error
17	DSP Programs	0
18	First Channel Set	0
19	Last Channel Set	0
20-21	MSTS Software Revision	00.00
22-23	GPS Timebreak Decimal	.0000(00)
24	Physical Cable Number	0
24	Port Number	0
25-26	Time Break (ms)	0
27	QC Test	0
27	AUX Box Parameters	Not present in system
28-31	Test Oscillator Frequency	000.00000 Hz
32	Test Oscillator Amplitude	0.0 (-dB)

CABLE #2 Bytes	STATUS BLOCK 2 Description	Starting Byte 896 Value
01-32	Not Used	

CABLE #2 Bytes	STATUS BLOCK 3 Description	Starting Byte 928 Value
01-32	Not Used	

CABLE #3 Bytes	STATUS BLOCK 1 Description	Starting Byte 960 Value
01-03	Transmitted Scan Count	0
04-06	Received Scan Count	0
07-09	Transmitted Extraction Count	92160
10-12	Received Extraction Count	92160
13	Scan/Extraction Count Status	No Error
14	Time Break Status	No Error
15	Logical Cable	0
16	Telemetry Processor Status	No Error
17	DSP Programs	0
18	First Channel Set	0
19	Last Channel Set	0

20-21	MSTS Software Revision	00.00
22-23	GPS Timebreak Decimal	.0000(00)
24	Physical Cable Number	0
24	Port Number	0
25-26	Time Break (ms)	0
27	QC Test	0
27	AUX Box Parameters	Not present in system
28-31	Test Oscillator Frequency	000.00000 Hz
32	Test Oscillator Amplitude	0.0 (-dB)

CABLE #3	STATUS BLOCK 2	Starting Byte 992
Bytes	Description	Value
01-32	Not Used	

CABLE #3	STATUS BLOCK 3	Starting Byte 1024
Bytes	Description	Value
01-32	Not Used	

CABLE #4	STATUS BLOCK 1	Starting Byte 1056
Bytes	Description	Value
01-03	Transmitted Scan Count	0
04-06	Received Scan Count	0
07-09	Transmitted Extraction Count	92160
10-12	Received Extraction Count	92160
13	Scan/Extraction Count Status	No Error
14	Time Break Status	No Error
15	Logical Cable	0
16	Telemetry Processor Status	No Error
17	DSP Programs	0
18	First Channel Set	0
19	Last Channel Set	0
20-21	MSTS Software Revision	00.00
22-23	GPS Timebreak Decimal	.0000(00)
24	Physical Cable Number	0
24	Port Number	0
25-26	Time Break (ms)	0
27	QC Test	0
27	AUX Box Parameters	Not present in system
28-31	Test Oscillator Frequency	000.00000 Hz
32	Test Oscillator Amplitude	0.0 (-dB)

CABLE #4	STATUS BLOCK 2	Starting Byte 1088
Bytes	Description	Value
01-32	Not Used	

CABLE #4	STATUS BLOCK 3	Starting Byte 1120
Bytes	Description	Value
01-32	Not Used	

CABLE #5	STATUS BLOCK 1	Starting Byte 1152
Bytes	Description	Value
01-03	Transmitted Scan Count	0
04-06	Received Scan Count	0
07-09	Transmitted Extraction Count	92160
10-12	Received Extraction Count	92160
13	Scan/Extraction Count Status	No Error
14	Time Break Status	No Error
15	Logical Cable	0
16	Telemetry Processor Status	No Error
17	DSP Programs	0
18	First Channel Set	0
19	Last Channel Set	0
20-21	MSTS Software Revision	00.00
22-23	GPS Timebreak Decimal	.0000(00)
24	Physical Cable Number	0
24	Port Number	0
25-26	Time Break (ms)	0
27	QC Test	0
27	AUX Box Parameters	Not present in system
28-31	Test Oscillator Frequency	000.00000 Hz
32	Test Oscillator Amplitude	0.0 (-dB)

CABLE #5	STATUS BLOCK 2	Starting Byte 1184
Bytes	Description	Value
01-32	Not Used	

CABLE #5	STATUS BLOCK 3	Starting Byte 1216
Bytes	Description	Value
01-32	Not Used	

CABLE #6	STATUS BLOCK 1	Starting Byte 1248
Bytes	Description	Value
01-03	Transmitted Scan Count	0
04-06	Received Scan Count	0
07-09	Transmitted Extraction Count	104448
10-12	Received Extraction Count	104448
13	Scan/Extraction Count Status	No Error
14	Time Break Status	No Error
15	Logical Cable	0

16	Telemetry Processor Status	No Error
17	DSP Programs	0
18	First Channel Set	0
19	Last Channel Set	0
20-21	MSTS Software Revision	00.00
22-23	GPS Timebreak Decimal	.0000(00)
24	Physical Cable Number	0
24	Port Number	0
25-26	Time Break (ms)	0
27	QC Test	0
27	AUX Box Parameters	Not present in system
28-31	Test Oscillator Frequency	000.00000 Hz
32	Test Oscillator Amplitude	0.0 (-dB)

CABLE #6	STATUS BLOCK 2	Starting Byte 1280
Bytes	Description	Value
01-32	Not Used	

CABLE #6	STATUS BLOCK 3	Starting Byte 1312
Bytes	Description	Value
01-32	Not Used	

CABLE #7	STATUS BLOCK 1	Starting Byte 1344
Bytes	Description	Value
01-03	Transmitted Scan Count	0
04-06	Received Scan Count	0
07-09	Transmitted Extraction Count	92160
10-12	Received Extraction Count	92160
13	Scan/Extraction Count Status	No Error
14	Time Break Status	No Error
15	Logical Cable	0
16	Telemetry Processor Status	No Error
17	DSP Programs	0
18	First Channel Set	0
19	Last Channel Set	0
20-21	MSTS Software Revision	00.00
22-23	GPS Timebreak Decimal	.0000(00)
24	Physical Cable Number	0
24	Port Number	0
25-26	Time Break (ms)	0
27	QC Test	0
27	AUX Box Parameters	Not present in system
28-31	Test Oscillator Frequency	000.00000 Hz
32	Test Oscillator Amplitude	0.0 (-dB)

CABLE #7	STATUS BLOCK 2	Starting Byte 1376
Bytes	Description	Value
01-32	Not Used	

CABLE #7	STATUS BLOCK 3	Starting Byte 1408
Bytes	Description	Value
01-32	Not Used	

CABLE #8	STATUS BLOCK 1	Starting Byte 1440
Bytes	Description	Value
01-03	Transmitted Scan Count	0
04-06	Received Scan Count	0
07-09	Transmitted Extraction Count	92160
10-12	Received Extraction Count	92160
13	Scan/Extraction Count Status	No Error
14	Time Break Status	No Error
15	Logical Cable	0
16	Telemetry Processor Status	No Error
17	DSP Programs	0
18	First Channel Set	0
19	Last Channel Set	0
20-21	MSTS Software Revision	00.00
22-23	GPS Timebreak Decimal	.0000(00)
24	Physical Cable Number	0
24	Port Number	0
25-26	Time Break (ms)	0
27	QC Test	0
27	AUX Box Parameters	Not present in system
28-31	Test Oscillator Frequency	000.00000 Hz
32	Test Oscillator Amplitude	0.0 (-dB)

CABLE #8	STATUS BLOCK 2	Starting Byte 1472
Bytes	Description	Value
01-32	Not Used	

CABLE #8	STATUS BLOCK 3	Starting Byte 1504
Bytes	Description	Value
01-32	Not Used	

CABLE #9	STATUS BLOCK 1	Starting Byte 1536
Bytes	Description	Value
01-03	Transmitted Scan Count	0
04-06	Received Scan Count	0
07-09	Transmitted Extraction Count	92160
10-12	Received Extraction Count	92160
13	Scan/Extraction Count Status	No Error
14	Time Break Status	No Error
15	Logical Cable	0
16	Telemetry Processor Status	No Error
17	DSP Programs	0
18	First Channel Set	0
19	Last Channel Set	0
20-21	MSTS Software Revision	00.00
22-23	GPS Timebreak Decimal	.0000(00)
24	Physical Cable Number	0
24	Port Number	0
25-26	Time Break (ms)	0
27	QC Test	0
27	AUX Box Parameters	Not present in system
28-31	Test Oscillator Frequency	000.00000 Hz
32	Test Oscillator Amplitude	0.0 (-dB)

CABLE #9	STATUS BLOCK 2	Starting Byte 1568
Bytes	Description	Value
01-32	Not Used	

CABLE #9	STATUS BLOCK 3	Starting Byte 1600
Bytes	Description	Value
01-32	Not Used	

CABLE #10	STATUS BLOCK 1	Starting Byte 1632
Bytes	Description	Value
01-03	Transmitted Scan Count	0
04-06	Received Scan Count	0
07-09	Transmitted Extraction Count	92160
10-12	Received Extraction Count	92160
13	Scan/Extraction Count Status	No Error
14	Time Break Status	No Error
15	Logical Cable	0
16	Telemetry Processor Status	No Error
17	DSP Programs	0
18	First Channel Set	0
19	Last Channel Set	0

20-21	MSTS Software Revision	00.00
22-23	GPS Timebreak Decimal	.0000(00)
24	Physical Cable Number	0
24	Port Number	0
25-26	Time Break (ms)	0
27	QC Test	0
27	AUX Box Parameters	Not present in system
28-31	Test Oscillator Frequency	000.00000 Hz
32	Test Oscillator Amplitude	0.0 (-dB)

CABLE #10 STATUS BLOCK 2		Starting Byte 1664
Bytes	Description	Value
01-32	Not Used	

CABLE #10 STATUS BLOCK 3		Starting Byte 1696
Bytes	Description	Value
01-32	Not Used	

NAVIGATION HEADER #1		Starting Byte 41728
Bytes	Description	Value
01-02	Master Block ID	$1
03-06	Length of Message	1666
07-10	Program Revision	0002
11-12	Shot Switch	Run-Out
13-26	Shot Time	211306.97268520060526
34-36	Time Reference	UTC
37-42	Shot Number	004032
43-58	Current Line Name	W06ARG1750P1
59-69	Master Latitude	-39.284747
70-80	Master Longitude	142.813628
81-86	Water Depth (meters)	119.0
87-97	Source Latitude	-39.287947
98-108	Source Longitude	142.815974
109-113	Master Gyro (degrees)	323.2
114-118	Master CMG (degrees)	329.7
119-122	Master Speed (knots)	4.3

GCS90 GUN-CONTROLLER HEADER #1		Starting Byte 41850
Bytes	Description	Value
01-06	ID String	*GCS90
07-10	Length of Block	1550
11-16	Line Number	1750P1
17-20	Shot Number	4032
21-22	Active Array Mask	07
23	Trigger Mode	External
24-25	Current Sequence Number	02
26-28	Number of Sub-Arrays	006
29-31	Number of Guns in Array	066
32-34	Number of Active Guns	028
35-37	Number of Delta-Errors	000
38-40	Number of Auto-Fires	000
41-43	Number of Mis-Fires	000
44-46	Delta Spread	006
47-52	Volume Fired	003090
53-66	Spare	
67-70	Manifold Pressure	2048
71-74	Deep Tow	0000
75-78	Sub-Array String Pressure	2033
79-82	Sub-Array String Pressure	2026
83-86	Sub-Array String Pressure	2029
87-90	Sub-Array String Pressure	2002
91-94	Sub-Array String Pressure	2022
95-98	Sub-Array String Pressure	

12.5 Example SEG-Y Header

12.5.1 Trace Headers

```
# This file contains the definition of trace headers and SEGY binary header
# for Woodside's archive tape formats - version M.11. Pre-stacked data.
# Date : 2006
#
trace_header
#
# Starting_Byte  Format  Parameter_Name     Data_Source   Source_Name
  1              INT4    TraceSeqNoLine     InternalData  TraceSeqNoLine
  5              INT4    TraceSeqNoReel     InternalData  TraceSeqNoReel
  9              INT4    FieldRecNo         PGSHeader     FFID
  13             INT4    TraceNoField       PGSHeader     CHAN
  17             INT4    SourcePointNo      PGSHeader     SHOT
  21             INT4    CMP                PGSHeader     CMP
  25             INT4    TraceNoSHOT        PGSHeader     SEQNO
  29             INT2    TraceType          PGSHeader     TYPE
  31             INT2    NoVertical         ConstantValue 1
  33             INT2    NoHorizontal       ConstantValue 1
  35             INT2    DataUse            ConstantValue 1
  37             INT4    Offset             PGSHeader     OFFSET
  41             INT4    ReceiverGroupElev  PGSHeader     RDEPTH
  45             INT4    SurfElevAtSource   ConstantValue 0
  49             INT4    SourceDepth        PGSHeader     SDEPTH
  53             INT4    ElevAtReceiver     ConstantValue 0
  57             INT4    ElevAtSource       ConstantValue 0
  61             INT4    WaterDepthSource   PGSHeader     WDS
  65             INT4    WaterDepthRec      ConstantValue 0
  69             INT2    ScalerElev         ConstantValue 1
  71             INT2    ScalerXYs          ConstantValue 1
  73             INT4    ShotX              PGSHeader     SHT-X
  77             INT4    ShotY              PGSHeader     SHT-Y
  81             INT4    ReceiverX          PGSHeader     REC-X
  85             INT4    ReceiverY          PGSHeader     REC-Y
  89             INT2    Units              ConstantValue 1
  91             INT2    WaterVelocity      ConstantValue 1500
  93             INT2    ReplacementVel     ConstantValue 0
  95             INT2    UpholeSource       ConstantValue 0
  97             INT2    UpholeReceiver     ConstantValue 0
  99             INT2    SourceDepthCorr    PGSHeader     SHTCOR
  101            INT2    RecDepthCorr       PGSHeader     RECCOR
  103            INT2    TotalStatic        PGSHeader     TOT-SHFT
  105            INT2    LagTimeA           ConstantValue 0
  107            INT2    GunRecorderDelay   PGSHeader     GUNDELAY
  109            INT2    DeepWaterDelay     ConstantValue 0
  111            INT2    WaterBottomTWT     PGSHeader     WBT
  113            INT2    OuterMuteEndTime   ConstantValue 0
  115            INT2    NoSampleOnTr       InternalData  NoSamp
  117            INT2    SampleInt          InternalData  SampInt
  119            INT2    InstGainType       ConstantValue 0
```

```
  121            INT2    InstGainConst      ConstantValue 0
  123            INT2    InitialGain        ConstantValue 0
  125            INT2    BadTraceIdent      PGSHeader     BADTR
  127            INT2    DespikeFlag        ConstantValue 0
  129            INT2    ConstantValue      ConstantValue 0
  131            INT2    ConstantValue      ConstantValue 0
  133            INT2    ConstantValue      ConstantValue 0
  135            INT2    ConstantValue      ConstantValue 0
  137            INT2    ConstantValue      ConstantValue 0
  139            INT2    ConstantValue      ConstantValue 0
  141            INT2    AntiAliasFreq3dB   ConstantValue 94
  143            INT2    AntiAliasSlope     ConstantValue 72
  145            INT2    NotchFiltFreq      ConstantValue 0
  147            INT2    NotchFilrSlope     ConstantValue 0
  149            INT2    LowCutFreq3dB      ConstantValue 5
  151            INT2    HighCutFreq        ConstantValue 94
  153            INT2    LowCutSlope        ConstantValue 18
  155            INT2    HighCutSlope       ConstantValue 72
  157            INT2    Year               PGSHeader     YEAR
  159            INT2    Day                PGSHeader     DAY
  161            INT2    Hour               PGSHeader     HOUR
  163            INT2    Minute             PGSHeader     MINUTE
  165            INT2    Second             PGSHeader     SECOND
  167            INT2    TimeBasisCode      ConstantValue 2
  169            INT2    TraceWeightFactor  PGSHeader     0
  171            INT2    na                 ConstantValue 0
  173            INT2    na                 ConstantValue 0
  175            INT2    na                 ConstantValue 0
  177            INT2    na                 ConstantValue 0
  179            INT2    na                 ConstantValue 0
  181            INT4    CMPX               PGSHeader     MID-X
  185            INT4    CMPY               PGSHeader     MID-Y
  189            INT4    Subline            PGSHeader     SUBLINE
  193            INT4    Xline              PGSHeader     XLINE
  197            INT4    na                 ConstantValue 0
  201            INT4    SailLine           PGSHeader     SEGYLINE
  205            INT4    StreamerNumber     PGSHeader     CABLENUM
  209        INT4    SourceDepthCorr_uM PGSHeader     SHTCOR2
  213            INT4    RecDepthCorr_uM    PGSHeader     RECCOR2
  217            INT4    FloatingDatum      ConstantValue 0
  221            INT4    TidalStatics_uM    PGSHeader     TCOR2
  225            INT4    ReceiverDepth      PGSHeader     RDEPTH
  229            INT4    CMPWaterDepth      ConstantValue 0
  233            INT4    ShotAmpScaler      ConstantValue 1000
  237            INT4    RecAmpScaler       ConstantValue 1000
end
```

```
tape_binary_header
  1               INT4    LineArchiveNum     ConstantValue 1
  5               INT4    LineNo             PGSHeader     SEGYLINE
  9               INT4    ReelNo             InternalData  ReelNo
  13              INT2    NoTraceRecord      InternalData  NoTraceRecord
  15              INT2    NoAuxTraceRecord   ConstantValue 0
  17              INT2    SampInt            InternalData  SampInt
  19              INT2    SampIntOrig        ConstantValue 2000
  21              INT2    NoSamp             InternalData  NoSamp
  23              INT2    NoSampOrig         ConstantValue 4608
  25              INT2    SampType           InternalData  SampType
  27              INT2    CDPFold            ConstantValue 0
  29              INT2    SortingType        ConstantValue 1
  31              INT2    VerticalSum        ConstantValue 1
  33              INT2    ConstantValue      ConstantValue 0
  35              INT2    ConstantValue      ConstantValue 0
  37              INT2    ConstantValue      ConstantValue 0
  39              INT2    ConstantValue      ConstantValue 0
  41              INT2    ConstantValue      ConstantValue 0
  43              INT2    ConstantValue      ConstantValue 0
  45              INT2    ConstantValue      ConstantValue 0
  47              INT2    ConstantValue      ConstantValue 0
  49              INT2    ConstantValue      ConstantValue 0
  51              INT2    ConstantValue      ConstantValue 0
  53              INT2    ConstantValue      ConstantValue 0
  55              INT2    LengthUnit         ConstantValue 1
  57              INT2    ConstantValue      ConstantValue 0
  59              INT2    ConstantValue      ConstantValue 0
end
```

12.5.2 EBCDIC Header

Example of EBCDIC Header for Woodside Energy Ltd.

```
C 1 CLIENT   :WOODSIDE ENERGY Ltd ; SURVEY :ARAGORN 3D PreSTM 2006
C 2 LINE NO  :W06ARG1550P1          DIRECTION : 151.00 DEGREE
C 3 AREA     :OTWAY BASIN
C 4 DATA-SET :INDENTED SHOTS
C 5 WEL SEG-Y VERSION :VERSION M.11
C 6 TAPE NO           :GQ2679 to GQ2684
C 7 ACQ PREFIX        :W06ARG        PROCESSED DATE   :APRIL 2006
C 8 SHOT/RCV INTERVAL :18.75/12.50    NO.GUNS/CABLES   :02/10
C 9 CABLE LENGTH      :4500m          RCVS PER CABLE   :360
C10 GUN SEPARATION    :60m            CABLE SEPARATION :120m
C11 FAR PORT SOURCE NO:ARRAY-2        FAR STARBOARD SOURCE NO.:ARRAY-1
C12 FAR PORT CABLE NO.:STREAMER-10    FAR STARBOARD CABLE NO. :STREAMER-1
C13 MIN OFFSET        :280m           MAX OFFSET       :4768m
C14 SPHEROID OF REF   :GRS1980          PROJECTION       :MGA 94 (UTM, 52s)
C15 COORDINATES UNITS :METRES         PROCESSED DATUM :GDA94
C16 BINNING ORIGIN (E,N)             :663327.104, 5583119.057
C17 BINNING ORIGIN (XLINE,INLINE)    :2280 , 850
C18 NO. XLINES/INLINES:13723/2075    XLINE/INLINE INT :6.25/30.00
C19 GRID MIN/MAX XLINE:2280/16002   GRID MIN/MAX INLINE:850/2924
C20 ROTATION ANGLE    :0.0(DEG)     (CLOCKWISE=POSITIVE)
C21 SAMPLE RATE (uS)  :4000           MAX TIME (MS)    :6140
C22 ====PROCESSED BY PGS GEOPHYSICAL ONBOARD RAMFORM VICTORY====
C23 REFORMAT:
C24 SEGD CONVERSION TO INTERNAL FORMAT,
C25 GUN/CABLE STATIC CORRECTION,
C26 GUN DELAY CORRECTION,
C27 TIDAL STATIC  CORRECTION (FLAGGED ONLY),
C28 ZP ANTI-ALIAS BUTTERWORTH FILTER: OUT - 93.75hz/72dB/oct,
C29 RESAMPLE 4MS,
C30 DESPIKE,
C31 ZP LOW CUT BUTTERWORTH FILTER 5hz/18dB/oct,
C32 NAVIGATION MERGE,
C33 BAD TRACE EDITS (FROM OBS LOGS),
C34 SINK (SWELL NOISE ATTENUATION),
C35 SEGY OUTPUT.
C36
C37
C38
C39
C40 END OF EBCDIC HEADER
```

12.6 P1/90 header

Example header used in the final P190

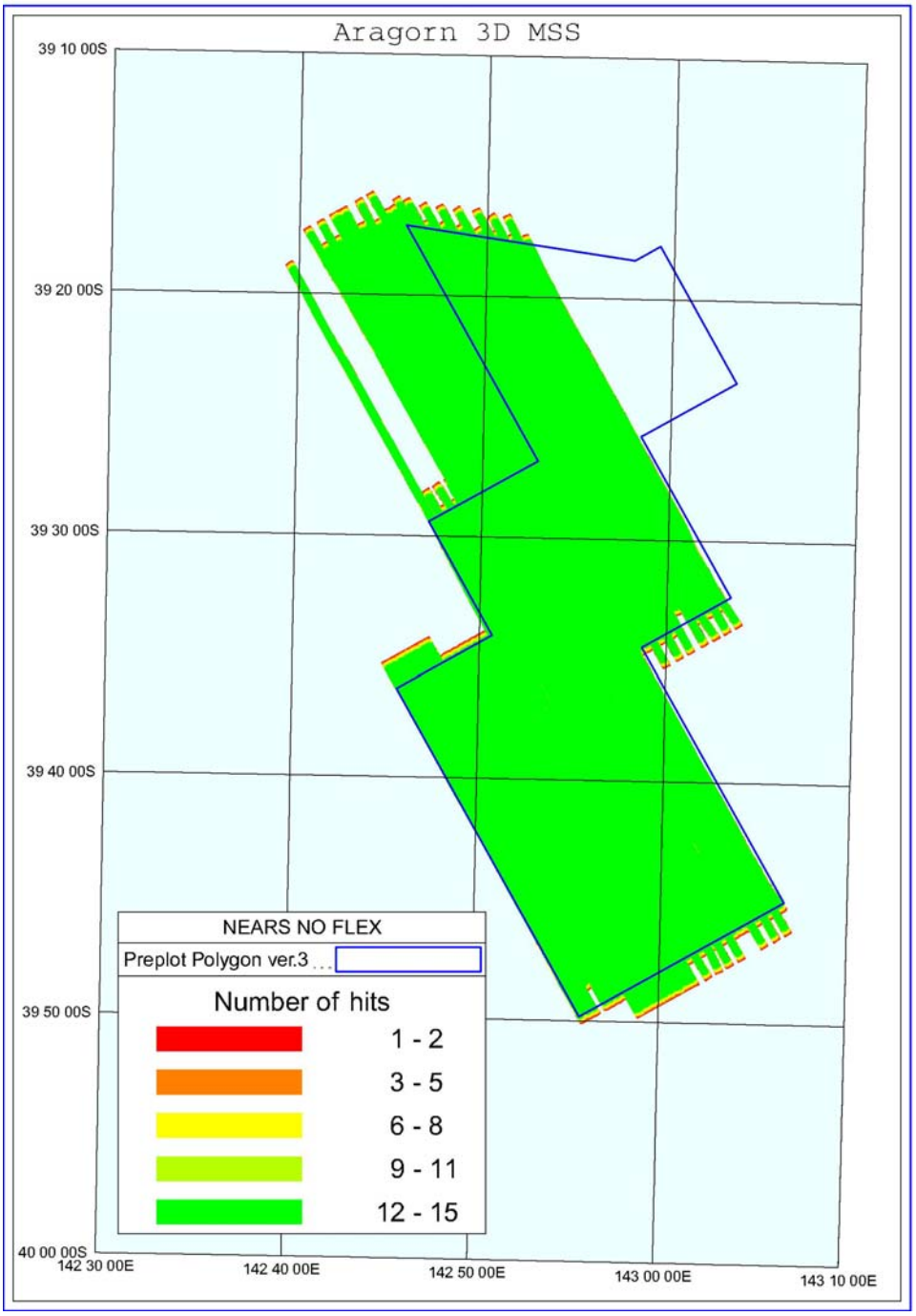
```
H0100 AREA                      ARAGORN 3D, MSS
H0101 GENERAL SURVEY DETAILS    3D SINGLE VESSEL, DUAL SOURCE, TEN STREAMERS
H0102 VESSEL DETAILS            M/V RAMFORM VICTORY        1
H0103 SOURCE DETAILS            STBD SOURCE                1   1
H0103 SOURCE DETAILS            PORT SOURCE                1   2
H0104 STREAMER DETAILS          STREAMER 1  360CH (STBD)   1       1   1
H0104 STREAMER DETAILS          STREAMER 2  360CH          1       2   2
H0104 STREAMER DETAILS          STREAMER 3  360CH          1       3   3
H0104 STREAMER DETAILS          STREAMER 4  360CH          1       4   4
H0104 STREAMER DETAILS          STREAMER 5  360CH          1       5   5
H0104 STREAMER DETAILS          STREAMER 6  360CH          1       6   6
H0104 STREAMER DETAILS          STREAMER 7  360CH          1       7   7
H0104 STREAMER DETAILS          STREAMER 8  360CH          1       8   8
H0104 STREAMER DETAILS          STREAMER 9  360CH          1       9   9
H0104 STREAMER DETAILS          STREAMER 10 360CH          1       A   A
H0105 OTHER DETAILS             N/A
H0200 DATE OF SURVEY            25 MARCH 2006 -CONTINUING
H0201 DATE OF ISSUE OF TAPE     ?? MARCH 2006
H0202 TAPE VERSION IDENTIFIER   W06ARGP011
H0203 LINE PREFIX
H0300 CLIENT                    WOODSIDE ENERGY LTD.
H0400 GEOPHYSICAL CONTRACTOR    PGS GEOPHYSICAL - MARINE ACQUISITION
H0500 POSITIONING CONTRACTOR    FUGRO SURVEY AS
H0600 POSITIONING PROCESSING    PGS GEOPHYSICAL - MARINE ACQUISITION
H0700 POSITIONING SYSTEM        SYSTEM I: SKYFIX.XP
H0700 POSITIONING SYSTEM        SYSTEM II: STARFIX.HP
H0700 POSITIONING SYSTEM        INTEGRATED NAV SYSTEM : SPECTRA VERSION 10.9.01
H0800 COORDINATE LOCATION       CENTER OF SOURCE
H0900 OFFSET SYSTEM TO SOURCE 1    1   2   30.00 -405.00
H0901 OFFSET SYSTEM TO SOURCE 2    1   2  -30.00 -405.00
H0902 OFFSET SYSTEM TO E/S         1   2    0.50   24.70
H0903 OFFSET SYS TO NAV REF PT     1   2    0.00    0.00
H1000 CLOCK TIME                GMT
H1100 RECEIVER GROUPS PER SHOT  3600
H1400 GEODETIC DATUM AS SURVEY  GDA94       GRS80        6378137.000 298.2572221
H1401 DATUM SHIFT GDA94-WGS84    000.0  00.0 000.0 0.015 0.014 0.016-0.0044380
H2600
H2600 DUE TO FORMAT LIMITATION IN RECORD H1401 EXACTLY DATUM SHIFT GDA94-WGS84:
H2600 dx=0.0046  dy=0.0394  dz=0.0687  rx=0.015486  ry=0.013723  rz=0.016079
H2600 SCALE CORRECTION: -0.004438E-6
H2600
H1500 GEODETIC DATUM POSTPROC.  GDA94       GRS80        6378137.000 298.2572221
H1501 DATUM SHIFT GDA94-WGS84    000.0  00.0 000.0 0.015 0.014 0.016-0.0044380
H2600
H2600 DUE TO FORMAT LIMITATION IN RECORD H1501 EXACTLY DATUM SHIFT GDA94-WGS84:
H2600 dx=0.0046  dy=0.0394  dz=0.0687  rx=0.015486  ry=0.013723  rz=0.016079
H2600 SCALE CORRECTION: -0.004438E-6 (BURSA WOLFE CONVENTION)
H2600
H1600 DATUM SHIFTS                 0.0   0.0   0.0 0.000 0.000 0.000 0.0000000
H1700 VERTICAL DATUM            MSL                     ECHO SOUNDER POSITION
H1800 PROJECTION                002 UTM
H1900 ZONE                      54S
H2000 GRID UNITS                1 INTERNATIONAL METERS    1.000000000000
H2001 HEIGHT UNITS              1 INTERNATIONAL METERS    1.000000000000
```

```
H2200 CENTRAL MERIDIAN          141 0 0.000E
H2600*****************************************************************************
H2600 THE ECHO SOUNDER DEPTH DATA HAS BEEN CORRECTED FOR PITCH. ROLL AND HEAVE
H2600 IN THE ECHO SOUNDER PRIOR TO BEING PASSED TO SPECTRA.
H2600
H2600 THE WATER DEPTH DATA HAS BEEN DESPIKED.
H2600
H2600 THE WATER DEPTHS HAVE BEEN CORRECTED FOR DRAFT (7.3 METERS),
H2600 SOUND VELOCITY (1491.64 M/S) AND TIDAL CHANGES.
H2600 CONSTANT SOUND VELOCITY (1491.64 M/S) USED ON SAIL LINES 1290 TO 1590
H2600
H2600 THE SOUND VELOCITY SET IN THE ECHO SOUNDER WAS 1500 M/S.
H2600
H2600 THE TSDIP RESULT OF 29 APRIL 2006 WERE USED WITH A PGS UTILITY PROGRAM
H2600 TO CORRECT THE DEPTHS FOR VELOCITY CHANGE IN THE WATER COLUMN.
H2600
H2600 TIDAL CORRECTIONS WAS APPLIED USING TIDAL DATA SUPPLIED BY THE CLIENT.
H2600 THE DATA WAS BASED ON TIDES AT THE LOCATION 39 30 S  142 55 E.
H2600
H2600 VERTICAL DATUM: MSL
H2600
H2600*****************************************************************************
H2600             FORMAT OF SHOT RECORDS
H2600      COLUMN           DESCRIPTION
H2600           1           'V','E', 'Z', 'S', 'C' OR 'T'
H2600                       V=VESSEL REFERENCE POINT
H2600                       E=ECHO SOUNDER POSITION
H2600                       S=CENTER OF SOURCE
H2600                       Z=INDIVIDUAL SOURCE POSITION
H2600                       C=COMMON MID POINT POSITION
H2600                       T=TAILBOUY POSITION
H2600         2-13          LINE NAME
H2600           17          VESSEL IDENTIFIER
H2600           18          SOURCE IDENTIFIER
H2600           19          TAILBUOY/OTHER IDENTIFIER
H2600        20-25          SHOT POINT NUMBER
H2600        26-35          LATITUDE (DDMMSS.SS)
H2600        36 46          LONGITUDE (DDDMMSS.SS)
H2600        47-55          MAP GRID EASTING IN METERS
H2600        56-64          MAP GRID NORTHING IN METERS
H2600        65-70          WATER DEPTH
H2600        71-73          JULIAN DAY
H2600        74-79          TIME HHMMSS
H2600
H2600             FORMAT OF RECEIVER RECORD
H2600           1             'R'
H2600         2-5             RECEIVER NUMBER
H2600         6-14            MAP GRID EASTING IN METERS
H2600        15-23            MAP GRID NORTHING IN METERS
H2600        24-27            RECEIVER DEPTH REFERENCED TO SEA LEVEL
H2600        28-31            RECEIVER NUMBER
H2600        32-40            MAP GRID EASTING IN METERS
H2600        41-49            MAP GRID NORTHING IN METERS
H2600        50-53            RECEIVER DEPTH REFERENCED TO SEA LEVEL
H2600        54-57            RECEIVER NUMBER
H2600        58-66            MAP GRID EASTING IN METERS
H2600        67-75            MAP GRID NORTHING IN METERS
H2600        76-79            RECEIVER DEPTH REFERENCED TO SEA LEVEL
H2600           80            STREAMER CODE
```

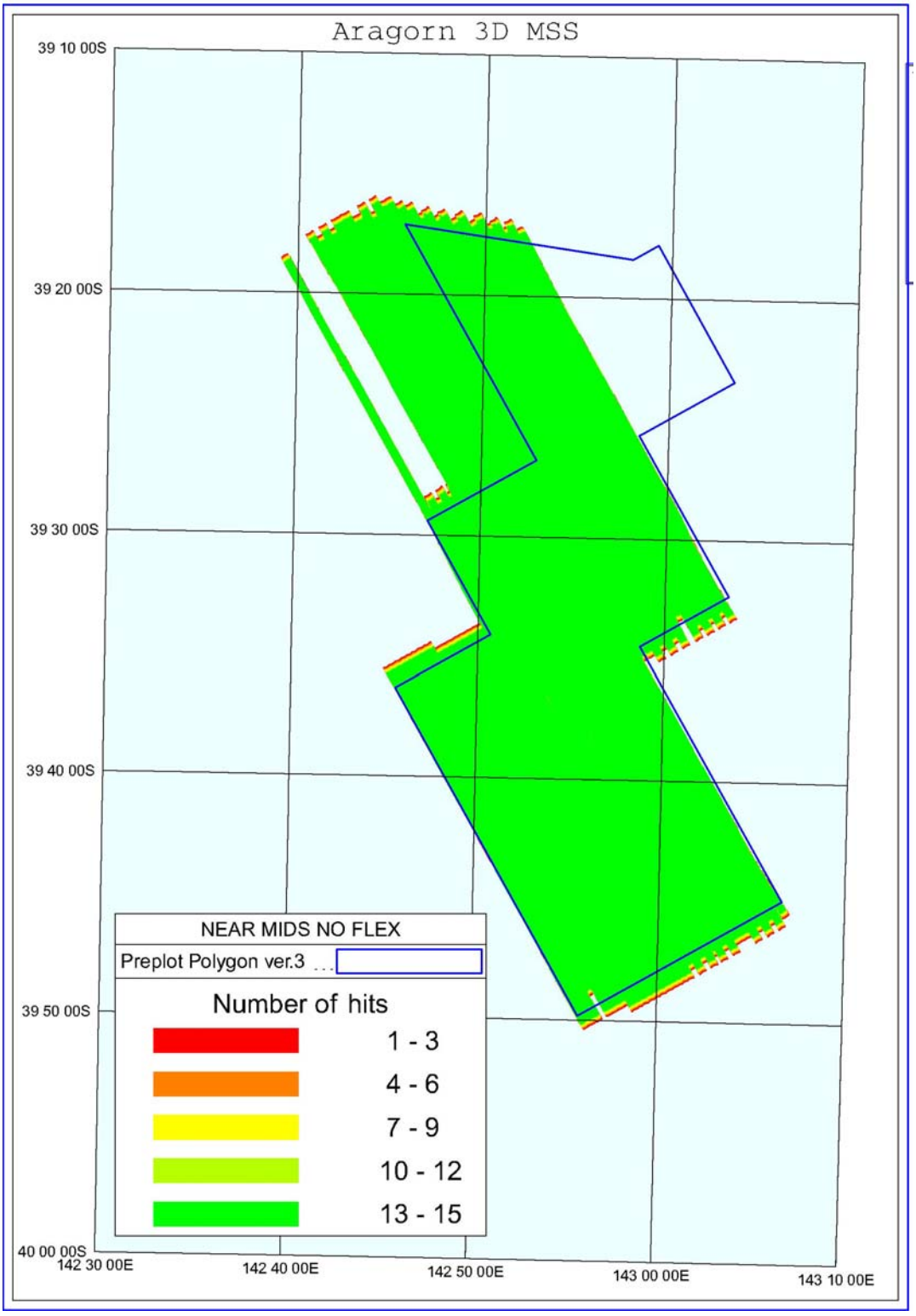
```
H2600*****************************************************************************
H2600 STREAMER AND TAILBUOY NUMBERING INCREMENTS FROM STARBOARD TO PORT.
H2600
H2600 STREAMER  1: RECEIVERS NUMBERED    1 (FAR) TO  360 (NEAR)
H2600 STREAMER  2: RECEIVERS NUMBERED  361 (FAR) TO  720 (NEAR)
H2600 STREAMER  3: RECEIVERS NUMBERED  721 (FAR) TO 1080 (NEAR)
H2600 STREAMER  4: RECEIVERS NUMBERED 1081 (FAR) TO 1440 (NEAR)
H2600 STREAMER  5: RECEIVERS NUMBERED 1441 (FAR) TO 1800 (NEAR)
H2600 STREAMER  6: RECEIVERS NUMBERED 1801 (FAR) TO 2160 (NEAR)
H2600 STREAMER  7: RECEIVERS NUMBERED 2161 (FAR) TO 2520 (NEAR)
H2600 STREAMER  8: RECEIVERS NUMBERED 2521 (FAR) TO 2880 (NEAR)
H2600 STREAMER  9: RECEIVERS NUMBERED 2881 (FAR) TO 3240 (NEAR)
H2600 STREAMER 10: RECEIVERS NUMBERED 3241 (FAR) TO 3600 (NEAR)
H2600
H2600 STREAMER ROTATIONS HAVE BEEN APPLIED ON A SHOT BY SHOT BASIS.
H2600
H2600 SPRINT CALCULATED INLINE MISCLOSURES ARE DERIVED ON A SHOT BY SHOT BASIS.
H2600 THESE INLINE MISCLOSURES ARE DISTRIBUTED LINEARLY OVER THE ACTIVE STREAMER
H2600 LENGTH. THE CORRECTED STREAMER LENGTH IS USED TO COMPUTE THE FINAL
H2600 RECEIVER POSITIONS.
H2600
H2600 SPRINT VERSION 4.3.3 IS USED FOR ONBOARD NAVIGATION PROCESSING.
H2600
H2600 PGS JOB NUMBER 2005098
H2600
H2600 ALL SHOTS FOR ALL STREAMERS ARE INCLUDED ON THIS TAPE, DATA NOT TO BE
H2600 PROCESSED (NTBP) IS INDICATED BELOW AS NECESSARY.
H2600
H2600 LINES CONTAINED IN THIS FILE:
H2600
H2600 LINE: ?????????             SEQUENCE:  ???   FSP:   ????   LSP:   ????
H2600
H2600
```

12.7 Coverage plots

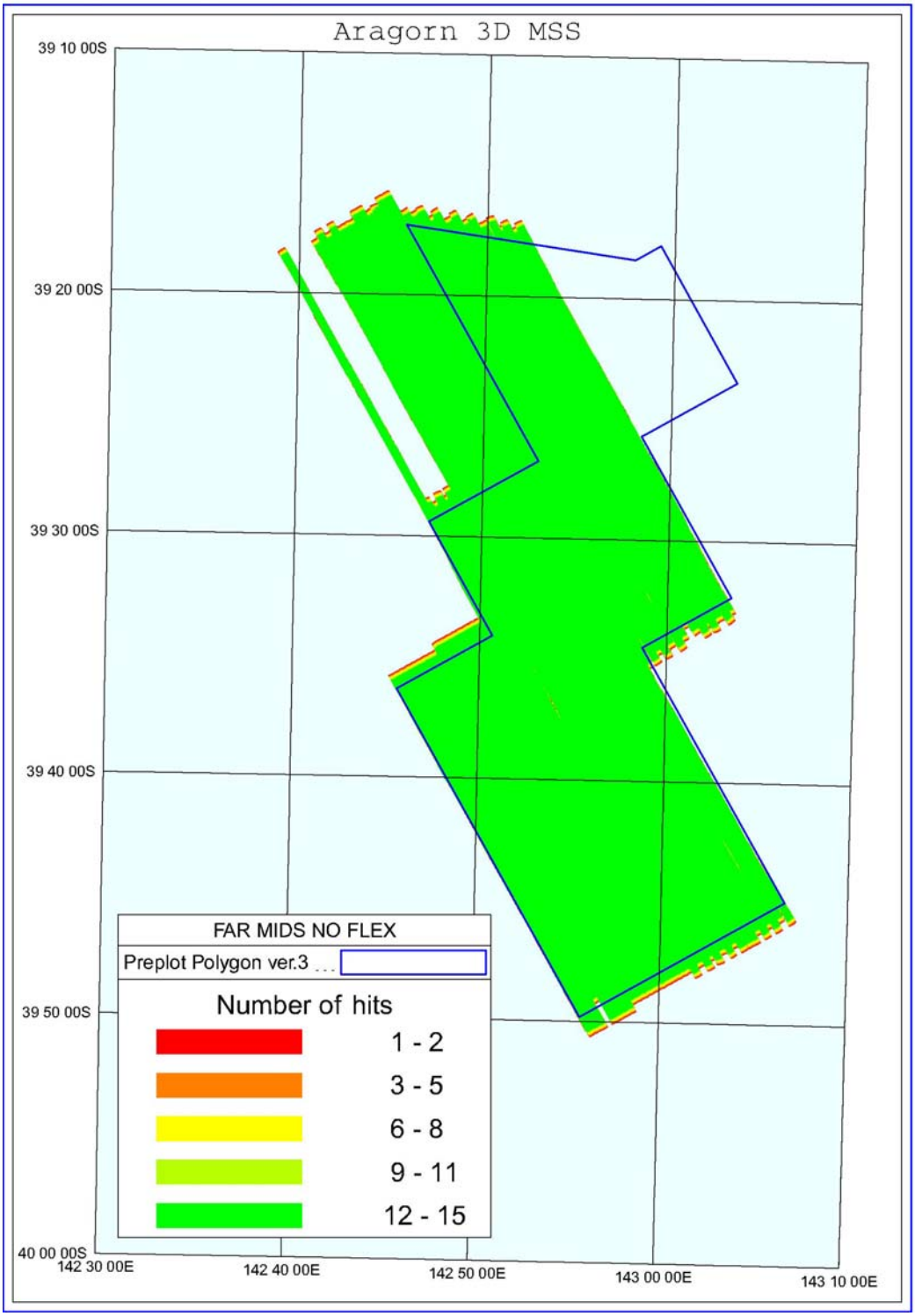
12.7.1 Nears no Flex



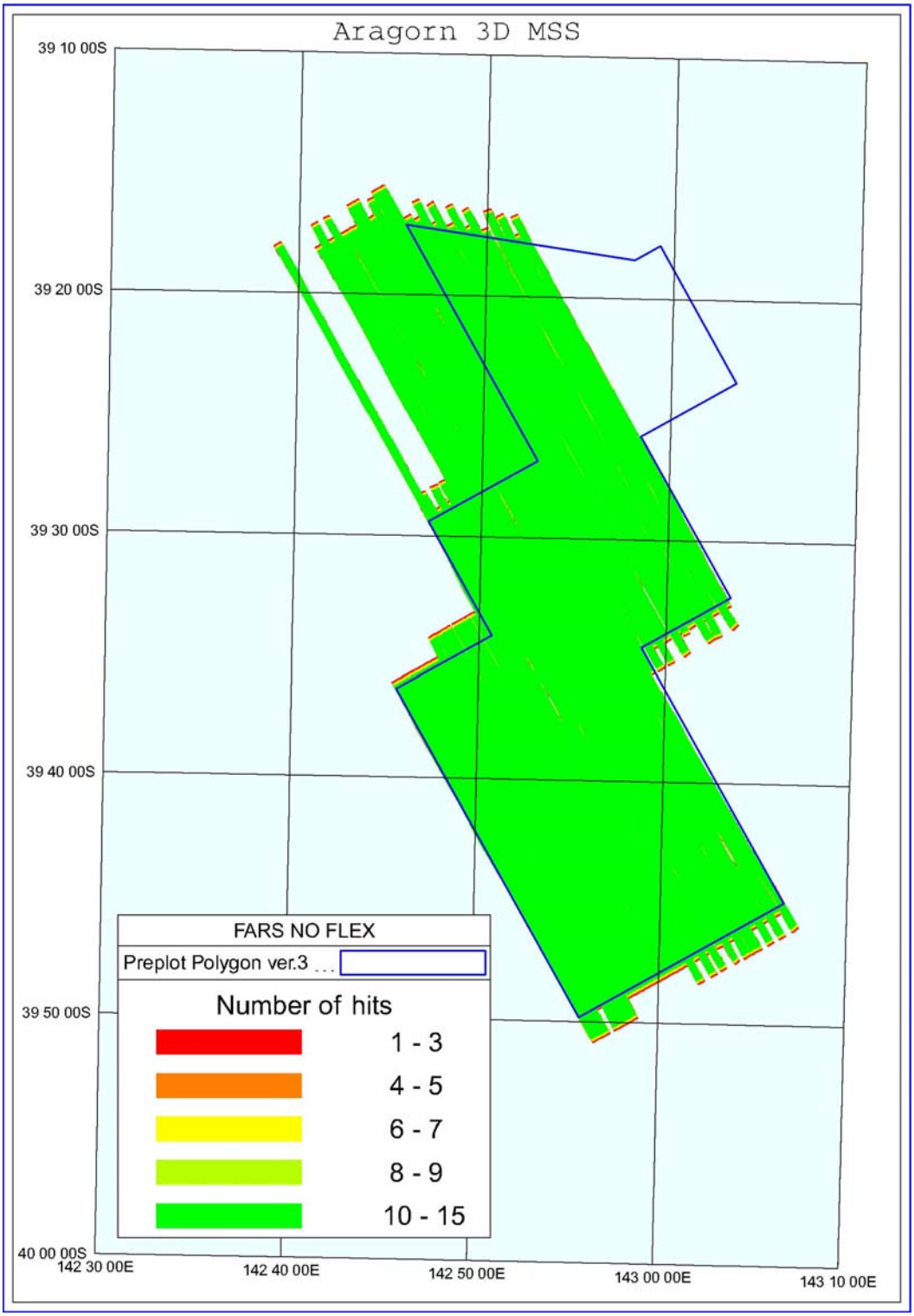
12.7.2 Nearmids no Flex



12.7.3 Far mids no Flex



12.7.4 Fars no Flex



12.7.5 Alls no Flex