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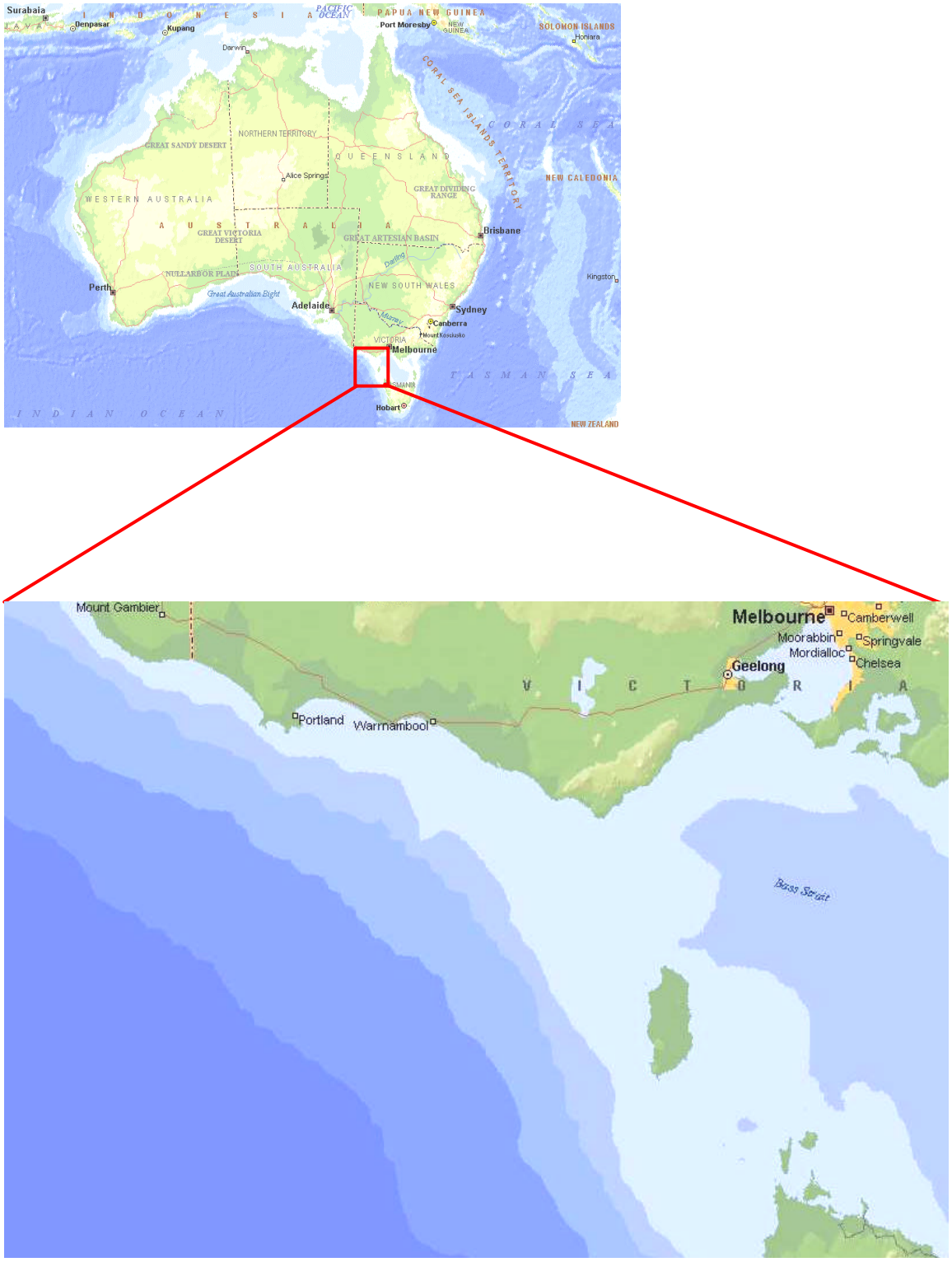
1 Survey Information and Objectives

This program for **Santos Limited** (Australia) comprised 1150km of full fold 2D seismic in Victorian Water Block VIC/P52. Water depths range from 200 to 2500m. This area is south east of Portland at the western end of the Bass Straits. The programme consisted of 7 strike lines & 23 dip lines. The dip lines ran SW to NE with the NE ends of lines running up the edge of the Continental Shelf.

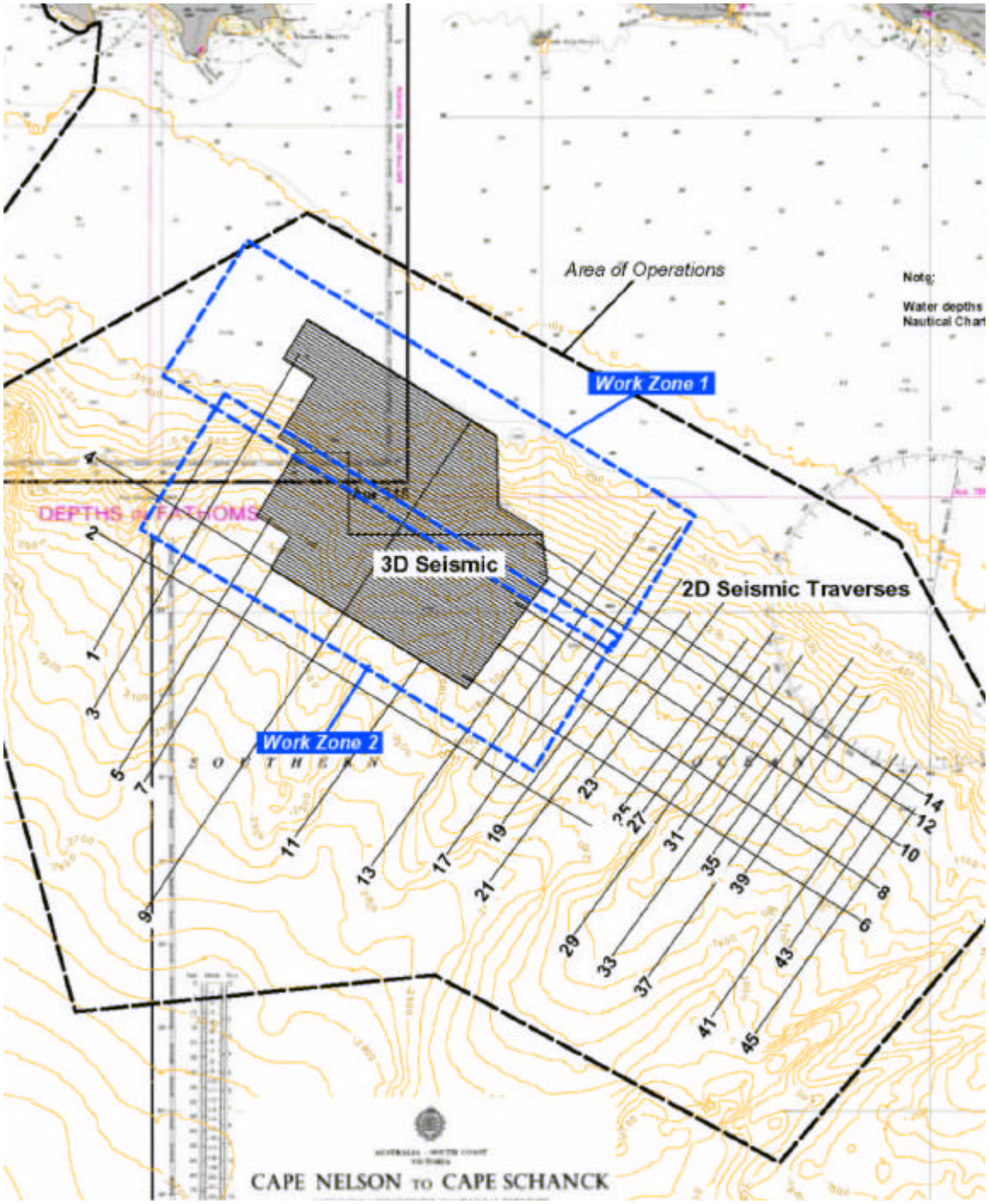
The ***Polar Duke*** carried out the acquisition for **Multiwave Geophysical Company ASA.** Acquisition equipment included a sleeve air gun source array of 3500 cubic inches and a single digital streamer, configured for 576 data traces and a length of 7200m. Positioning was by Differential GPS and onboard Quality Control maintained using a ProMAX QC system.

The vessel initially mobilized for the project in Cairns, Australia on 5th November before carrying out a small survey in Portland Bay. She then proceeded directly to the survey area and commenced production on 23rd November. The 30 lines of seismic data acquisition were completed in 47 line sequences by 15th December 2002.
After completion the vessel continued south, directly onto the next adjacent survey for Santos, to the west of Tasmania.

2 Area Location Map



3 Prospect Map



4 Survey Parameters and Original Line Coordinates

Survey Report

Date Generated: 09/10/2002
Time Generated: 13:26:33

PSD Details

Projection Type: Transverse Mercator
Origin Longitude: 1410000.000E
Origin Latitude: 0000000.000N
Scale Factor: 0.9996000000
False Easting: 500000.00E
False Northing: 10000000.00N

Spheroid Name: GRS 80
Semi Major Axis: 6378137.000
Inverse Flattening: 298.2572221

Datum Name: GDA-94
Dx (m): 0.0
Dy (m): 0.0
Dz (m): 0.0
Rx (sec): 0.0
Ry (sec): 0.0
Rz (sec): 0.0
Ds (ppm): 0.0

Units: meters

2D Survey

Survey Name:

2D Line Name:		OS02-01		
FSP:		1001	**LSP:**	2091
Segment: 1				
Start Easting:		536257.04	**Start Longitude:**	141°25'08.152"E
Start Northing:		5679012.01	**Start Latitude:**	39°2'13.913"S
End Easting:		549877.39	**End Longitude:**	141°34'28.499"E
End Northing:		5702602.0	**End Latitude:**	38°49'26.245"S
Azimuth/Bearing:	29.738			
Distance:	27250 m			

2D Line Name:		OS02-02		
FSP:		1001	**LSP:**	3609
Segment: 1				
Start Easting:		536267.02	**Start Longitude:**	141°25'05.844"E
Start Northing:		5693267.96	**Start Latitude:**	38°54'31.446"S
End Easting:		591990.12	**End Longitude:**	142°3'55.714"E
End Northing:		5659459.23	**End Latitude:**	39°12'33.376"S
Azimuth/Bearing:	120.982			
Distance:	65200 m			

Section 1: **General Information**

2D Line Name:	OS02-03		
FSP:	1001	**LSP:**	2864
Segment: 1			
Start Easting:	536159.99	**Start Longitude:**	141°25'05.383"E
Start Northing:	5672384.01	**Start Latitude:**	39°5'48.937"S
End Easting:	559741.19	**End Longitude:**	141°41'14.449"E
End Northing:	5712528.14	**End Latitude:**	38°44'02.033"S
Azimuth/Bearing:	30.1681		
Distance:	46575 m		

2D Line Name:	OS02-04		
FSP:	1001	**LSP:**	1959
Segment: 1			
Start Easting:	536397.02	**Start Longitude:**	141°25'09.674"E
Start Northing:	5701487.03	**Start Latitude:**	38°50'04.794"S
End Easting:	556689.98	**End Longitude:**	141°39'15.120"E
End Northing:	5688783.78	**End Latitude:**	38°56'53.016"S
Azimuth/Bearing:	121.783		
Distance:	23950 m		

2D Line Name:	OS02-05		
FSP:	1001	**LSP:**	2345
Segment: 1			
Start Easting:	539075.96	**Start Longitude:**	141°27'08.165"E
Start Northing:	5665682.03	**Start Latitude:**	39°9'25.891"S
End Easting:	556541.19	**End Longitude:**	141°39'07.279"E
End Northing:	5694371.53	**End Latitude:**	38°53'51.788"S
Azimuth/Bearing:	31.0471		
Distance:	33600 m		

2D Line Name:	OS02-06		
FSP:	1001	**LSP:**	3104
Segment: 1			
Start Easting:	577794.96	**Start Longitude:**	141°53'56.850"E
Start Northing:	5676512.96	**Start Latitude:**	39°3'25.214"S
End Easting:	622121.31	**End Longitude:**	142°24'59.080"E
End Northing:	5648267.88	**End Latitude:**	39°18'22.936"S
Azimuth/Bearing:	121.937		
Distance:	52575 m		

2D Line Name:	OS02-07		
FSP:	1001	**LSP:**	2150
Segment: 1			
Start Easting:	541797.96	**Start Longitude:**	141°29'01.900"E
Start Northing:	5664234.04	**Start Latitude:**	39°10'12.407"S
End Easting:	556682.22	**End Longitude:**	141°39'14.796"E
End Northing:	5688789.6	**End Latitude:**	38°56'52.829"S
Azimuth/Bearing:	30.9172		
Distance:	28725 m		

2D Line Name:	OS02-08		
FSP:	1001	**LSP:**	3087
Segment: 1			
Start Easting:	580874.0	**Start Longitude:**	141°56'03.217"E
Start Northing:	5680557.01	**Start Latitude:**	39°1'13.033"S
End Easting:	624332.74	**End Longitude:**	142°26'29.069"E
End Northing:	5651755.89	**End Latitude:**	39°16'28.690"S
Azimuth/Bearing:	122.943		
Distance:	52150 m		

Section 1: **General Information**

2D Line Name:	OS02-09		
FSP:	1001	**LSP:**	3654
Segment: 1			
Start Easting:	541918.03	**Start Longitude:**	141°29'10.086"E
Start Northing:	5650002.05	**Start Latitude:**	39°17'54.049"S
End Easting:	578983.0	**End Longitude:**	141°54'34.463"E
End Northing:	5704975.57	**End Latitude:**	38°48'01.584"S
Azimuth/Bearing:	33.6834		
Distance:	66325 m		

2D Line Name:	OS02-10		
FSP:	1001	**LSP:**	3073
Segment: 1			
Start Easting:	583844.02	**Start Longitude:**	141°58'04.944"E
Start Northing:	5684555.01	**Start Latitude:**	38°59'02.346"S
End Easting:	627193.57	**End Longitude:**	142°28'25.396"E
End Northing:	5656223.91	**End Latitude:**	39°14'02.303"S
Azimuth/Bearing:	122.556		
Distance:	51800 m		

2D Line Name:	OS02-11		
FSP:	1001	**LSP:**	2032
Segment: 1			
Start Easting:	558162.99	**Start Longitude:**	141°40'25.939"E
Start Northing:	5657529.97	**Start Latitude:**	39°13'46.484"S
End Easting:	573286.3	**End Longitude:**	141°50'48.548"E
End Northing:	5678390.82	**End Latitude:**	39°2'25.706"S
Azimuth/Bearing:	35.5153		
Distance:	25775 m		

2D Line Name:	OS02-12		
FSP:	1001	**LSP:**	3059
Segment: 1			
Start Easting:	586445.0	**Start Longitude:**	141°59'51.475"E
Start Northing:	5687987.96	**Start Latitude:**	38°57'10.084"S
End Easting:	629243.13	**End Longitude:**	142°29'48.631"E
End Northing:	5659455.98	**End Latitude:**	39°12'16.402"S
Azimuth/Bearing:	123.061		
Distance:	51450 m		

2D Line Name:	OS02-13		
FSP:	1001	**LSP:**	2785
Segment: 1			
Start Easting:	566598.96	**Start Longitude:**	141°46'18.959"E
Start Northing:	5654185.03	**Start Latitude:**	39°15'32.800"S
End Easting:	592763.6	**End Longitude:**	142°4'12.828"E
End Northing:	5690286.21	**End Latitude:**	38°55'53.213"S
Azimuth/Bearing:	35.4465		
Distance:	44600 m		

2D Line Name:	OS02-14		
FSP:	1001	**LSP:**	3103
Segment: 1			
Start Easting:	586036.03	**Start Longitude:**	141°59'32.978"E
Start Northing:	5691323.02	**Start Latitude:**	38°55'22.051"S
End Easting:	629669.43	**End Longitude:**	142°30'04.601"E
End Northing:	5662061.71	**End Latitude:**	39°10'51.672"S
Azimuth/Bearing:	123.221		
Distance:	52550 m		

2D Line Name:	OS02-15		
FSP:	1001	**LSP:**	2411
Segment: 1			
Start Easting:	578969.04	**Start Longitude:**	141°54'50.123"E
Start Northing:	5665933.95	**Start Latitude:**	39°9'07.978"S
End Easting:	599438.38	**End Longitude:**	142°8'47.746"E
End Northing:	5694618.84	**End Latitude:**	38°53'30.052"S
Azimuth/Bearing:	34.9361		
Distance:	35250 m		

2D Line Name:	OS02-17		
FSP:	1001	**LSP:**	2849
Segment: 1			
Start Easting:	575042.99	**Start Longitude:**	141°52'10.733"E
Start Northing:	5655513.03	**Start Latitude:**	39°14'47.242"S
End Easting:	602267.06	**End Longitude:**	142°10'46.106"E
End Northing:	5692822.55	**End Latitude:**	38°54'27.144"S
Azimuth/Bearing:	35.5696		
Distance:	46200 m		

2D Line Name:	OS02-19		
FSP:	1001	**LSP:**	2420
Segment: 1			
Start Easting:	581227.04	**Start Longitude:**	141°56'27.236"E
Start Northing:	5658880.02	**Start Latitude:**	39°12'56.027"S
End Easting:	602495.79	**End Longitude:**	142°10'58.598"E
End Northing:	5687259.05	**End Latitude:**	38°57'27.497"S
Azimuth/Bearing:	36.2567		
Distance:	35475 m		

2D Line Name:	OS02-21		
FSP:	1001	**LSP:**	2550
Segment: 1			
Start Easting:	579778.97	**Start Longitude:**	141°55'29.604"E
Start Northing:	5652431.96	**Start Latitude:**	39°16'25.655"S
End Easting:	603164.14	**End Longitude:**	142°11'28.522"E
End Northing:	5683284.38	**End Latitude:**	38°59'36.128"S
Azimuth/Bearing:	36.5774		
Distance:	38725 m		

2D Line Name:	OS02-23		
FSP:	1001	**LSP:**	2185
Segment: 1			
Start Easting:	591385.04	**Start Longitude:**	142°3'28.300"E
Start Northing:	5663957.02	**Start Latitude:**	39°10'07.723"S
End Easting:	609366.74	**End Longitude:**	142°15'43.902"E
End Northing:	5687458.88	**End Latitude:**	38°57'18.025"S
Azimuth/Bearing:	36.7537		
Distance:	29600 m		

2D Line Name:	OS02-25		
FSP:	1001	**LSP:**	1966
Segment: 1			
Start Easting:	594916.97	**Start Longitude:**	142°5'56.922"E
Start Northing:	5661065.02	**Start Latitude:**	39°11'40.160"S
End Easting:	609571.2	**End Longitude:**	142°15'56.574"E
End Northing:	5680221.09	**End Latitude:**	39°1'12.677"S
Azimuth/Bearing:	36.7224		
Distance:	24125 m		

Section 1: **General Information**

2D Line Name:	OS02-27		
FSP:	1001	**LSP:**	2043
Segment: 1			
Start Easting:	596732.04	**Start Longitude:**	142°7'13.069"E
Start Northing:	5660106.98	**Start Latitude:**	39°12'10.512"S
End Easting:	612503.77	**End Longitude:**	142°17'58.135"E
End Northing:	5680831.31	**End Latitude:**	39°00'51.545"S
Azimuth/Bearing:	36.5654		
Distance:	26050 m		

2D Line Name:	OS02-29		
FSP:	1001	**LSP:**	2529
Segment: 1			
Start Easting:	589131.99	**Start Longitude:**	142°2'02.792"E
Start Northing:	5646367.02	**Start Latitude:**	39°19'39.083"S
End Easting:	611963.7	**End Longitude:**	142°17'37.961"E
End Northing:	5676979.98	**End Latitude:**	39°2'56.702"S
Azimuth/Bearing:	36.0629		
Distance:	38200 m		

2D Line Name:	OS02-31		
FSP:	1001	**LSP:**	2001
Segment: 1			
Start Easting:	600825.99	**Start Longitude:**	142°10'04.940"E
Start Northing:	5657848.0	**Start Latitude:**	39°13'22.102"S
End Easting:	615505.01	**End Longitude:**	142°20'04.582"E
End Northing:	5678076.89	**End Latitude:**	39°2'19.468"S
Azimuth/Bearing:	35.2293		
Distance:	25000 m		

2D Line Name:	OS02-33		
FSP:	1001	**LSP:**	2367
Segment: 1			
Start Easting:	593249.01	**Start Longitude:**	142°4'55.981"E
Start Northing:	5643847.03	**Start Latitude:**	39°20'59.251"S
End Easting:	613388.25	**End Longitude:**	142°18'40.550"E
End Northing:	5671415.27	**End Latitude:**	39°5'56.515"S
Azimuth/Bearing:	35.4647		
Distance:	34150 m		

2D Line Name:	OS02-35		
FSP:	1001	**LSP:**	2132
Segment: 1			
Start Easting:	604603.96	**Start Longitude:**	142°12'43.963"E
Start Northing:	5655169.0	**Start Latitude:**	39°14'47.378"S
End Easting:	621331.8	**End Longitude:**	142°24'06.966"E
End Northing:	5677956.37	**End Latitude:**	39°2'20.533"S
Azimuth/Bearing:	35.5166		
Distance:	28275 m		

2D Line Name:	OS02-37		
FSP:	1001	**LSP:**	2641
Segment: 1			
Start Easting:	597320.99	**Start Longitude:**	142°7'47.248"E
Start Northing:	5641611.95	**Start Latitude:**	39°22'10.124"S
End Easting:	621468.59	**End Longitude:**	142°24'14.724"E
End Northing:	5674733.67	**End Latitude:**	39°4'04.980"S
Azimuth/Bearing:	35.38		
Distance:	41000 m		

Section 1: **General Information**

2D Line Name:	OS02-39		
FSP:	1001	**LSP:**	2024
Segment: 1			
Start Easting:	608146.0	**Start Longitude:**	142°15'12.953"E
Start Northing:	5653000.97	**Start Latitude:**	39°15'56.128"S
End Easting:	623071.84	**End Longitude:**	142°25'22.055"E
End Northing:	5673761.29	**End Latitude:**	39°4'35.706"S
Azimuth/Bearing:	34.9228		
Distance:	25575 m		

2D Line Name:	OS02-41		
FSP:	1001	**LSP:**	2469
Segment: 1			
Start Easting:	604547.97	**Start Longitude:**	142°12'51.606"E
Start Northing:	5637360.99	**Start Latitude:**	39°24'24.948"S
End Easting:	626192.61	**End Longitude:**	142°27'36.428"E
End Northing:	5666988.09	**End Latitude:**	39°8'13.754"S
Azimuth/Bearing:	35.3822		
Distance:	36700 m		

2D Line Name:	OS02-43		
FSP:	1001	**LSP:**	2051
Segment: 1			
Start Easting:	612981.01	**Start Longitude:**	142°18'39.802"E
Start Northing:	5644517.03	**Start Latitude:**	39°20'29.047"S
End Easting:	628196.88	**End Longitude:**	142°29'00.629"E
End Northing:	5665900.09	**End Latitude:**	39°8'47.983"S
Azimuth/Bearing:	34.6056		
Distance:	26250 m		

2D Line Name:	OS02-45		
FSP:	1001	**LSP:**	2425
Segment: 1			
Start Easting:	608850.01	**Start Longitude:**	142°15'52.974"E
Start Northing:	5634764.98	**Start Latitude:**	39°25'47.222"S
End Easting:	629713.49	**End Longitude:**	142°30'05.375"E
End Northing:	5663600.84	**End Latitude:**	39°10'01.736"S
Azimuth/Bearing:	35.0858		
Distance:	35600 m		

Total 2D Line Length: 1148.7 km

5 Contract Work Order

CONTRACT WORK ORDER

GENERAL

	CONTRACT
Client:	Santos
Vessel(s):	Polar Duke
Job number:	6151
Bid number	
Client contract number/ref:	
Location:	Otway Basin
Area:	W.Victoria
Type of survey:	2D
Area, or total kms:	1148.7 km
Line heading:	Various
Number of lines:	30 lines
Line length:	Various
Acquisition method:	Single streamer / single source
Estimated start date:	23th November 2002
Estimated duration:	14 days
OHSE checklists completed	
	STREAMER
Type of streamer	SYNTRAK RDA Streamer
Number of streamers	1
Separation	n/a
Streamer length	7200m
No. of channels	576
Group interval	12.5 m
Streamer depth	**7m** +/- 1 m Allowed deeper in poor swell conditions.
Water Depth	50-3000m
	RECORDING
Instrument type	SYNTRAK 960-24
Record length	10s records
Sample rate	2ms
Recording filter: Hi-cut	206 Hz @ 276 dB/ Octave
Recording filter: Lo-cut	Out: 3 Hz @ 6 dB/ Octave , IN 3 Hz @ 12 dB/ Octave
Filter type	Linear
Pre-Amplifier Gain	12 dB
Tape format	Seg D Ver.1.00 8058 - 32 Bit IEEE
Recording media	IBM 3590
Tape Copy	Via ProMAX QC
TOC (Diskos/Petrobank) files regd?	No
	SOURCE
Source type	Airgun
Source controller	GCS-90
Number of sources	1
Source separation	n/a
Volume per source	3500 cu.in.
Source depth	**5 m** +/- 0.5 m
Source pressure	2000 psi
Source length	11.78 m
Number of subarrays per source	4
Subarray separation	6, 13, 6 m
Flip/Flop	No
Shot point interval per shot	**37.5m**
Shot point location	Common Midpoint
Near fields to be recorded?	Yes
Total SCFM required at 5.0 knots	1540
Source firing specifications	+/- 1.25 ms
Signed:	Operation Manager

CONTRACT WORK ORDER

NAVIGATION **Side 1**

Geodetic Parameters	
Spheroid	GRS 80
Semi-Major Axis	6378137
Inverse Flattening	298.2572221
Work Datum	WGS84
Datum Transformation:	0
dX (m)	0
dY (m)	0
dZ (m)	0
rX (arc secs)	0
rY (arc secs)	0
rZ (arc secs)	0
Scale (ppm)	0
Projection	Transverse Mercator
Zone if UTM	
Central Meridian	141°E
Scale Factor	0.9996
False Easting (m)	500000
False Northing (m)	10,000,000
Latitude of Origin	0°
Datum Transformation Test-Coordinate	
Transformation from Datum.	-N/A
Transformation to Datum.	-
Latitude in WGS 84.	-
Longitude in WGS 84.	-
Latitude in Local Datum.	-
Longitude in Local Datum.	-
Northing in Local Projection.	-
Easting in Local Projection.	-
Geoidal Height	
Location of Prospect Centre: Lat	4 different areas, see audit folder
Location of Prospect Centre: Lon.	
Source of Geoidal Height Data	
Navigation System	
Navigation/QC System	SPECTRA
Vessel Positioning Systems	
First Navigation System	Fugro Starfix MRDGPS
First RTCM Delivery System	Spot Optus
DGPS Reference Stations	Melbourne, Bathurst, Adelaide, Brisbane and Dunedin
Sub-Contractor	Fugro Survey A/S
Contact Person	Øyvind Røegh, Tel: +47 22 13 46 43
Second Navigation System	Fugro Starfix MRDGPS
Second RTCM Delivery System	StarfixMN-8 via Inmarsat and Spot AP-Sat
DGPS Reference Stations	Melbourne, Bathurst, Auckland, Kalgoorlie and Dunedin
Sub-contractor	Fugro Survey A/S
Contact person	Øyvind Røegh, Tel: +47 22 13 46 43

CONTRACT WORK ORDER

NAVIGATION **Side 3**

Streamer / Source Positioning Systems	
Tailbuoy positioning	rGPS
Streamer positioning	compasses recorded
Source Positioning	rGPS
Line and Shot Point Numbering	
Line Name Format:	Prefixes OS02-
	followed by NN-SSS where NN is line no and SSS in sequence.
First SP for prime lines	1001
First SP for reshoot lines	1001
First SP for infill lines	N/A
Incrementing/Decrementing	Yes
Incrementing/Decrementing factor	1
Source firing on even numbers	-
Line and Shot Point Geometry	
Shot Fire Interval	37.5m
Receiver Group Interval	12.5 m
Run out	106 shots
Number of Streamers	1
Acquisition Geometry Type	single/single
Offset CS - CFG	140 m
Water Depth Processing	
Echosounder standard settings	VP=1500ms^{-1}, draft=0
Vertical datum	MSL
Tidal corrections	
Tidal correction source	
Echosounder frequency	12 kHz
Power output	More than 1kW
Sea depth	More than 6000m

CONTRACT WORK ORDER

SEISMIC QC **Side 6**

PROCESSING PRODUCTS			
Processing Product	**Comment (incr)**	**Processing Product**	**Comment (incr)**
Noise Record RMS	per seq. - at SOL	Brute Stack (raw)	per seq.
Near Trace Display	per seq. - all shots	Brute Stack (filtered)	per seq.
Shot-Trace RMS (last 500ms)	per seq. - all shots	FK & FT Analysis	as appropriate
Ambient RMS	per seq. - all shots	Seismic Attributes	as appropriate
Direct Arrival RMS	per seq. - all shots	Spreadsheets, logs	yes
Raw Shot Display	per seq. - every 4th km		
Velocity Picking	per seq. - every 4th km		
CDP Gather Display	per seq. - every 4th km		

DELIVERABLES					
	Client	**Office**		**Client**	**Office**
RMS Plots	yes	n/a	QC Logs	yes	yes
Near Trace Plots	yes	n/a	Processing Report	yes	yes
Brute Stack Plots	yes	n/a			
SEG Y Brute Stacks	yes	n/a			
Velocities (ascii format)	yes	n/a			

CLIENT CONTACTS AND DELIVERY ADDRESS	
Client contacts and address:	
Seismic deliverables address:	

COMMENTS	
	Signed:

6 Seismic & Vessel Particulars

6.1 Streamer and Sensors Details

Item	description	type	amount	remark
Streamer	24 bit, digital distributed electronic	SYNTRAK RDA	Up to 7.2km active	
Depth Control	Digicourse	5011	26	Located every 300m along the streamer
Buoyancy	Kerosene	Isopar		
Retrievers				1 per km
Streamer skin	Polyurethane			
Section Length	75 m			
Lead-in	300 m			
Group Length	12.5 m			
Max number of channels			960	6.25m @ 2ms

6.2 Recording System Details

Item	description	type	amount	remark
Acquisition	SYNTRAK	960-24		
Format	SED D	De-multiplexed		
Recording	3590 cartridge	IBM comp.	4	
Bird Controller	Digicourse	293B		
Sampling				2ms
Plotter	22”	OYO Geospace	1	
Printer	A4	Epson	3	Label
Printer	A4	HP	2	Logs, tests etc.

6.3 Seismic QC Details

Item	description	type	amount	remark
QC	ProMAX	2D		
Plotter	24”	OYO Geospace	1	

6.4 Navigation Details

Item	description	type	amount	remark
Integrated Navigation	Concept	Spectra		
Compasses	Digicourse	5011		Every 300m along the streamer.
Streamer positioning	RGPS	Various	1	Geotrack.
Source Positioning	RGPS	Various	2	Geotrack, on outer sub-arrays.
Data logging	UKOOA	P2/94 P1/90		3590, Exabyte, CD Rom.
Echo Sounder	Simrad	EA500	1	Deepwater transducer.
Gyro				As vessel description.
Helmsman Steering display	Robertson	Robtrack Helmsman		

7 Vessel Specifications

M/V Polar Duke

Main Particulars

Loa	66,65m
L.p.p.	61,44m
B.mld.	13,00m
Draft	5,80m
Draft mld sh.deck	9,50m
Deadweight	1119mt
Fuel Oil	1000cbm
Aviation fuel	50cbm
Fresh water	85cbm
IMO No	8200838
P & I Club	Skuld
Call sign	LACS4
Built	1983
Gross/net tonnage	1646.49/493.95
Flag	Norwegian

Class
DnV no: 13520
DnV + 1Aa-E0-HELDK-Sealer
Classed for Worldwide trade and registered in Norwegian International Ship Register

Offshore survey
Designed for offshore survey, core drilling and hydrographic survey.
Separate joystick manoeuvring.
Can be arranged for ROV handling, towed vehicle, bottom sampling, site survey.
Moonpool. Ø 36 inch.

Research facilities
Research facilities are designed for scientific and/or logistic expeditions in Antarctic and Arctic areas.
Lab. survey area - Dry Lab. and Wet. Lab. with uncontaminated sea water system.
Separate climate control and power supply.
Separate store. High-pressure hydraulic system for additional scientific winches. TV-monitoring aft deck.
Heavy duty Mob boat for assistance.
Spare Ø16 inch bottom valve for sonar etc.
Electric and mechanical workshop facilities.
1 PC CTD Winch with 3500m wire ø 10mm speed 50m/min @ 120l/min

Cargo Logistics
Under deck bale capacity of about 1385cbm
Arctic fuel in ships ordinary fuel tanks.
Jet A1 fuel in separate ships tank (56cbm)
12t - 15m / 22t - 8m crane with 100m/50m wire
Provision crane 1,5t - 7,5m

Electronics
Navigation and communication equipment to highest international standards, conventional as well as satellite equipment.

Environment
Equipped with oily water separator and incinerator for garbage. Waste water treatment arrangement. Fuel oil storage arrangement to minimize risk of accidental oil spill. Separate tank for storing bilge water when in Antarctic and Arctic waters

Accommodation

Crew:	11 cabins, 15 berths
Charterer:	15 cabins, 27 berths
Common:	Hospital, 3 berths

Ice-going
DnV "Sealer class", hull strength as icebreaker.
Proven ice-going capability and manoeuvrability during numerous expeditions to Antarctic.
De-icing in foreship and superstructure.
All equipment well suited to harsh conditions.
Machinery cooling standby arrangement.
Impact resistant low friction paint on underwater hull
Proven rudder and propeller protection.

Seismic Exploration Facilities
2 pc MPD Dual Umbilical winches
1 PC MPD Streamer Winch cap. 7200m + 72mm streamers
2 pc Hamworthy compressors each 800 scfm
2 pc Hamworthy compressors each 400 scfm

Electrical power
1 x E.C.C. 1640kVA shaft generator
1 x Stamford MC 334C - 112,5kVA aux generator
1 x Stamford MC 534C - 305 kVA aux. generator
440/220V 60Hz

Machinery
Main engine:
2 off MAK 6M 453aK 1650 kW / 2250 bhp each at 600RPM

Side thrusters:
Bow 1 x 425 kW / 570 bhp
Stern 1 x 425 kW / 570 bhp

Helicopter Deck
Bell 212, Max 5,08 T. Not currently certified for use in the Philippines.

Safety
Built according to DnV, Solas and Norwegian Ship Control rules. Enclosed lifeboats. Inflatable life rafts. Survival suits for all personnel. Fire detection and monitoring to highest available standard. Special helicopter deck protection arrangement. Internal communication and p.a. system. Q.A. according to highest standard (DnV - SEP). Safety and contingency manuals onboard and in use. Hospital facilities.

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1 List of Key Personnel

1.1 Onboard Personnel

POSITION	CREW 1	CREW 2
Party Chief	Geoff Clarke	John Hennessey
Captain	Palmar Slettebakk	Peter Brandal
Chief Engineer	Earl O'Callaghan	Anders Fosse
Chief Observer	Cliff Gobbitt	Bjorn-Erik Melum
Chief Navigator	Lars Roes	Leif-Olav Saetenes
Chief Mechanic	Tore Nygaard	Gary Herritt
QC leader	Stuart Kelly	Adam Gebarski
Client Representative	Drew Murray	Gary McWilliam

1.2 Office Support Personnel

POSITION	NAME	OFFICE
Operation Manager	Atle Jacobsen	+ 47 55 94 77 65
Operation Supervisor	Kai Aaseboe	+ 47 55 94 77 69
Technical Manager	Jan-Aage Langeland	+ 47 55 94 77 53
Instrument Support	Franck Andersen	+ 47 55 94 77 54
Navigation Support	Willy Forland	+ 47 55 94 77 63
Mechanical Support	Eivind Haavik	+ 47 55 94 77 57
QC Support	Christophe Massacand	+ 47 55 94 77 68

2 Field Information and Observations

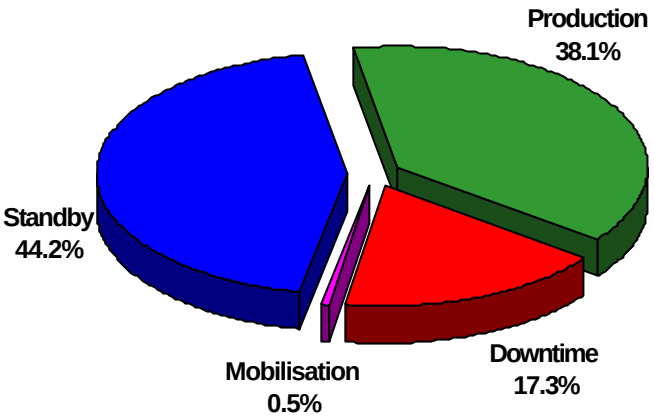
2.1 Timing Summary

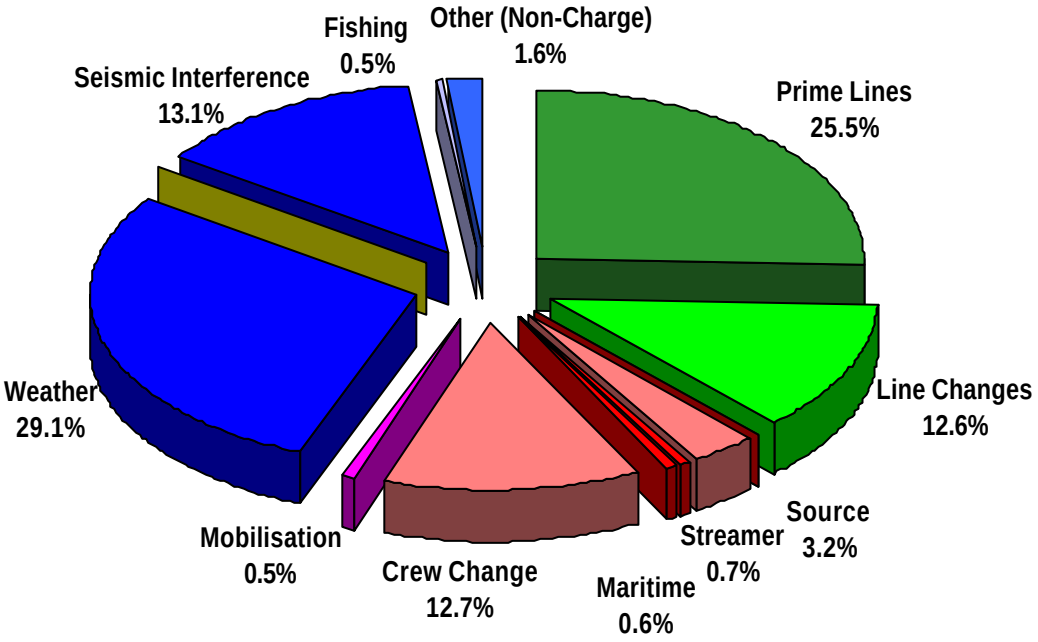
VESSEL	*M/V Polar Duke*
AREA	*OS02*
JOB No's.	*6151*
CLIENT	*Santos - Australia*

TIMING SUMMARY

	OPERATIONAL		TECHNICAL DOWN TIME								STAND BY (external downtime)						P R O D.		QHSE
DATE	Prime Lines	Line Changes	Instr.	Nav.	Mech.	Streamer	Towing	Maritime	Mob Demob	Transit	Weather	Crew Change	Seis. Interfer.	Obstr / Fishing	Other	Hours	Line Km	Speed	Meetng & Drills
23. Nov	3.63				3.92								5.28		8.68	21.52	32.4000	4.82	
24. Nov	14.77	8.78			0.45											24.00	134.4750	4.92	0.50
25. Nov	13.13	7.83						3.03								24.00	115.7625	4.76	
26.Nov	14.70	5.77											3.53			24.00	135.2250	4.97	
27.Nov	10.13	4.00			4.20								5.67			24.00	90.9375	4.85	
28.Nov	9.58	4.00			5.80						4.57		0.05			24.00	87.7500	4.95	
29.Nov	12.13	2.50											9.37			24.00	105.1500	4.68	
30.Nov	12.55	7.32			3.45								0.68			24.00	109.8375	4.73	
01.Dec	8.47	2.83											10.05	2.65		24.00	76.5375	4.88	1.00
02.Dec	10.43	6.42											7.15			24.00	95.9625	4.97	0.50
03.Dec	5.25	5.17									9.38		4.20			24.00	47.1375	4.85	
04.Dec											24.00					24.00	0.0000		
05.Dec											24.00					24.00	0.0000		
06.Dec											24.00					24.00	0.0000		
07.Dec											24.00					24.00	0.0000		
08.Dec	9.01	4.52									8.07		2.40			24.00	82.8375	4.96	1.00
09.Dec	4.50	4.00									13.87		1.63			24.00	38.4375	4.61	
10.Dec											7.00	17.00				24.00	0.0000		
11.Dec												24.00				24.00	0.0000		0.50
12.Dec												24.00				24.00	0.0000		
13.Dec											19.00	5.00				24.00	0.0000		
14.Dec	7.68	2.00				4.00					1.37		8.95			24.00	69.7125	4.90	
15.Dec	4.03	4.00							2.52		0.42		13.03			24.00	34.7625	4.66	0.50
Wk 47	18.40	8.78	0.00	0.00	4.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.28	0.00	8.68	45.52	166.8750	4.87	0.50
Wk 48	80.69	34.25	0.00	0.00	13.45	0.00	0.00	3.03	0.00	0.00	4.57	0.00	29.35	2.65	0.00	167.99	721.2000	4.83	1.00
Wk 49	24.69	16.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	113.45	0.00	13.75	0.00	0.00	168.00	225.9375	4.93	1.50
Wk 50	16.21	10.00	0.00	0.00	0.00	4.00	0.00	0.00	2.52	0.00	41.66	70.00	23.61	0.00	0.00	168.00	142.9125	4.72	1.00
	Prime Lines	Line Changes	Instr.	Nav.	Mech.	Streamer	Towing	Maritime	Mob Demob	Transit	Weather	Crew Change	Seis. Interfer.	Obstr / Fishing	Other	Hours	Line Km	Speed	Meetng & Drills
Total	**140.00**	**69.14**	**0.00**	**0.00**	**17.82**	**4.00**	**0.00**	**3.03**	**2.52**	**0.00**	**159.68**	**70.00**	**71.99**	**2.65**	**8.68**	**549.51**	**1256.9250**	4.84	**4.00**
	209.14		**24.85**									**313.00**							

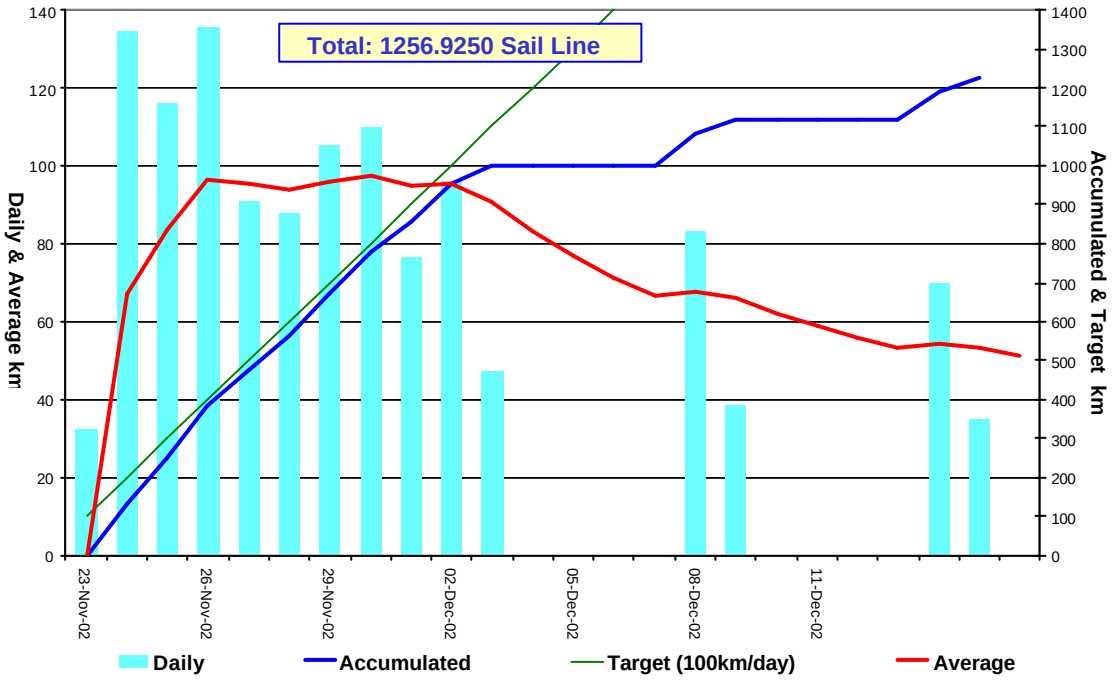
2.2 Timing Summary - Graphical





Hours		Percent
549.51		100%
140.0	Prime Lines	25.5%
69.1	Line Changes	12.6%
0.0	Instruments	0.0%
0.0	Navigation	0.0%
17.8	Source	3.2%
4.0	Streamer	0.7%
3.0	Maritime	0.6%
70.0	Crew Change	12.7%
2.5	Mobilisation	0.5%
159.7	Weather	29.1%
72.0	Seismic Interference	13.1%
2.7	Fishing	0.5%
8.7	Other	1.6%
209.1	Production	38.1%
94.8	Downtime	17.3%
2.5	Mobilisation	0.5%
243.0	Standby	44.2%

2.3 Production Statistics - Graphical



2.4 Production Log

Seq	Line	Dir	Start Date	First SP	Last SP	Shots	Km's	Notes
001	OS02-06	122	23/11	1001	1864	864	32.4000	Line stopped owing to source air leak
002	OS02-06	122	24/11	1759	1864	106		Overlap
002	OS02-06	122	24/11	1865	2507	643	24.1125	Line complete
003	OS02-43	035	24/11	1001	1805	805	30.1875	Line complete
004	OS02-45	215	24/11	1950	897	1054	39.5250	Line complete
005	OS02-41	035	24/11	1001	2084	1084	40.6500	Line complete
006	OS02-39	215	25/11	1683	897	787	29.5125	Line complete
007	OS02-35	36	25/11	1001	1859	859	32.2125	Line complete
008	OS02-37	215	25/11	2094	897	1198	44.9250	Line complete
009	OS02-33	036	26/11	1001	2016	1016	38.1000	Line complete
010	OS02-14	122	26/11	2182	2506	319	11.9625	Line partly shot only to give time slot to Western Monarch
011	OS02-12	302	26/11	2373	897	1477	55.3875	Line complete
012	OS02-08	122	27/11	1001	2496	1494	56.1250	Line complete
013	OS02-10	302	27/11	2382	1906	477	17.8875	Line stopped owing to source air leak
014	OS02-10	302	27/11	2011	1906	106		Overlap
014	OS02-10	302	27/11	1905	897	1009	37.8375	Line complete
015	OS02-04	302	27/11	1640	1159	482	18.0750	Line stopped owing to source air leak
016	OS02-04	302	28/11	1264	1159	106		Overlap
016	OS02-04	302	28/11	1158	897	262	9.8250	Line complete
017	OS02-02	122	28/11	1001	2844	1844	69.1500	Line complete
018	OS02-14	302	29/11	2188	897	11		Overlap
018	OS02-14	302	29/11	2187	897	1291	48.4125	Line complete
019	OS02-01	209	29/11	1728	897	832	31.2000	Line complete
020	OS02-03	030	29/11	1001	1383	383	14.3625	Line partly shot only to give time slot to Western Monarch
021	OS02-03	030	29/11	1278	1383	106		Overlap
021	OS02-03	030	29/11	1384	432	964	36.1500	Line complete
022	OS02-05	210	30/11	1897	1669	229	8.5875	Line stopped owing to source air leak
022	OS02-05	210	30/11	1774	1669	106		Overlap
023	OS02-05	210	30/11	1668	897	772	28.9500	Line complete
024	OS02-07	031	30/11	1001	1871	871	32.6625	Line complete
025	OS02-09	034	01/12	2160	2874	625	23.4375	Line partly shot only to give time slot to Western Monarch

026	OS02-09	034	01/12	1860	1974	115		Overlap
026	OS02-09	034	01/12	1975	2249	275	10.3125	Line complete
026	OS02-09	034	01/12	2250	2355	106		Overlap
027	OS02-11	214	01/12	1688	897	792	29.7000	Line complete
028	OS02-09	034	01/12	1001	1974	974	36.5250	Line complete
028	OS02-09	034	01/12	1975	2080	106		Overlap
029	OS02-15	034	02/12	1001	1469	469	17.5875	Line partly shot only to give time slot to Western Monarch
030	OS02-13	215	02/12	1492	1001	492	18.4500	Line partly shot only to give time slot to Western Monarch
031	**NTBP**							Line aborted and scratched d.t. seismic interference
032	OS02-15	034	02/12	1364	1469	106		Overlap
032	OS02-15	034	02/12	1470	2045	576	21.6000	Line complete
033	OS02-29	216	03/12	2020	897	1124	42.1500	Line complete
034	OS02-31	035	03/12	1001	1772	772	28.9500	Line complete
035	OS02-21	215	03/12	2034	1652	383	14.3625	Line partly shot only to give time slot to Western Monarch
036	**NTBP**							Line aborted d.t. deteriorating weather conditions
037	OS02-13	215	08/12	2190	1493	698	26.1750	Line complete
037	OS02-13	215	08/12	1492	1284	209		Overlap – Extra run-out d.t. high feather on previous line
038	OS02-23	035	08/12	1001	1894	894	33.5250	Line complete
039	**NTBP**							Line scratched d.t. excessive swell noise
040	OS02-19	035	09/12	1210	2051	842	31.5750	Part line complete (started partway along line)
041	OS02-27	216	09/12	1696	897	800	30.0000	Line complete (NB! This line was first pending for re-shoot, but later accepted)
042	OS02-17	215	14/12	2099	1954	146	5.4750	Line partly shot only to give time slot to Western Monarch Also line shortened at SOL d.t. crab pots
043	OS02-17	215	14/12	2059	1954	106		Overlap
043	OS02-17	215	14/12	1953	897	1057	39.6375	Line complete
044	OS02-25	216	15/12	1644	897	748	28.0500	Line complete
045	OS02-21	216	15/12	1757	1652	106		Overlap
045	OS02-21	216	15/12	1651	1335	317	11.8875	Line partly shot only to give time slot to Western Monarch
046	OS02-21	216	15/12	1440	1335	106		Overlap
046	OS02-21	216	15/12	1334	1026	309	11.5875	Line considered complete – terminated early to give time slot to WM
047	OS02-19	036	15/12	1001	1209	209	7.8375	Part line - Line now complete
047	OS02-19	036	15/12	1210	1315	106		Overlap

2.5 Daily Summary

Saturday 23rd November 2002
The ***Polar Duke*** completed the OEP02 survey and turned south to clear the area. The source and streamer front were recovered, for streamer reconfiguration to 7200m, on the transit to the prospect.
The streamer was fully deployed by mid-morning and contact made with the ***Western Monarch*** shooting a 3D program within the borders of the 2D program. A shooting time slot was not available for the ***Polar Duke*** until mid afternoon.

Production commenced on line OS02-06-001 shooting SE, away from the ***Western Monarch*****.** Noise levels were acceptable for both vessels when they resumed production. Streamer depth was set to 7m. An air leak on sub-array #4 caused a circle after 32km. Production resumed on line OS02-06-002 at midnight.

Three toolbox meetings held prior to source and streamer work.

Sunday 24th November 2002
Line OS02-06-002 was completed and a normal line change taken to OS02-43-003. Sea conditions were generally improved and streamer depth kept at 7m. Seismic interference from the ***Western Monarch*** was at low levels on the beam.

Production continued on line OS02-45-004 and OS02-41-005 without problems, seismic interference occasionally to 20µB from abeam.
Line change to OS02-39-006 continued through midnight.

SOLAS training sessions were held after lunch, with all crew participating in four groups.

Monday 25th November 2002
Line change to OS02-39-006 was extended due to essential engine maintenance, to replace a fuel pump. There was no interference for most of this line, but steadily increasing swell noise.

Line OS02-35-007 was shot heading north towards the Nautilus area, where there was some static fishing activity by the ***Gwen Caine***. A tight turn around to avoid buoys was taken back to OS02-37-008, while the guard vessel ***Perfect Lady*** assisted in lifting pots clear. This line was affected by strong seismic interference from abeam for a time.

Line OS02-33-009 was started with the streamer depth set down to 8m as a long south-westerly swell was causing some noise problems. This line continued through midnight.

Tuesday 26th November 2002
Line OS02-33-009 was completed and a quick turn made to pick up 11km on the eastern end of line OS02-14-010. A normal line change was taken onto OS02-12-011, shooting with the ***Western Monarch*** as they headed in the same NW direction on line 1168. ***Polar Duke*** was able to complete their line as the *Monarch* line changed, but then had to wait while the ***Western Monarch*** shot their next line, 1440 heading SE. Some time-share resulted.

Production resumed on OS02-08-012 also heading SE, and this line continued through midnight.

Perfect Lady came alongside mid-morning to transfer the data from the previous prospect to the ***Western Monarch*** for shipment ashore.

Wednesday 27th November 2002
Line OS02-08-012 was completed and the normal line change extended to allow the ***Western Monarch*** to clear. However, line OS02-10-013 was stopped after only 18km due to an air leak, requiring a circle for repairs. The line was resumed and completed as OS02-10-014.

The swell height started to increase up to 5-6m through the morning but the streamer depth was kept at 8m. Noise levels on the cross swell direction were low, but extreme into the swell. There was a delayed turn onto line OS02-04-015 while the ***Monarch*** completed their line. Line OS02-04-015 was stopped shortly before midnight due to a source air leak.

There were toolbox meetings prior to work on the source.

Thursday 28th November 2002
Line 04 was completed as OS02-04-016 and some source repairs carried out in the line change to OS02-02-017. A further major air leak on the run in to this line caused another circle. Production finally resumed mid-morning as the swell lengthened and noise conditions gradually improved.

Line OS02-31-018 was attempted with the long swell astern, but noise levels were too high even with the streamer depth set at 9-10m. The ***Polar Duke*** continued to the northeast on weather standby, to pick up the remaining part of line 14.

Production on line OS02-14-018 commenced shortly before midnight. This part of the line was shot in the opposite direction from the previous portion OS02-14-010.

Perfect Lady came alongside to transfer some test data to the ***Victory II*** **(*Western Monarch's*** guard boat*)* for shipment ashore.

There were three toolbox meetings prior to work on the source.

Friday 29th November 2002
Line OS02-14-018 was completed and the source recovered for maintenance.

The run in to line OS02-01-019 was delayed further as the ***Western Monarch*** requested a CPA of 4 miles while they passed in the opposite direction. This line was shooting into the 3 to 4m south westerly swell and the streamer depth set at 9m. Noise levels and streamer depth control was poor as a result.

Line OS02-03-020 was stopped after 14km as the ***Western Monarch*** started up their line. The ***Polar Duke*** circled, waiting for them to complete before continuing the line as OS02-03-021. This line continued through midnight. Swell noise levels continued poor.

A toolbox meeting was held prior to work on the source. Full ship's management audit was carried out during the afternoon.

Saturday 30th November 2002
Line OS02-03-021 was completed, and a rapid turn off line made to avoid the ***Western Monarch*** as they ran in on theirs.
Line OS02-05-022 commenced in very poor conditions with head seas and the streamer depth set at 9m. The line was stopped after 9km due to a source air leak and a circle made for repair. The line resumed as OS02-05-023 with the streamer depth set to 10m. Noise levels were still high.

This line was completed and the turn made onto OS02-07-024. Noise levels in the following seas were acceptable at 10m-streamer depth, and the line completed while the ***Western Monarch*** was down for technical reasons. This opportunity was also taken to shoot the top part of 09 after a quick turn onto line as OS02-09-025. The northern 23km were completed at midnight.

A toolbox meeting was held prior to recovery of the source. A small fuel oil leak from a tank vent was used as the basis for an oil spill drill during the morning.

Sunday 1st December 2002
The ***Polar Duke*** ran back to pick up line 11 heading south, but ***Western Monarch*** requested a shutdown on the run in to line due to excessive interference. The ***Polar Duke*** continued south then turned back to shoot a mid-section of 09 as line OS02-09-026, in ***Western Monarch's*** line change. This section successfully tied with sequence 025.

The ***Polar Duke*** turned south again to shoot line OS02-11-027 heading south, which was completed. Recovery of the port outer source and some manoeuvring was required to enable the workboat to be used for transfer of two whale-watchers from the ***Total Voyager***. Weather conditions were ideal for this operation but had deteriorated within an hour. 20 to 25 knot winds from the north-east brought up short steep seas during the late afternoon.

The final southern section of line 09 was completed as OS02-09-028. Line change continued through midnight.

Toolbox meetings were held prior to recovery of the source and deployment of the workboat. New personnel were given safety tour of vessel.

Monday 2nd December 2002
Production continued onto line OS02-15-029 heading north. The streamer depth was increased to 10m to reduce the amount of swell noise. This line was terminated after 17km due to excessive seismic interference abeam from the ***Western Monarch.*** The ***Polar Duke*** circled back and picked up line OS02-13-030 mid-way and heading south. This part line was stopped 3km from the end at the request of the ***Western Monarch.*** This southern end of the line was considered complete.

Line OS02-17-031 was shot heading north but aborted after 8km and all NTBP due to excessive seismic interference from abeam. The ***Polar Duke*** slid across to pick up the northern part of line 15 as OS02-15-032 and this was successfully completed. The vessel then headed east to clear the ***Western Monarch*** and shoot line OS02-29-033 heading south. This line continued through midnight.

Tuesday 3rd December 2002
Line OS02-29-033 was completed and normal line change taken to OS02-31-034. This was followed by line OS02-21-035 heading south. This line was terminated after 14km at request of ***Western Monarch.*** The ***Polar Duke*** continued down the line and came back up OS02-23-036 once ***Western Monarch*** had completed. However sea conditions had deteriorated significantly and the line was aborted after 3km and all data NTBP.

The source was recovered for safety and the head of the lead-in recovered for maintenance. Weather forecasts were reviewed, generally poor for the next two to three days, and the decision taken to recover the streamer. Three to four sections were damaged by multiple slashed cuts, consistent with shark bites. The vessel was hove to on prospect with all gear onboard by late evening.
Two toolbox meetings were held prior to recovery of the source and streamer. The ***Perfect Lady*** was released to head for shelter at 15:00 local time. See TQM 0228 incident report on a streamer reel brake failure.

Wednesday 4th December 2002
Vessel hove-to on prospect with all gear onboard. Weather standby.

Thursday 5th December 2002
Vessel hove-to, now SW of prospect with all gear onboard. Weather standby.

Friday 6th December 2002
Vessel turned fair seas and back on prospect with all gear onboard. Sea conditions had moderated sufficiently by early evening to allow streamer deployment to begin. Streamer deployment in weather standby continued through midnight.
Toolbox meeting held prior to streamer deployment.

Saturday 7th December 2002
Full equipment deployment was completed by early morning. Swell noise levels were tested on both remaining headings but were excessive even with the streamer set at 12m. The vessel went into a holding pattern in the centre of the prospect, remaining on weather standby for the rest of the day.
Toolbox meeting held prior to streamer deployment and head adjustments. The ***Perfect Lady*** was back on prospect at first light.

Sunday 8th December 2002
The source was deployed during the early hours and production resumed on the northern end of line OS02-13-037. This sequence completed the line, with the overlap onto sequence 030 charged as time-share. Production continued on line OS02-23-038 and then onto part line OS02-21-039 to complete sequence 035. Swell noise levels began to increase down this sequence 039 and the line is accepted but as a possible re-shoot.

Swell noise levels were too high on the northerly heading, but improved as the vessel ran up the line. Acquisition on part line OS02-19-040 resumed 8km up the line, and continued through midnight.

The ***Western Monarch*** planned to be at their first start of line around midnight but was delayed.
There was a toolbox meeting prior to work on the source sub-arrays during line change.

Monday 9th December 2002
The northern part of line OS02-19-040 was completed. An extended line change was taken over to line OS02-27-041 to avoid the ***Western Monarch***, which was working on her streamers to the SW of their prospect. Sequence 041 was strongly affected by swell noise bursts and was rejected after assessment of the brute stacks. An extended run in was taken to the next line to assess swell noise and streamer control in the following seas. Sea conditions were too poor for production and the vessel turned back into the seas for source recovery.

Weather standby continued on prospect until early evening, when the decision was taken to recover the streamer and head into port for crew change.

The ***Perfect Lady*** was released to return to port at 12:30 local time.

Three toolbox meetings were held prior to work on, then recovery of the source, and recovery of the streamer.

Tuesday 10th December 2002
The ***Polar Duke*** continued towards Melbourne, and arrived alongside early afternoon and started re-supply.

Wednesday 11th December 2002
A full crew change took place during the morning. The Clients and Party Chiefs held a mid-survey handover briefing session. The vessel finally departed Melbourne at 17:00 hrs Local, remaining in transit back to the prospect area through to midnight.

Thursday 12th December 2002
The vessel continued in transit back to the prospect area through to early afternoon, the transit slowed slightly due to our direction directly into the heavy seas. At 15:09 Local streamer deployment operations commenced, involving slight ballast adjustments and a section replacement along with the normal streamer deployment. This work continued through until midnight.

Friday 13th December 2002
Streamer deployment and minor repairs continued until 05:00 hrs local by which time the streamer was deployed and all Instrument tests performed satisfactorily. Swell noise and streamer control had also been observed in both line directions and found to be unacceptable, denoting the vessel as down for weather until the sea conditions moderated. The streamer was towed on alternate line headings throughout the day to observe noise levels, as the sea conditions slowly began to settle. A decision to attempt line OS02-17 from the NE to the SW. was made and the vessel proceeded towards the run-in for a possible start shortly after midnight.

Saturday 14th December 2002
The vessel began production on line OS02-17-042 at 01:22 local but was forced to terminate early for the Monarch (traffic / timeshare problem). The vessel circled and resumed acquisition on OS02-17-043 at 06:28 local, which continued to the end of line. A standard line change, followed by an extension to the line change (timesharing) plus a period of streamer work, brought the vessel to line OS02-25-044. Production commenced at 21:14 local and continued through until midnight.

Sunday 15th December 2002

The day began in production on line OS02-25-044 that continued to its completion. This was followed by a line change and an extension for time sharing. Production resumed on line OS02-21-045 but the line had to be terminated early due to seismic interference from the ***Western Monarch***. The vessel circled and picked up the remainder of this line during the next available timeshare slot. Approximately 1 km of the southern end of the pre-plotted line (plus its run-out) was missing from line OS02-21 (unable to acquire before ***Western Monarch*** commenced shooting again). Another line change came next followed by an extension for time sharing until production began once more on line OS02-19-047. This line was only partially shot – the southern portion of the line not acquired originally – and production continued through to the completion of the line and its overlap with the prior segment. Due to time constraints this was the final line of the survey, and the source equipment was subsequently recovered in preparation for the transit to the next survey location.

2.6 Field Information and Encountered Problems

2.6.1 Obstructions / Installations on the Field

There were no man-made obstructions or offshore oil installations in the survey area. Water depths ranged from 200-3000 m. There were no known physical obstructions. The dip lines ended in shallower water.

2.6.2 Traffic / Shipping Lanes

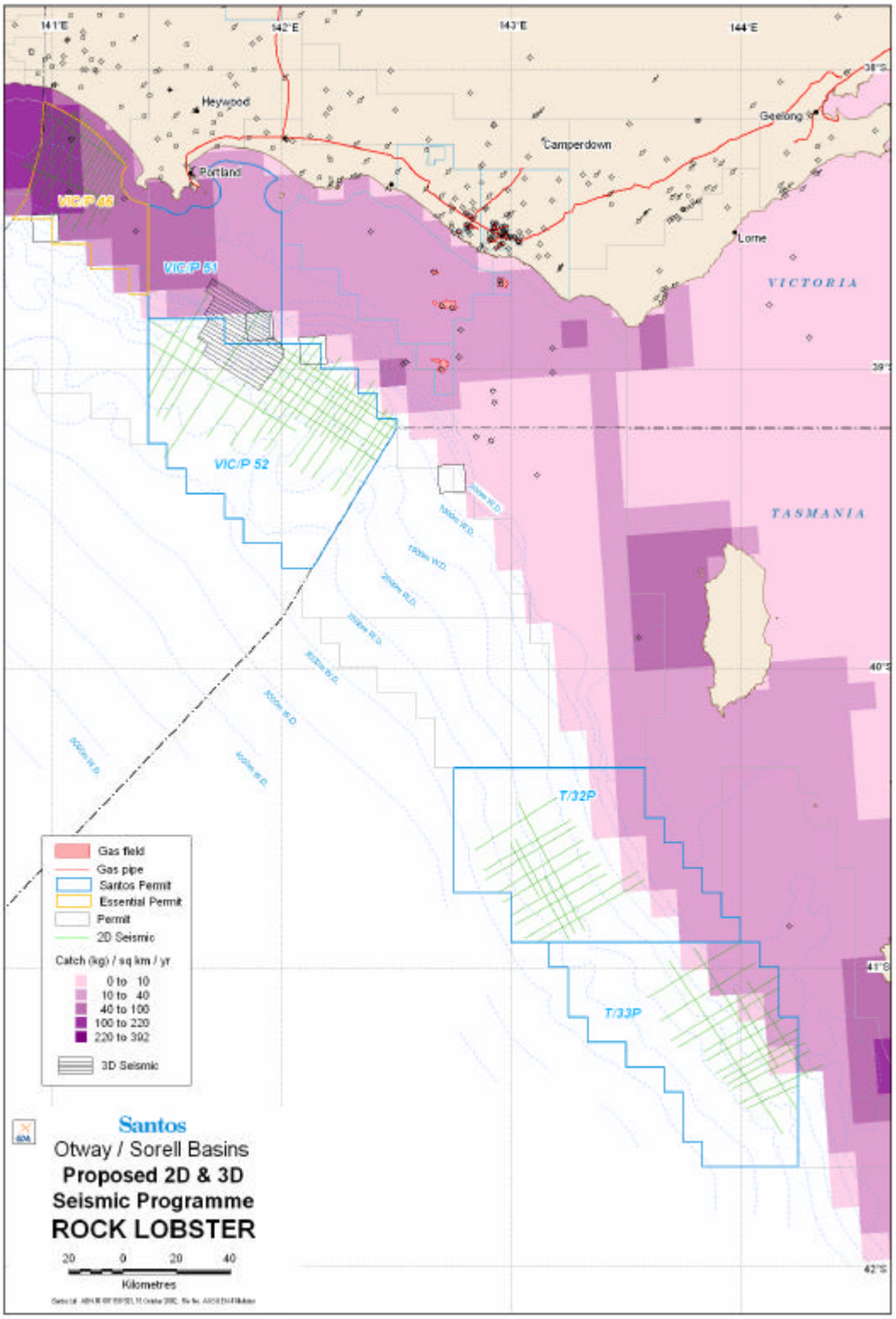
There were no designated shipping lanes in the prospect area. However the prospect was across the local shipping route between Melbourne and Adelaide. There were two or three ships per hour passing at only the busiest time but it was often completely quiet particularly during the weekend periods. All shipping responded quickly to the VHF radio and there were no problems at all.

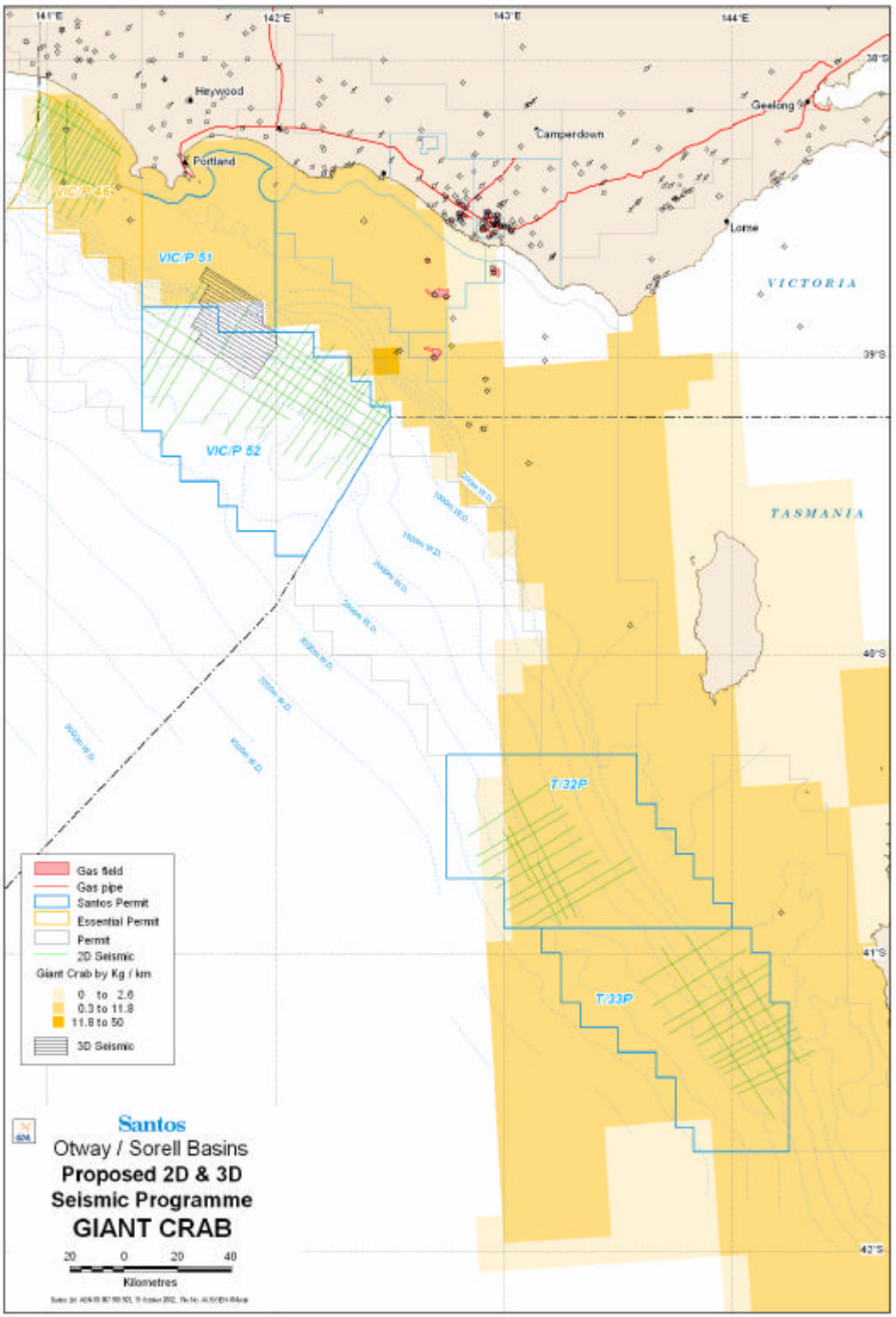
"Perfect Lady"

2.6.3 Fishing Activity

Fishing activity in the prospect area was light. Some small boats, using static buoyed pots for crab and lobster fishing worked inside of the 200m-depth contour. Santos had prepared the prospect well in advance, and there was very good cooperation with the fishing fleets.
A local vessel with 20 knots top speed, the ***Perfect Lady***, accompanied the ***Polar Duke*** during this survey and was a great help in scouting obstructions ahead. They were also licensed to lift and move static gear if required.

The following next 5 charts show the main types of possible fishing in the prospect area.


141°E
142°E
143°E
144°E
38°S
39°S
40°S
41°S
42°S
Heywood
Portland
Camperdown
Geelong
Lorne
VICTORIA
TASMANIA
VIC/P 48
VIC/P 51
VIC/P 52
T/32P
T/33P
Gas field
Gas pipe
Santos Permit
Essential Permit
Permit
2D Seismic
Catch (kg) / sq km / yr
0 to 10
10 to 40
40 to 100
100 to 220
220 to 392
3D Seismic
Santos
Otway / Sorell Basins
Proposed 2D & 3D
Seismic Programme
ROCK LOBSTER
20 0 20 40
Kilometres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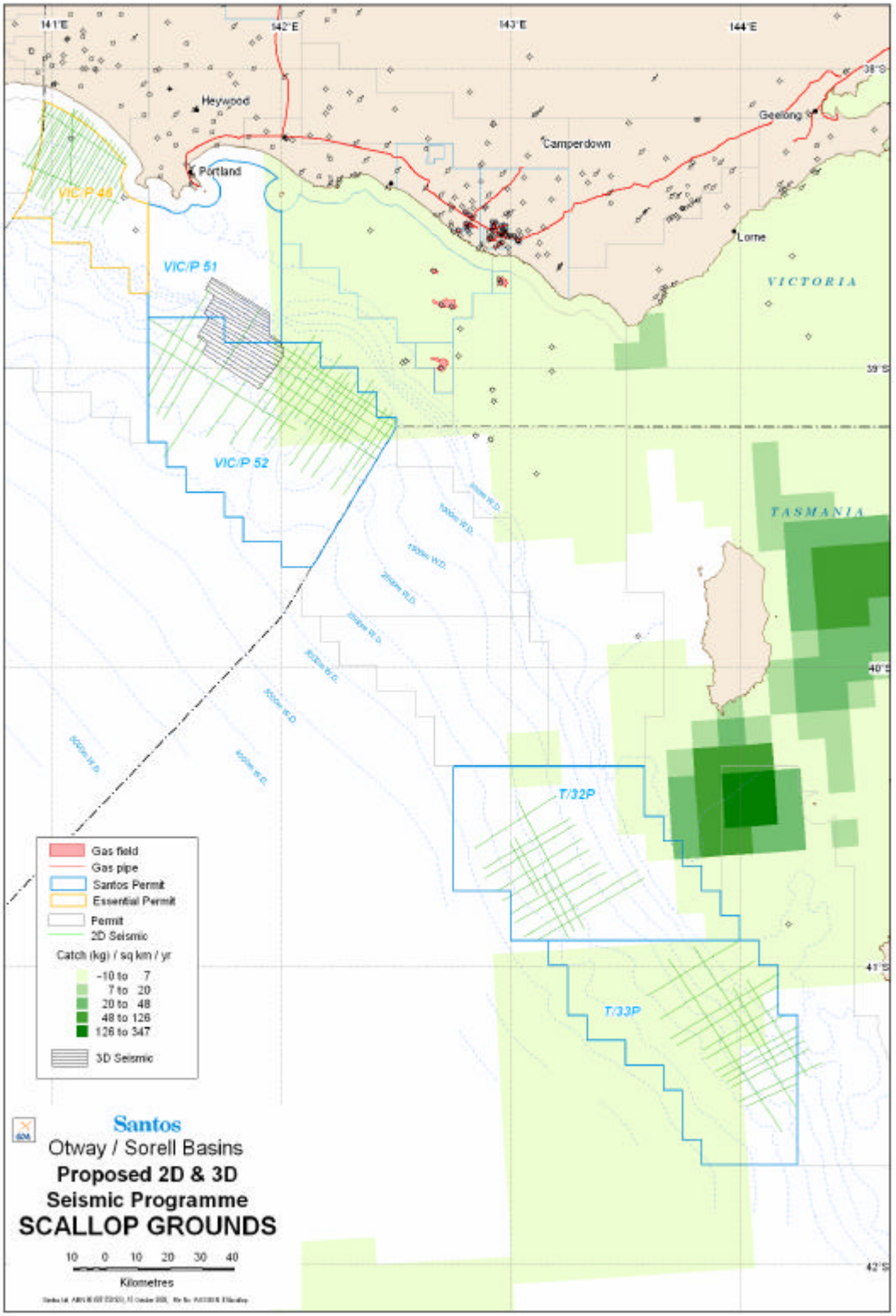
142°E
143°E
144°E
38°S
39°S
40°S
41°S
42°S
Heywood
Portland
Camperdown
Geelong
Lorne
VICTORIA
TASMANIA
VIC/P 45
VIC/P 51
VIC/P 52
T/32P
T/33P
Gas field
Gas pipe
Santos Permit
Essential Permit
Permit
2D Seismic
Giant Crab by Kg / km
0 to 2.6
0.3 to 11.8
11.8 to 50
3D Seismic
Santos
Otway / Sorell Basins
Proposed 2D & 3D
Seismic Programme
GIANT CRAB
20 0 20 40
Kilometres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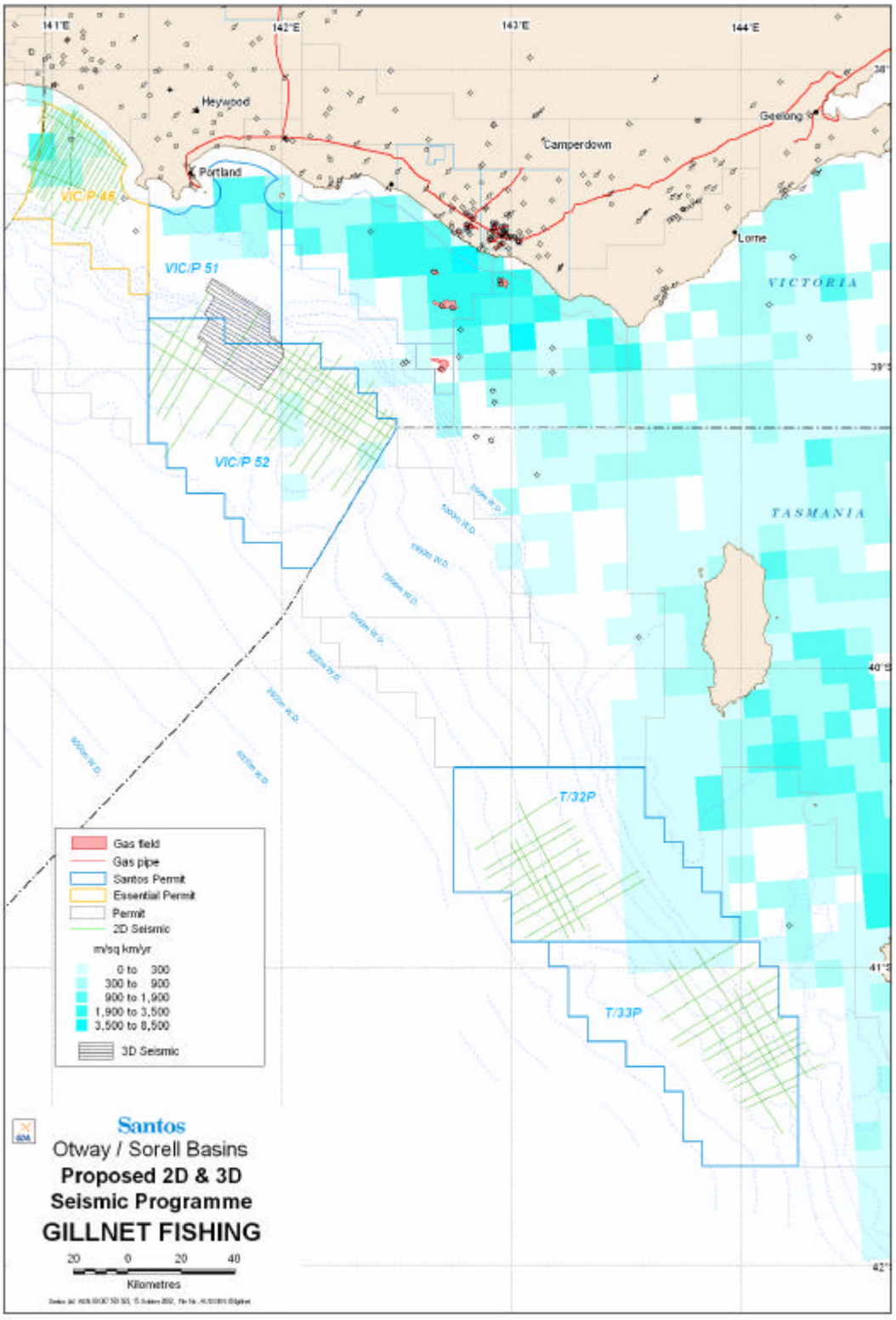
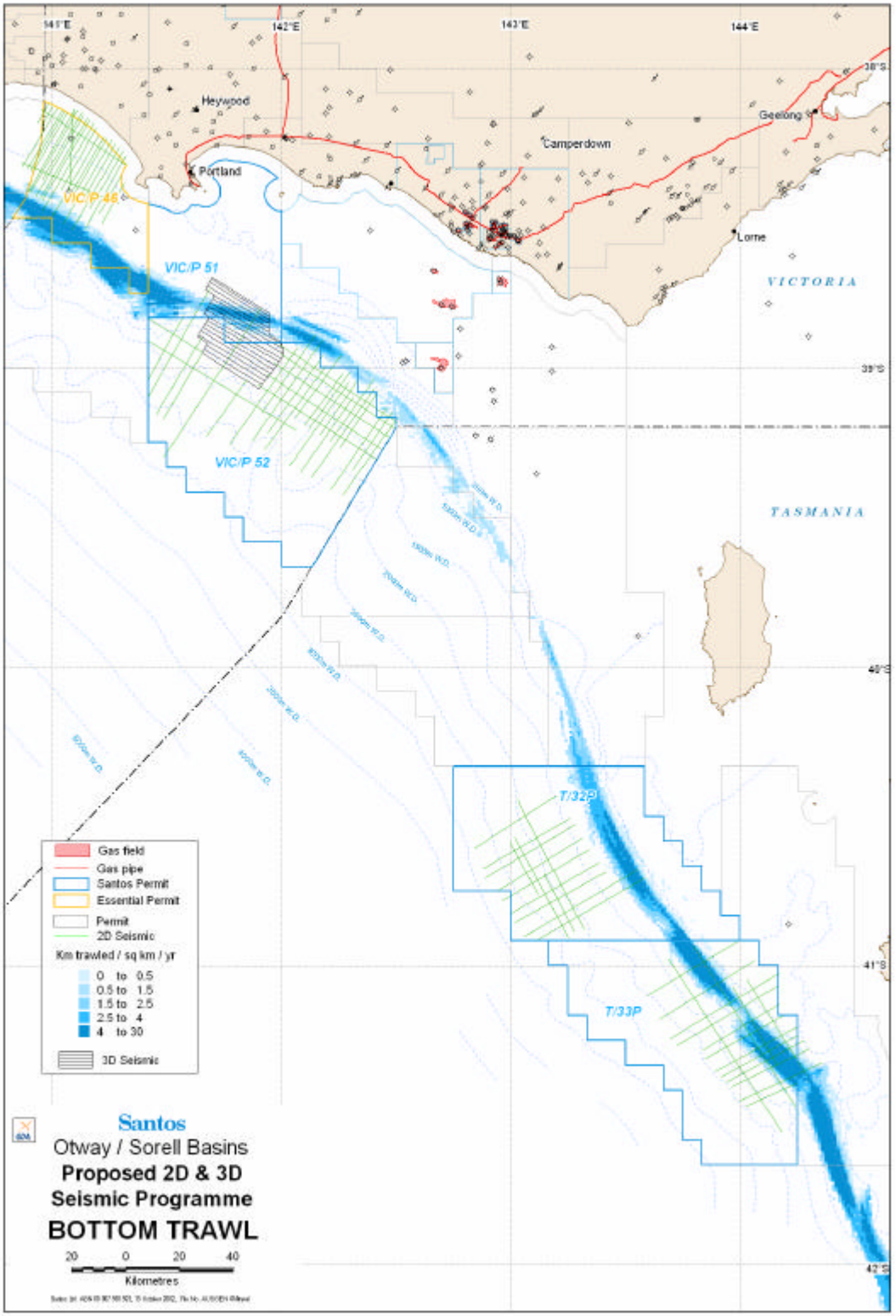
40°S
41°S
42°S
Heywood
Portland
Camperdown
Geelong
Lorne
VICTORIA
TASMANIA
VIC/P 46
VIC/P 51
VIC/P 52
T/32P
T/33P
Gas field
Gas pipe
Santos Permit
Essential Permit
Permit
2D Seismic
Catch (kg) / sq km / yr
-10 to 7
7 to 20
20 to 48
48 to 126
126 to 347
3D Seismic
Santos
Otway / Sorell Basins
Proposed 2D & 3D
Seismic Programme
SCALLOP GROUNDS
10 0 10 20 30 40
Kilometres


141°E
142°E
143°E
144°E
Heywood
Portland
Camperdown
Geelong
Lorne
VICTORIA
TASMANIA
VIC/P 45
VIC/P 51
VIC/P 52
T/32P
T/33P
Gas field
Gas pipe
Santos Permit
Essential Permit
Permit
2D Seismic
m/sq km/yr
0 to 300
300 to 900
900 to 1,900
1,900 to 3,500
3,500 to 8,500
3D Seismic
Santos
Otway / Sorell Basins
Proposed 2D & 3D
Seismic Programme
GILLNET FISHING
20 0 20 40
Kilometres


141°E
142°E
143°E
144°E
38°S
Heywood
Portland
Camperdown
Geelong
Lorne
VICTORIA
VIC/P 46
VIC/P 51
VIC/P 52
39°S
TASMANIA
40°S
T/32P
T/33P
41°S
42°S
Gas field
Gas pipe
Santos Permit
Essential Permit
Permit
2D Seismic
Km trawled / sq km / yr
0 to 0.5
0.5 to 1.5
1.5 to 2.5
2.5 to 4
4 to 30
3D Seismic
Santos
Otway / Sorell Basins
Proposed 2D & 3D
Seismic Programme
BOTTOM TRAWL
20 0 20 40
Kilometres

2.6.4 Seismic Interference and Time Share

The ***Western Monarch*** was conducting a concurrent 3D survey for **Santos** on the same prospect. The 3D crew had priority at all times. Much of the data acquired had some seismic interference but to a level, which did not affect final quality. Some lost time to "time share" for the ***Polar Duke*** was also inevitable but every effort was made to keep this to a minimum.

2.6.5 Environmental Obstacles

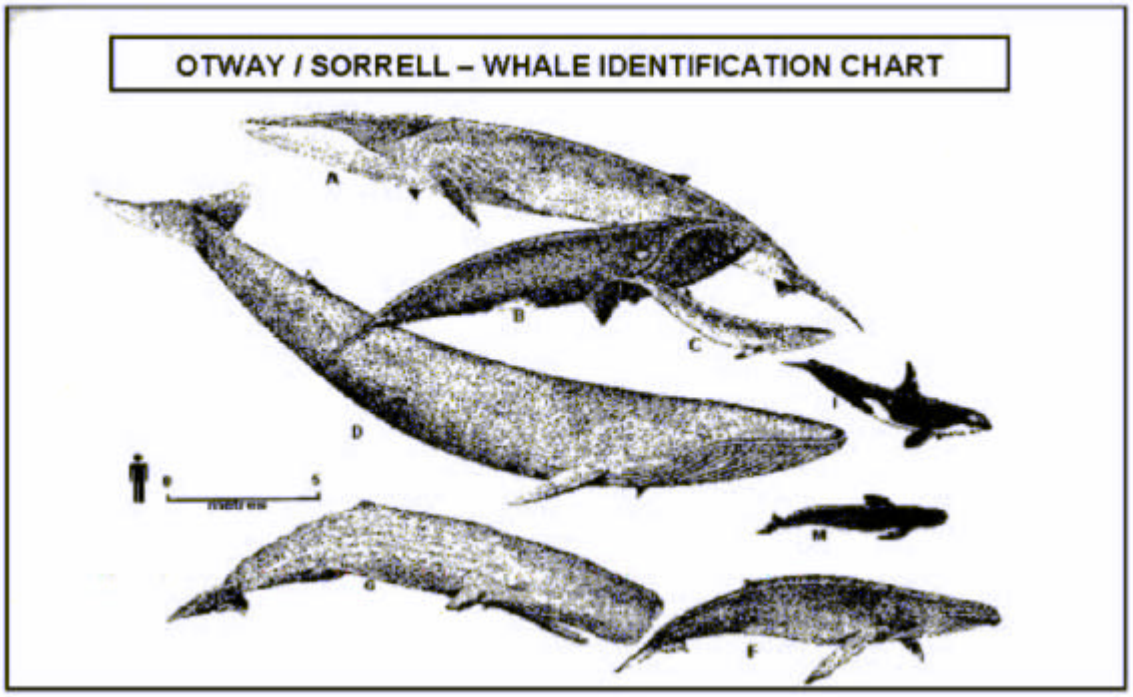
The survey area is strongly affected by oceanic swells from the SW. Strong currents tended to run along the coast and were highly variable in nature on the prospect. Overall current direction was frequently affected by the local weather situation.

2.6.6 Operational Observations

Daily production rates were good during calmer weather periods. The good preparation carried out by Santos prior to the survey meant that there was very limited conflict of operations with the fishing activity in the region.

2.6.7 Cetacean Activity

The survey area is known to be in an area of high whale activity. Standard company precautions were taken to minimise any disturbance, as set out in the flow diagram below. The survey was timed to be between whale migration periods through the Straits.



FIN WHALE (A)

HUMPBACK WHALE (F)

15m long; black above and whitish below; baleen grey-black; large head (1/3 of length); "warts" on head; up to 25 throat grooves or pleats; small dorsal fin slightly aft of midpoint between head and tail; exceptionally long flippers (3.5m+) scalloped on their front margins; sometimes leaps completely out of the water (breaching) and its body is "humpbacked" on re-entering; beats surface with flukes (lobtailing); spout is spherical and about 3m high.

SPERM WHALE (G)

High square fronted head, a third of total length, and the lower jaw does not extend as far forward as the front of the head, directs the spout forward at an angle; no dorsal fin, only a series of bumps, the first and most prominent located about two-thirds of the way from the snout to the tail; flippers relatively extremely small; black or nearly black colour.

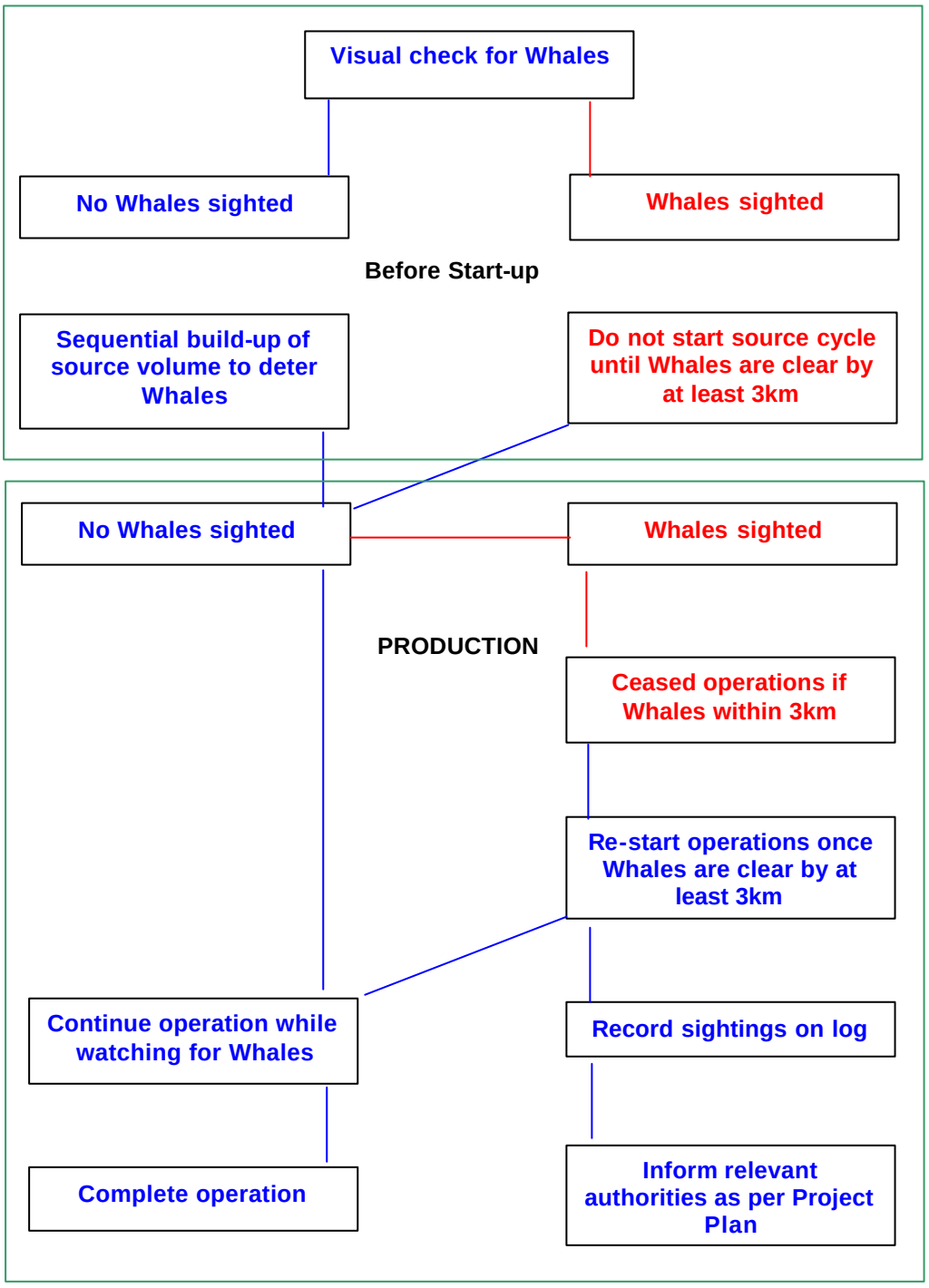
KILLER WHALE (I)

Predator which travels in packs; can "stand" on its tail sticking its head out of the water; 10m long (females a third smaller); very large dorsal fin - 2m; flippers are blunt; flukes are very broad; black colour with lens-shaped white spot behind each eye and patches of white under the chin, on the belly and behind the dorsal fin on each side of the streamlined boby.

PILOT WHALE (M)

6m long; uniform black colour except for white patch under the chin which narrows to a slim white line along the stomach; high broad-based dorsal fin located almost exactly in the middle of the back; flippers are lsim and melon-like bulge; travel in schools.

Cetacean Encounter Procedure



3 HSE Summary

Toolbox meetings were held whenever a task involving major equipment and several crewmembers was about to be carried out. This included but was not limited to work on the seismic source and streamer, and operations with the ship's workboat. All toolbox meetings were noted in the Bridge Log Book and the daily number of meetings held logged by the Party Chief.

New members of the crew were given safety orientation tours of the vessel at the start of the survey, and regular safety drills, SOLAS Training and meetings held.

The following table lists the HSE activities in chronological order during this short survey period.

Date	Action	Hours	Number of crew
24 Nov	SOLAS training for all crew in four groups	0.5	29
30 Nov	Oil spill drill to contain small diesel oil spill	1.0	10
01 Dec	MOB drill during workboat personnel transfer	0.5	6
01 Dec	Safety tour of vessel for new personnel	0.5	3
08 Dec	Full crew safety meeting, except minimum manning for Bridge and Recording Room	1.0	27
11 Dec	Boat drill held following vessel crew change	0.5	32
11 Dec	Safety Induction tour of vessel for new personnel	0.5	5
15 Dec	Fire drill (simulated fire in aft lounge) held	0.5	28

There was one Near Miss, no Incidents or cases requiring medical treatment during the survey period. TQM report follows:

TQM DUK 0228

1.	Short report description	: Streamer winch brake released itself and started letting out cable.
2.	Type of report	: Near Accident
3.	Event description	: Seismic crew doing work on lead-in when suddenly the streamer winch start paying out cable by it self. The winch letting out about 50 metres before the brake reactivate again.
	Master	: Palmar Slettebakk
	Author	: Palmar Slettebakk/Gunnar Bergvik
	Date/Time of event	: 03.12.2002 at 1640 hrs lt.
	Weather condition	: Westerly 7, Seas 6
	Other condition	: N/A
	Ships position	: S39°10' E142°10'
	Personnel involved	: Clifford Gobbit and Ivar Atteraas
4.	Immediate Action	: Secured streamer
5.	Probable cause	: Various pressure on the brake after the winch is stopped, causing self release of the brake. Brake pressure relief valve missing.
6.	Corrective action	: Modification on hydraulic winch equipment required to be completed.
7.	Experience Transfer recommended:	

4 Shipment List

PI Number	Description	Shipped to	Department	Date shipped	Shipped from
PD-2002-091	Seismic Data Job 6151 OEP02 Santos **Original**	Robertson Perth	INS	26-Nov-02	At sea, Melbourne
PD-2002-092	Seismic Data Job 6151 OEP02 Santos **Copy**	Robertson Perth	INS	11-Dec-02	Melbourne
PD-2002-093	Processing Plots & Stack Tapes Job 6151 OEP02	Robertson Perth	PROC	26-Nov-02	At sea, Melbourne
PD-2002-094	**Santos OS02-37-008 line Data, Obs-, Nav-, Proc- Logs**	Robertson Perth	INS/NAV/PROC	27-Nov-02	At sea, Melbourne
PD-2002-095	MGC copy Final report and nav data OEP02	MGC, Bergen	PC	27-Nov-02	At sea, Melbourne
PD-2002-096	**Seismic Data Job 6151 OS02 Santos Original**	Robertson Perth	INS	11-Dec-02	Melbourne
PD-2002-097	**Seismic Data Job 6151 OS02 Santos Copy**	Robertson Perth	INS	10-Jan-03	Eden, Vic.
PD-2002-098	Lithium batteries for disposal	Beaufort Shipping	INS	11-Dec-02	Melbourne
PD-2002-099	Defective Depth transducers	Cirrus UK	Mech	11-Dec-02	Melbourne
PD-2002-100	Processing Plots & Stack Tapes Job 6151 OEP02	Robertson Perth	PROC	10-Dec-02	Melbourne
PD-2002-101	6 lobster pots to be returned to owners	Perfect Lady, Portland	INS	11-Dec-02	Melbourne
PD-2002-102	**NAV Data Santos OS02 Otway Basin, Australia**	Robertson Perth	NAV	10-Jan-03	Eden, Vic.
PD-2002-103	**NAV Data Santos OS02 Otway Basin, Australia**	MGC, Bergen	NAV	10-Jan-03	Eden, Vic.
PD-2002-104	**Seismic Data Job 6151 OS02 Santos Original**	Robertson Perth	INS	10-Jan-03	Eden, Vic.
PD-2002-105	**Seismic Data Job 6151 OS02 Santos Copy**	Robertson Perth	INS	10-Jan-03	Eden, Vic.
PD-2002-106	NAV Data Santos SS02 Sorell Basin, Tasmania	WesternGeco Perth	NAV	10-Jan-03	Eden, Vic.
PD-2002-107	NAV Data Santos SS02 Sorell Basin, Tasmania	MGC, Bergen	NAV	10-Jan-03	Eden, Vic.
PD-2002-108	**Processing Plots & Stack Tapes Job 6151 OS02**/SS02	Robertson Perth	PROC	10-Jan-03	Eden, Vic.
PD-2002-109	**Promax Backups:** OEP02/**OS02**/SS02/GBS02/GS02	MGC, Bergen	PROC	10-Jan-03	Eden, Vic.

4.1 Seismic Data

Original Tapes
First Shipment

PD-2002-096

11- Dec. 2002

SENDER: M/V Polar Duke
C/o Beaufort Shipping Agency Company
99,Queensbridge Street, Southbank, Vic. 3006
GPO Box 88A, Melbourne, Victoria 3001
E-Mail beaufort.melb@beaufortshipping.com
Attn. J. Duncan Tel: +61 3 9254 1599
Fax : +61 3 9696 9267

CONSIGNEE:
Robertson Research Australia Pty Ltd.'
69, Outram Street'
West Perth
Western Australia 6005

Attention Kelly Buglehole

ORIGINAL TAPES

Type of freight:
Sea/Land/Air

Box	Item	Serial no.	General description of content	Weight(kg)	Value(US)
1	1	n/a	Box containing 30 seismic data cartridges reel nos. 165-194	7	$2,500
2	1	n/a	Box containing 30 seismic data cartridges reel nos. 195-224	7	$2,500
3	1	n/a	Box containing 04 Seismic data cartridges reel nos. 225-228.	12	$1,000
			1 x CD containing Seismic observers Logs and Tape Logs for original and copy tapes.		
			Paper seismic Observers Logs, Nav logs, Gun Logs, and syntrak printouts		
			1 cartridge with pre-contract tests, with printouts. Daily test printouts.		
			2 x Seismic data cartridges with attenuation shots recorded on Polar Duke of Western		
			Monarch shooting.		
			1 x CD containing Navigation shipment data		

Total weight: 26kg

Total boxes: 3

Total value: $6,000.00

For custom purposes only

Certified true and correct for MGC AS

Geoff Clarke - Party Chief, M/V Polar Duke

Collected from the Polar Duke by

Name:

Signature

Original Tapes
Second Shipment

PD-2002-104

22- Dec. 2002

SENDER: M/V Polar Duke
C/o Beaufort Shipping Agency Company
99,Queensbridge Street, Southbank, Vic. 3006
GPO Box 88A, Melbourne, Victoria 3001
E-Mail beaufort.melb@beaufortshipping.com
Attn. J. Duncan Tel: +61 3 9254 1599
Fax : +61 3 9696 9267

CONSIGNEE:
Robertson Research Australia Pty Ltd.,
69, Outram Street,
West Perth,
Western Australia 6005

Attention: Kelly Buglehole

ORIGINAL TAPES

Type of freight: **Sea/Land/Air**	

Box	Item	Serial no.	General description of content	Weight(kg)	Value(US)
1	1	n/a	Box containing 7 seismic Data Cartridges Reel Nos. 229 - 235	3	$700
	1	n/a	1 x CD containing Seismic observers Logs and Tape Logs for original and copy tapes.	2	N.C.V.
			Paper seismic Observers Logs, Nav logs, Gun Logs, and syntrak printouts		
			***** Otway Basin OS02 Survey : Line Sequences No. 042 - 047 *****		

Total weight: 5 kg

Total boxes: 1

Total value: $700.00

For custom purposes only

Certified true and correct for MGC AS

John Hennessey - Party Chief, M/V Polar Duke

Collected from the Polar Duke by

Name:

Signature

Copy Tapes
First Shipment

PD-2002-097

11- Dec. 2002

SENDER: M/V Polar Duke
C/o Beaufort Shipping Agency Company
99,Queensbridge Street, Southbank, Vic. 3006
GPO Box 88A, Melbourne, Victoria 3001
E-Mail beaufort.melb@beaufortshipping.com
Attn. J. Duncan Tel: +61 3 9254 1599
Fax : +61 3 9696 9267

CONSIGNEE:
Robertson Research Australia Pty Ltd.'
69, Outram Street'
West Perth
Western Australia 6005

Attention Kelly Buglehole

Fax : +61 3 9696 9267

COPY TAPES

Type of freight:
Land

Box	Item	Serial no.	General description of content	Weight(kg)	Value(US)
1	1	n/a	Box containing 30 seismic data cartridges reel nos. 165-194	7	$2,500
2	1	n/a	Box containing 30 seismic data cartridges reel nos. 195-224	7	$2,500
3	1	n/a	Box containing 04 seismic data cartridges reel nos 225-228	2	$500
			1 x CD with Obsevers Logs and Tape Logs for original and copy tapes.		

Total weight: 7

Total boxes: 3

Total value: $5,500.00

For custom purposes only

Certified true and correct for MGC AS

Geoff Clarke - Party Chief, M/V Polar Duke

Collected from the Polar Duke by

Name:

Signature

Copy Tapes
Second Shipment

PD-2002-105

22- Dec. 2002

SENDER: M/V Polar Duke
C/o Beaufort Shipping Agency Company
99,Queensbridge Street, Southbank, Vic. 3006
GPO Box 88A, Melbourne, Victoria 3001
E-Mail beaufort.melb@beaufortshipping.com
Attn. J. Duncan Tel: +61 3 9254 1599
Fax : +61 3 9696 9267

CONSIGNEE:
Robertson Research Australia Pty Ltd.,
69, Outram Street,
West Perth,
Western Australia 6005

Attention: Kelly Buglehole

COPY TAPES

Type of freight:	
Sea/Land/Air	

Box	Item	Serial no.	General description of content	Weight(kg)	Value(US)
1	1	n/a	Box containing 7 seismic Data Cartridges (Copies) Reel Nos. 229 - 235	3	$700
	1	n/a	1 x CD containing Seismic observers Logs and Tape Logs for original and copy tapes.	0.5	N.C.V.
			***** Otway Basin OS02 Survey : Line Sequences No. 042 - 047 *****		

Total weight: 3.5 Kg

Total boxes: 1

Total value: $700.00

For custom purposes only

Certified true and correct for MGC AS

John Hennessey - Party Chief, M/V Polar Duke

Collected from the Polar Duke by

Name:

Signature

4.2 Navigation Data

The first shipment of navigation data was included in shipment PD-2002-096.

Shipment PD-2002-102 and PD-2002-103did however contain the whole set of Otway Basin OS02 navigation data.

PD-2002-102

Date: December 22 , 2002

SENDER: M/V Polar Duke
C/o Beaufort Shipping Agency Company
99,Queensbridge Street, Southbank, Vic. 3006
GPO Box 88A, Melbourne, Victoria 3001
E-Mail beaufort.melb@beaufortshipping.com
Attn. J. Duncan Tel: +61 3 9254 1599
Fax : +61 3 9696 9267

CONSIGNEE:
Robertson Research Australia Pty Ltd.'
69, Outram Street'
West Perth
Western Australia 6005

Attention Kelly Buglehole

Type of freight:
COURIER

SANTOS OS02 - Otway Basin, Australia - Sequence numbers 001-047

Box	Item	Serial no.	General description of content	Weight(kg)	Value(US)
1	2	N/a	2 CD's of Navigation Data containing Raw p294/p190/Processed p294, Line Summaries, Logs, Offsets and associated files.	0.1	$10

Total weight: 0.1kg

Total boxes: 1

Total value: $10.00

For custom purposes only

Certified true and correct for MGC AS

Alan Allen - Navigation, M/V Polar Duke

Collected from the Polar Duke by

Name:

Signature

PD-2002-103

December 22, 2002

SENDER: M/V Polar Duke
C/O Beaufort Shipping Agency Company
99,Queensbridge Street, Southbank, Vic. 3006
GPO Box 88A, Melbourne, Victoria 3001
E-Mail beaufort.melb@beaufortshipping.com
Attn. J. Duncan Tel: +61 3 9254 1599
Fax : +61 3 9696 9267

CONSIGNEE:
Multiwave Geophysical ASA
Damsgardsveien 131
N-5162 Bergen
NORWAY

Attn: Kai Aaseboe/Willy Forland **Tel: +47-55-94-77-50**

Type of freight:	
Air COURIER	**SANTOS OS02 - Otway Basin, Australia - Sequence numbers 001-047**

Box	Item	Serial no.	General description of content	Weight(kg)	Value(US)
1	2	N/a	2 CD's of Navigation Data containing Raw p294/p190/Processed p294,	0.1	$10
			Line Summaries, Logs, Offsets and associated files.		

Total weight: 0.1kg

Total boxes: 1

Total value: $10.00

For custom purposes only

Certified true and correct for MGC AS

Alan Allen - Navigation, M/V Polar Duke

Collected from the Polar Duke by

Name:

Signature

4.3 Processing Data

PD-2002-108

Date: **30-Dec-02**

SENDER: M/V Polar Duke
C/o Beaufort Shipping Agency Company
99,Queensbridge Street, Southbank, Vic. 3006
GPO Box 88A, Melbourne, Victoria 3001
E-Mail beaufort.melb@beaufortshipping.com
Attn. J. Duncan Tel: +61 3 9254 1599
Fax : +61 3 9696 9267

CONSIGNEE:
Robertson Research Australia Pty Ltd.'
69, Outram Street'
West Perth
Western Australia 6005

Attention Kelly Buglehole

Type of freight:
Air/Land

Box	Item	Serial no.	General description of content	Weight(kg)	Value(US)
1	1-6	N/A	Otway Basin, OS02, Paper plots (Brute stacks, Raw stacks, NTG, RMS Seg 042-047)	2.00	$5.00
	7-11	N/A	Otway Basin, OS02, 5 x 8mm tapes of SEGY stack data, ProMAX archives & UNIX archive of line	0.50	$10.00
	12	N/A	Otway Basin, OS02, 1 x floppy disk of line stacking velocities	0.10	$1.00
	13-46	N/A	Sorell Basin, SS02, Paper plots (Brute stacks, Raw stacks, NTG, RMS Seg 001-034)	5.00	$5.00
	47-51	N/A	Sorell Basin, SS02, 5 x 8mm tapes of SEGY stack data, ProMAX archives & UNIX archive of line d	0.50	$10.00
	52	N/A	Sorell Basin, SS02, 1 x floppy disk of line stacking velocities	0.10	$1.00

Total weight: $8.20

Total boxes: 1

Total value: $32.00

For custom purposes only

Certified true and correct for MGC AS

John Hennessey - Party Chief, M/V Polar Duke

Collected from the Polar Duke by

Name:

Signature

5 Tape Logs

Tape log for box 1 of 3, shipment 1

Polar Duke Data Tape Log

Prospect	**Santos-OS02**
Box	**001**
Original/Copy	**Original**
Shipment No.	**PD-2002-096**

Line Name	Seq	Reel	FSP	LSP	FF	LF	Status
OS02-06-001	001	165	1001	1824	999	1824	
OS02-06-001	001	166	1825	1887	1825	1888	**Incomplete**
OS02-06-002	002	167	1759	2507	1757	2508	**Complete**
OS02-43-003	003	168	1001	1805	1000	1806	**Complete**
OS02-45-004	004	169	1950	1126	1951	1126	
OS02-45-004	004	170	1125	987	1125	986	**Complete**
OS02-41-005	005	171	1001	1825	1000	1825	
OS02-41-005	005	172	1826	2084	1826	2085	**Complete**
OS02-39-006	006	173	1683	897	1684	896	**Complete**
OS02-35-007	007	174	1001	1825	1000	1825	
OS02-35-007	007	175	1826	1859	1826	1860	**Complete**
OS02-37-008	008	176	2094	1270	2095	1270	
OS02-37-008	008	177	1269	897	1269	896	**Complete**
OS02-33-009	009	178	1001	1825	1000	1825	
OS02-33-009	009	179	1826	2016	1826	2017	**Complete**
OS02-14-010	010	180	2182	2506	2182	2507	**Incomplete**
OS02-12-011	011	181	2373	1549	2374	1549	
OS02-12-011	011	182	1548	897	1548	896	**Complete**
OS02-08-012	012	183	1001	1825	1000	1825	
OS02-08-012	012	184	1826	2496	1826	2497	**Complete**
OS02-10-013	013	185	2382	1901	2383	1900	**Incomplete**
OS02-10-014	014	186	2011	1187	2012	1187	
OS02-10-014	014	187	1186	897	1186	896	**Complete**
OS02-04-015	015	188	1640	1150	1641	1149	**Incomplete**
OS02-04-016	016	189	1263	897	1264	896	**Complete**
OS02-02-017	017	190	1001	1825	1000	1825	
OS02-02-017	017	191	1826	2651	1826	2651	
OS02-02-017	017	192	2652	2844	2652	2845	**Complete**
OS02-14-018	018	193	2198	1374	2199	1374	
OS02-14-018	018	194	1373	897	1373	896	**Complete**

Tape log for box 2 of 3, shipment 1

Polar Duke Data Tape Log

Prospect	**Santos-OS02**
Box	**002**
Original/Copy	**Original**
Shipment No.	**PD-2002-096**

Line Name	Seq	Reel	FSP	LSP	FF	LF	Status
OS02-01-019	019	195	1728	904	1729	904	
OS02-01-019	019	196	903	897	903	896	**Complete**
OS02-03-020	020	197	1001	1383	1000	1384	**Incomplete**
OS02-03-021	021	198	1278	2102	1277	2102	
OS02-03-021	021	199	2103	2347	2103	2348	**Complete**
OS02-05-022	022	200	1897	1663	1898	1662	**Incomplete**
OS02-05-023	023	201	1776	950	1775	950	
OS02-05-023	023	202	949	897	949	895	**Complete**
OS02-07-024	024	203	1001	1825	1000	1825	
OS02-07-024	024	204	1826	1871	1826	1872	**Complete**
OS02-09-025	025	205	2160	2874	2160	2875	**Incomplete**
OS02-09-026	026	206	1860	2355	1860	2356	**Incomplete**
OS02-11-027	027	207	1888	897	1889	895	**Complete**
OS02-09-028	028	208	1001	1825	1000	1825	
OS02-09-028	028	209	1826	2080	1826	2081	**Complete**
OS02-15-029	029	210	1001	1469	1000	1497	**Incomplete**
OS02-13-030	030	211	1492	1001	1492	1000	**Incomplete**
OS02-17-031	031	212	1001	1233	1000	1233	**NTBP**
OS02-15-032	032	213	1364	2045	1363	2046	**Complete**
OS02-29-033	033	214	2020	1196	2021	1196	
OS02-29-033	033	215	1195	897	1195	896	**Complete**
OS02-31-034	034	216	1001	1772	1000	1773	**Complete**
OS02-21-035	035	217	2034	1652	2035	1651	**Incomplete**
OS02-23-036	036	218	1001	1066	1000	1067	**NTBP**
OS02-13-037	037	219	2190	1983	2190	1983	
OS02-13-037	037	220	1982	1982	1982	1982	**Tape Quit DNP**
OS02-13-037	037	221	1972	1284	1981	1292	**Complete**
OS02-23-038	038	222	1001	1825	1000	1825	
OS02-23-038	038	223	1826	1894	1826	1895	**Complete**
OS02-21-039	039	224	1757	933	1758	933	**Continued**

Tape log for Box 3 of 3 shipment 1

Polar Duke Data Tape Log

Prospect	Santos OS02
Box	3
Original/Copy	Original
Shipment No.	PD-2002-97

Line Name	Seq	Reel	FSP	LSP	FF	LF	Status
OS02-21-039	039	225	932	897	932	896	Complete
OS02-19-040	040	226	1210	2035	1210	2035	
OS02-19-040	040	227	2036	2051	2036	2052	Complete
OS02-27-041	040	228	1696	897	1696	896	NTBP

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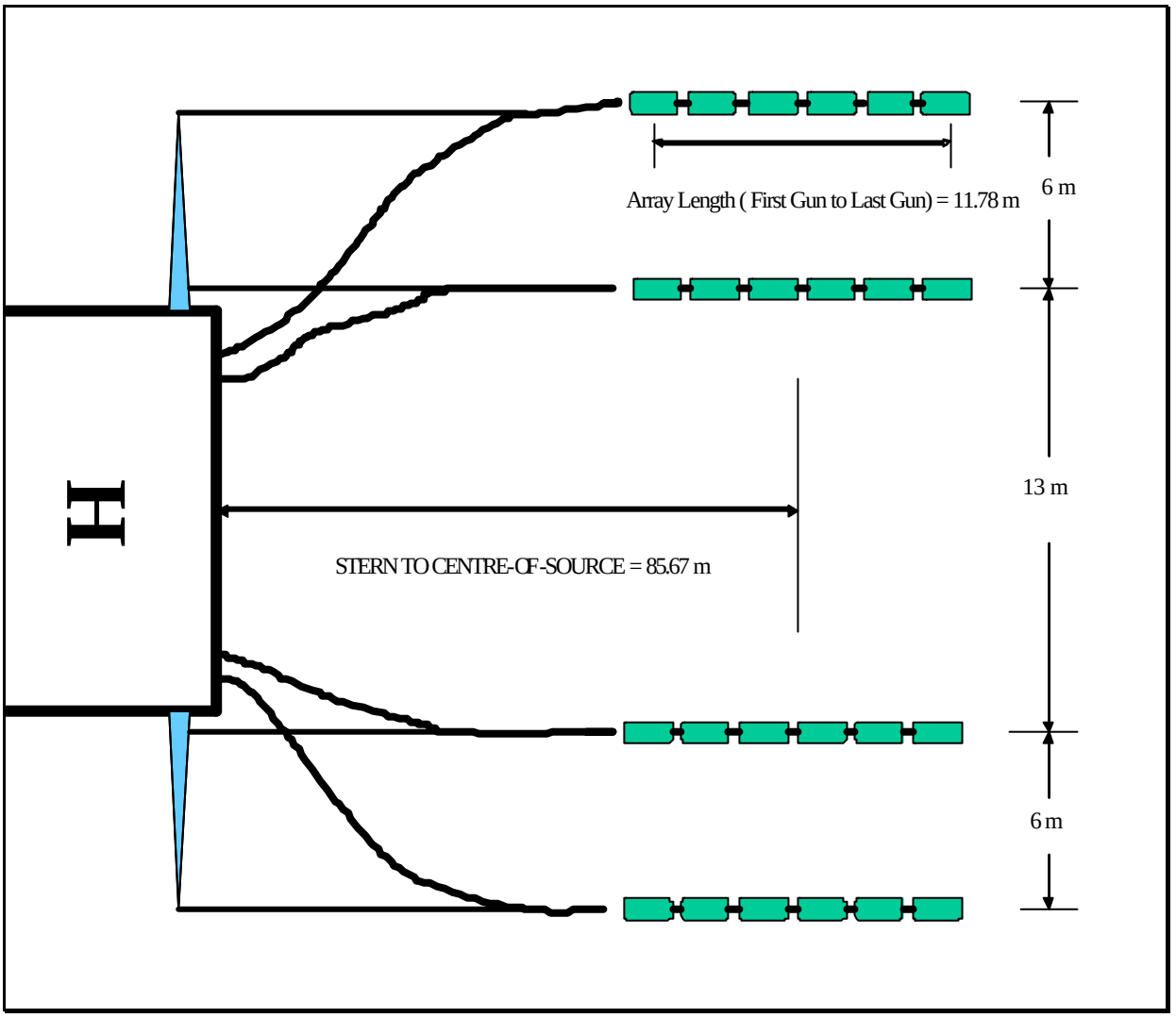
1 Towing Configuration

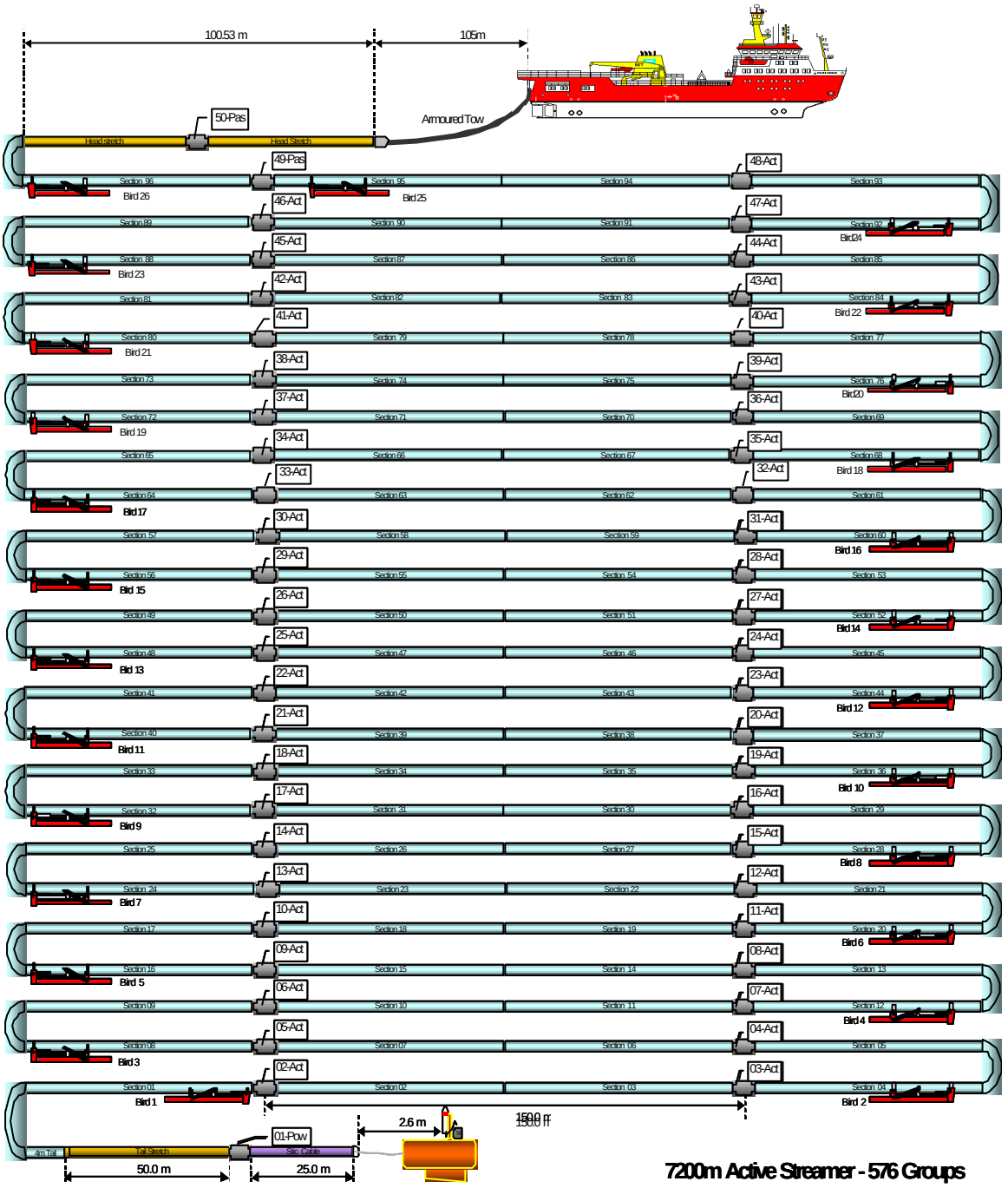


2 Streamer Configuration

2.1 Streamer System Description

Syntrak 960 Streamer Details	
Number of Streamers	1
Type of Streamer	Syntrak 960-24, RDA 1
Numbering Convention	1 Tail – 576 Vessel
Section Length	75m nominal
Streamer Length	7200m
Groups per Streamer	576 Groups
Group Intervals	12.5m / 16-Phones
Hydrophones Spacing	0.78125m
Jacket Type	Polyurethane, 4mm wall
Hydrophone Array	Benthos RDA split group
Ballast Fluid (fluid-quantity)	Isopar-M (200 litres/active sect)
Number of Hydrophones	8-phones / 6.25m
Channels per Electronic Module	12
Data Transmission Link	Twin Axial Pair
Active Group Lengths	12.5m
Streamer Depth	6m
Group Capacitance	0.128 uF/6.25
Group Sensitivity	20Volts/Bar
Active Data Acquisition Modules	48
Passive Data Acquisition Modules	2
Passive Power Module	1
Number of Stretch Sections	3
In Front of the Streamer	2
End of the Streamer	1
No of Compasses per Streamer	26
No of Depth Transducers per Streamer	26

2.2 Streamer Layout 7200m



2.3 Streamer Configuration 7200m

POLAR DUKE STREAMER DIAGRAM

STREAMER 7200m
GROUP INT 12.5m
BIRD COILS Head
MODULES 48

DATE 24th Nov 2002

Leadin 116m Deployed

..\..\History List\Module History ..xls
..\..\History List\Section History.xls
..\..\OFF GOING ON COMING.xls
..\..\Maint Report.xls

	Section	Patch	Ser. No	Mdl	clip on	Lead	Weight	Chann.	Bird	S/N	Fin	SRD	Comments.
	Lead In												
	Slip Ring		10286	2-P									
	Armored		0398-10020				60.kg						
	Stretch	H	1296-10020										
			10291	1-P									
	Stretch		0498-10555HS										
T	96		0397-10543		1.5	0	1.5kg	571\576	26	17866			Chnl 571 dead
			3122	48									
H	95		0397-10598		0	0		565\570					
T	94	C	0297-10496		1	0	1.kg	559\564	25	18660		SRD	
			3142	47									
H	93		0397-10532		2	0	2.kg	553\558					
T	92		0397-10562		2	0	2.kg	547\552					
			1924	46									
H	91	C	0397-10553		2	0	2.kg	541\546					
T	90	C	0397-10547		2	0	2.kg	535\540	24	6080			
			2582	45									
H	89		0397-10589		2	0	2.kg	529\534					
T	88	C	0397-10583		2	0	2.kg	523\528					
			1898	44									
H	87	C	0297-10518		1.5	0	1.5kg	517\522					
T	86		0397-10536		1.5	0	1.5kg	511\516	23	18896			
			2588	43									
H	85		0297-10461		1.5	0	1.5kg	505\510					
T	84		0397-10571		1.5	0	1.5kg	499\504					
			1872	42									
H	83		0397-10567		2	0	2.kg	493\498					
T	82		0397-10551		1.5	0	1.5kg	487\492	22	8426			
			1804	41									
H	81		0397-10565		1.5	0	1.5kg	481\486					
T	80		0297-10485		1.5	0	1.5kg	475\480					
			7058	40									
H	79		0397-10582		2	0	2.kg	469\474					
T	78		0297-10499		2	0	2.kg	463\468	21	12024		SRD	
			1895	39									
H	77		0297-10505		2	0	2.kg	457\462					
T	76		0298-31380		1.5	0	1.5kg	451\456					
			7067	38									
H	75		0397-10545		1.5	0	1.5kg	445\450					
T	74		0397-10593		1.5	0	1.5kg	439\444	20	19247			
			7069	37									
H	73		0598-31587		1.5	0	1.5kg	433\438					
T	72	C	0397-10555		1.5	0	1.5kg	427\432					cold patch at head
			3133	36									
H	71	C	0297-10474		2	0	2.kg	421\426					
T	70		0397-10557		2.5	0	2.5kg	415\420	19	6962			
			1907	35									
H	69		0397-10588		1.5	0	1.5kg	409\414					
T	68		0397-10546		2	0	2.kg	403\408					
			3143	34									
H	67	C	0397-10577		2	0	2.kg	397\402					
T	66		0597-10682		3	0	3.kg	391\396	18	18332			
			3245	33									
H	65	C	0397-10542		1	0	1.kg	385\390					
T	64		0297-10524		2	0	2.kg	379\384					
			3238	32									
H	63	C	0397-10538		1	0	1.kg	373\378					
T	62		0397-10554		3	0	3.kg	367\372	17	19568		SRD	
			2579	31									
H	61	C	0397-10548		2	0	2.kg	361\366					
T	60		0397-10568		1	0	1.kg	355\360					
			3237	30									
H	59		0197-31025		3	0	3.kg	349\354					
T	58		0397-10533		1.5	0	1.5kg	343\348	16	7224			
			3139	29									
H	57		0297-10489		1	0	1.kg	337\342					
T	56		0197-10395		2.5	0	2.5kg	331\336					
			2578	28									
H	55		0397-10579		2.5	0	2.5kg	325\330					
T	54		0297-10527		1	0	1.kg	319\324	15	22741			
			3126	27									
H	53	C	1197-20983		1.5	0	1.5kg	313\318					
T	52		0697-31296		1.5	0	1.5kg	307\312					
			2583	26									
H	51		0397-10570		1.5	0	1.5kg	301\306					
T	50		0297-10500		2	0	2.kg	295\300	14	8087			
			3251	25									

Section 3: **Equipment Configuration**

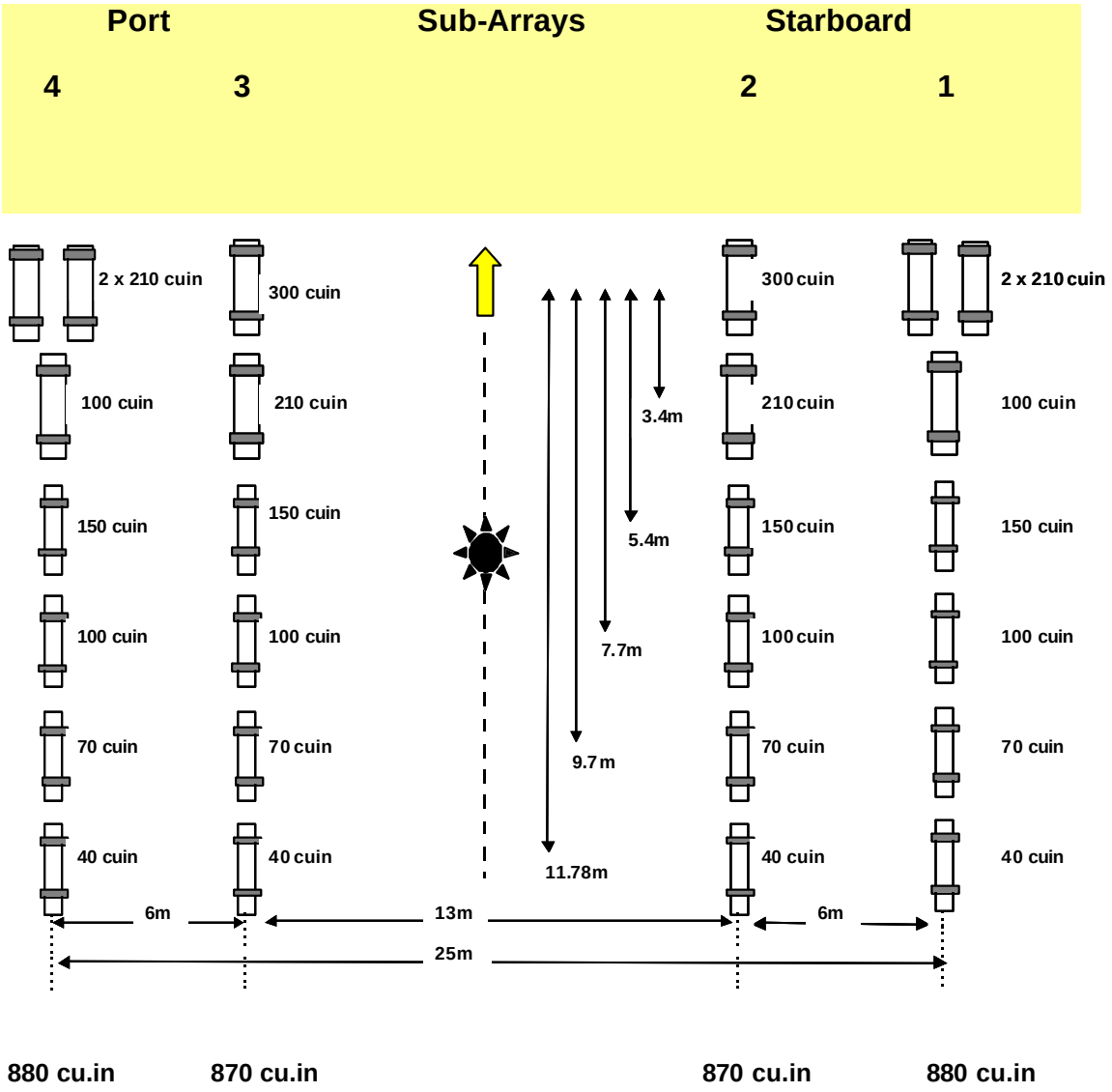
	Section	Patch	Ser. No	Mdl	clip on	Lead	Weight	Chann.	Bird	S/N	Fin	SRD	Comments.
H	49		0297-10509		1	0	1.kg	289\294					
T	48	C	0297-10476		2	0	2.kg	283\288					
			3252	24									
H	47		0397-10594		2	0	2.kg	277\282					
T	46		0297-10520		2	0	2.kg	271\276	13	11758		SRD	
			3234	23									
H	45		0498-31559		1.5	0	1.5kg	265\270					
T	44		0397-10595		1.5	0	1.5kg	259\264					
			2575	22									
H	43		0397-10541		1.5	0	1.5kg	253\258					
T	42	H	0294-10511		2	0	2.kg	247\252	12	12198			
			3250	21									
H	41	C	0297-10525		1	0	1.kg	241\246					
T	40	C	0197-10403		2	0	2.kg	235\240					
			3141	20									
H	39		0297-10494		1	0	1.kg	229\234					
T	38		0397-10592		2	0	2.kg	223\228	11	10560			Chnl 223 noisy
			2738	19									
H	37	C	0297-10502		1	0	1.kg	217\222					
T	36		0397-10596		2	0	2.kg	211\216					
			3240	18									
H	35	C	0397-10535		2.5	0	2.5kg	205\210					
T	34		0297-10526		2.5	0	2.5kg	199\204	10	15333			
			1922	17									
H	33		0297-10473		2	0	2.kg	193\198					
T	32	C	0297-10519		2.5	0	2.5kg	187\192					
			3125	16									
H	31		0397-10550		1	0	1.kg	181\186					
T	30		0397-10540		2.5	0	2.5kg	175\180	9	18424		SRD	
			2593	15									
H	29		0297-10498		1	0	1.kg	169\174					
T	28		0397-10575		1	0	1.kg	163\168					
			3145	14									
H	27		0397-10561		2	0	2.kg	157\162					
T	26		0397-10559		2	0	2.kg	151\156	8	19014			
			3124	13									
H	25		0397-10586		1	0	1.kg	145\150					
T	24		0397-10552		3	0	3.kg	139\144					
			1925	12									
H	23		0397-10607		3	0	3.kg	133\138					CHNL 137 Hyd Lkg
T	22		0397-10560		3	0	3.kg	127\132	7	8494			
			3233	11									
H	21		0397-10585		3	0	3.kg	121\126					
T	20		0397-10576		1	0	1.kg	115\120					
			3242	10									
H	19		0397-10537		3	0	3.kg	109\114					
T	18		0397-10584		1	0	1.kg	103\108	6	7584			
			1839	9									
H	17		0297-10521		1	0	1.kg	97\102					
T	16		0397-10587		1	0	1.kg	91\96					
			3123	8									
H	15		0297-10522		1	0	1.kg	85\90					
T	14		0297-10475		1	0	1.kg	79\84	5	14895			
			2576	7									
H	13		0397-10534		1	0	1.kg	73\78					
T	12		0397-10581		3	0	3.kg	67\72					
			1839	6									
H	11		0397-10558		1	0	1.kg	61\66					
T	10		0198-10845		2	0	2.kg	55\60	4	18848			
			3246	5									
H	9		0397-10574		1	0	1.kg	49\54					
T	8		0297-10516		1	0	1.kg	43\48					
			3127	4									
H	7	C	0397-10590		4	0	4.kg	37\42					
T	6	C	0297-10512		3	0	3.kg	31\36	3	15223		SRD	
			1930	3									
H	5	C	0297-10517		2	0	2.kg	25\30					
T	4	C	0397-10572		2	0	2.kg	19\24					
			1875	2									
H	3	C	0397-10591		1	0	1.kg	13\18					
T	2	H	0397-10556		1	0	1.kg	7\12	2	20006			
			2580	1									
H	1		0397-10549		1		1.kg	1\6	1	7606			
	4metre	1097-10024-4T											
	Stretch	SS1-0297-1388HS											
			12125	PP									
	Stic												
	Tailbuoy												

3 Source Configuration

3.1 Source System Description

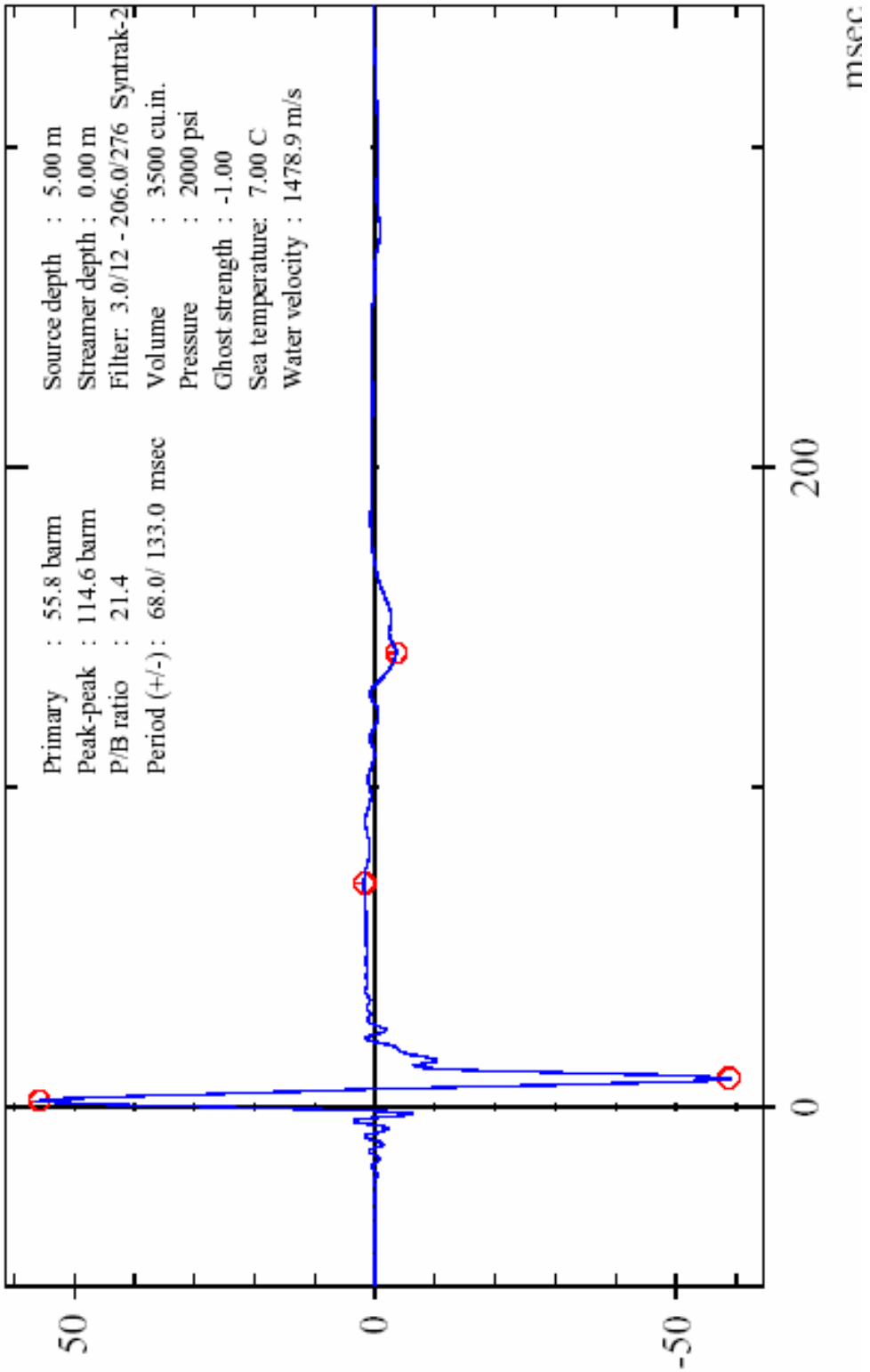
Source Parameters	
Number of Source Arrays	1
Array Separation	N/A
Array Length	11.78m
Array Width	25m
Number of Strings per Array	4
Source Volume	3500 Cubic Inches
Number of Hydrophones per Array	4
Number of Depth Transducers per Array	12
Number of Guns per Array	26
Number of Clusters per Array	2
Airgun Type	VS-X Sleeve Air Gun
Operating Pressure	2000 psi. (Nominal)
Depth of Guns	5m
Peak-to-Peak Amplitude	114.6 barm
Primary-to-Bubble Ratio	21.4

3.2 Source Layout

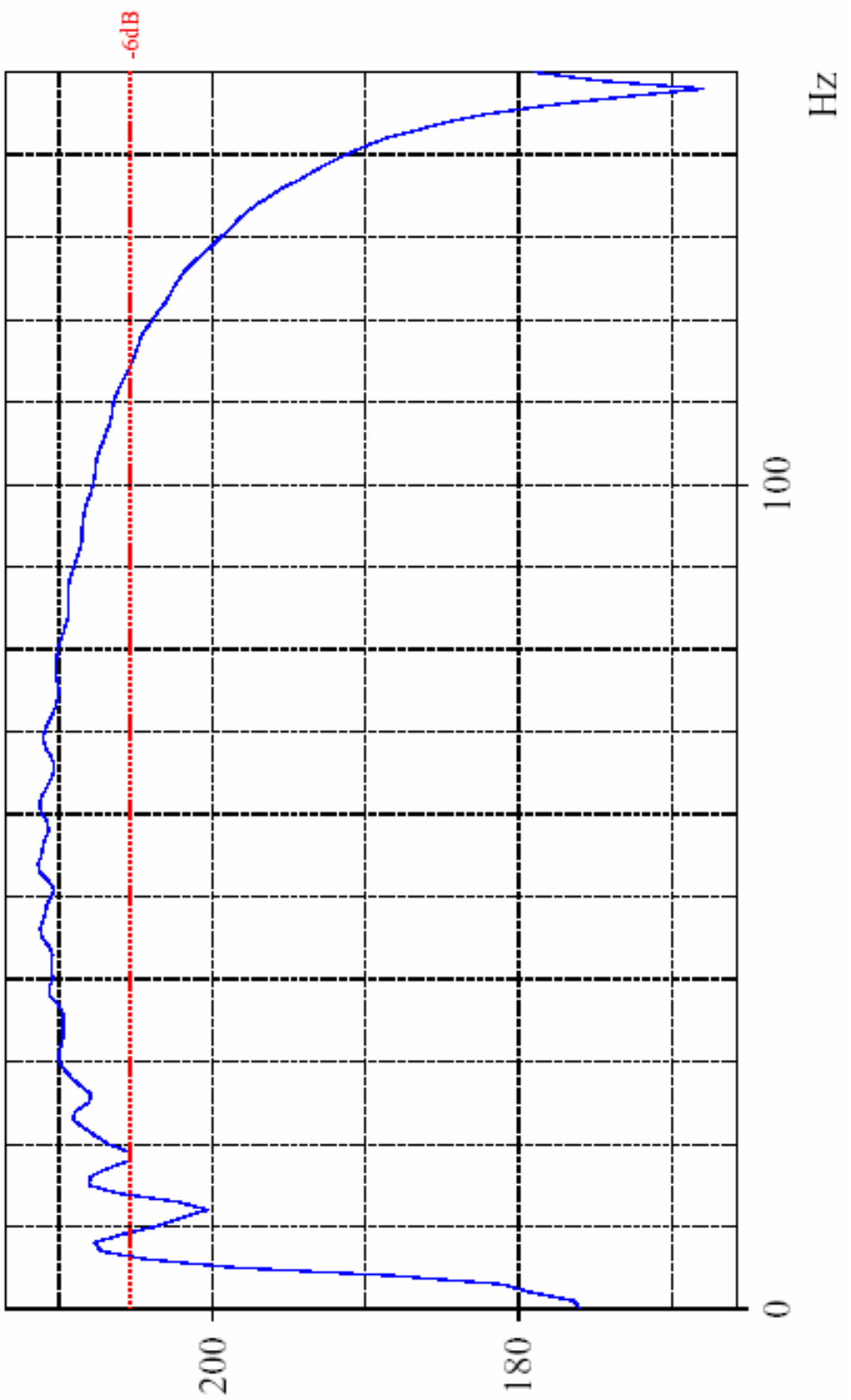


The source array consists of 4 sub-arrays with a total volume of 880 cu.in. for each outer array, and a total volume of 870 cu.in for each of the inner array. Each outer sub-array contains 6 gun locations with a total of 7 guns per sub-array. Each inner array consists of only 6 guns.

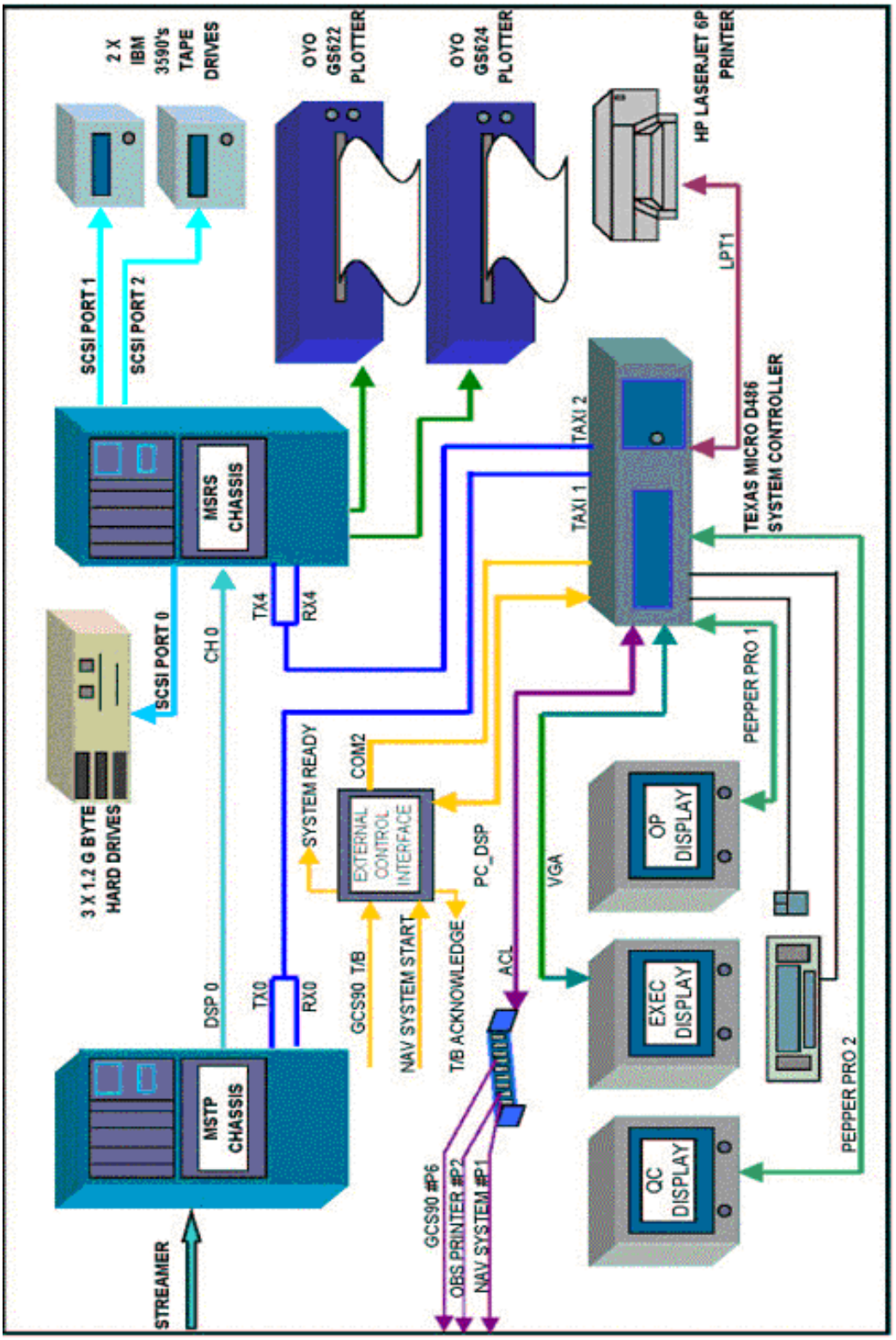
3.3 Far Field Signature



3.4 Amplitude Spectrum



4 Instrumentation Room System Diagram



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1 Navigation and Positioning System Description

1.1 System Configuration

1.1.1 Navigation Hardware and Software

System	Hardware (Type and Serial No.)	Software version
CONCEPT	Spectra Integrated Navigation Sys.	9.8.03
FGPS	SeisPos Navigation Processing sys	10.80/11.00
External Header	General Header	Syntron v2
Acoustic System	None	
TS-meter	SD204	Minisoft 200W
Echo Sounders	Simrad EA-500 12Khz	
Gravity Sensor	N/A	
Current Meter	None	

1.2 Survey Positioning Method Used

The survey was carried out using MGC's standard mode of operation for single streamer and single source surveys. Positioning of the vessel was by differential DGPS, with delivery of differential correction data in RTCM-104 format.

Source and front-end streamer positions were computed by gyro compass orientated layback from the reference point to tow-point, and first compass from the tow-point to the centre of source and centre of the near group. The offset from the centre of source to centre of the near group was verified by use of waterbreaks. Streamer tail end positioning was accomplished by compass streamer modelling and an active GPS tailbuoy.

1.3 Surface Positioning

1.3.1 Vessel Navigation

Summary

System 1: Trimble 4000SSi receiver
RTCM Delivery System: Fugro Starfix via the Optus SPOT satellite link.
Computation Software: Fugro MRGPS version 2.4.09

System 2: Trimble 4000SSi receiver
RTCM Delivery System: Fugro Starfix via the Inmarsat AP-SAT SPOT satellite links.
Computation Software: Fugro MRGPS version 2.4.09

Fugro MRDGPS interfaced to the Spectra System provided primary vessel positioning.

The two sources of corrections were transmitted to and received onboard the vessel by independent means thereby providing a high degree of redundancy to ensure continuous vessel positioning.

Although Selective Availability was turned off in May 2000 differential corrections are still required in conjunction with GPS positioning to provide a high quality continuous vessel position.

Reference Stations Used (Primary System) Source: Spot Optus

Name	ID	Latitude	Longitude	Distance	Comments
Melbourne	385	037°48'29.014" S	144°57'48.027" E	325 kms	Selected constantly
Bathurst	336	033°25'46.902" S	149°34'01.960" E	930kms	Selected constantly
Brisbane	275	027°28'38.507" S	153°01'37.338" E	1640kms	Selected constantly
Dunedin	026	045° 52'10.214" S	170°30"39.315" E	2550kms	Selected constantly
Broome	185	017°57'36.389" S	116°04'32.992" E	2900kms	Selected constantly

Reference Stations Used (Secondary System) Source: Inmarsat POR and Spot AP-SAT

Name	ID	Latitude	Longitude	Distance	Comments
Melbourne	385	037°48'29.014" S	144°57'48.027" E	325 kms	Selected constantly
Bathurst	336	033°25'46.902" S	149°34'01.960" E	930 kms	Selected constantly
Kalgoorlie	315	030°45'06.959" S	121°28'49.881" E	2000 kms	Selected constantly
Townsville	195	019°15'52.647" S	146°48'44.108" E	2200 kms	Selected constantly
Darwin	125	012°22'25.628" S	130°52'17.261" E	3100 kms	Selected constantly

1.3.2 Float Navigation

Source surface navigation was provided by the Fugro RGPS software and interfaced to Spectra. The in-sea units incorporated a GPS receiver and interfacing for direct data transmission of the raw satellite position by conventional UHF telemetry radio.

Raw GPS position from the floats was compared against the GPS position of the vessel and a range and bearing calculated. These range / bearing values were input into Spectra with a resultant relative position better than 3 metres.

1.4 Streamer and Source Positioning

1.4.1 Streamer Compasses

26 series 5011 Digibird combined magnetic compass and streamer depth controllers were attached to the streamer.

Compass Sampling Rate = 2 seconds
Averaging period = 14 seconds

Magnetic Declination entered into Spectra for this Prospect was:
10.68° at Position: 039°05'00.000"S 142°05'00.000"E

The computation was performed using GeoMag V2.2.0.0 for 2002-09-01 and verified by Ship's Charts.

Compass performance was monitored on a line-to-line basis throughout the acquisition phase of the survey.

1.4.2 Gyro Compass

The gyro compass used during the survey was:

Primary Gyro 1: Anschutz Kiel Type:110-310 Serial No: 3974
C-O = -0.90degrees

Secondary Gyro 2: Anschutz Kiel Type:110-310 Serial No: 5185
C-O = -1.80 degrees

1.4.3 Velocity of Sound in Water

Values from the ' Western Monarch's ' CTD Sound Velocity Probe was used so we both had the same velocity of sound value on the prospect area and was measured at 1506.0 m/s at position 38°52'48" S 141°55'12" E.

1.4.4 Echo Sounders

Primary Echo Sounder: Simrad Model EA500 12KHz
Secondary Echo Sounder: Furuno Model FCN-271

The echo sounders speed of sound was set to 1506.0 m/s. A draught correction of ZERO was entered in both echo sounders. The water depth exceeded the range of the secondary echo sounder and consequently no data was recorded with this sensor throughout the survey.

2 Navigation Systems Verification and Monitoring

2.1 Echo Sounder Verification

The primary echo sounder, Simrad EA-500 12khz, was installed and tested by qualified technicians January 15, 2002 while in port Singapore.

A lead-line verification was carried out on the secondary Furuno FCN-271 echo sounder while alongside East Arm Wharf in Darwin, December 2001. Two tests were carried out at one-hour intervals:

Test 1 : 18.5m / 18.0m *Echosounder reading of 12.1m*

Test 2 : 18.2m / 18.0m *Echosounder reading of 12.1m*

Average lead-line distance = 18.17m

All depths recorded are based on the position of the Fathometer's transducer on the vessel's Hull. Depths are NOT draught corrected and all depths should have 5.65m added to the depth to give the true water depth from the surface.

2.2 Gyro Monitoring

C&B Survey Group was appointed to carry out the Gyro calibration work on M/V Polar Duke at Cairns dock in Australia. The datum point for GPS observations was PSM no.52097 and verified with measurements to PSM no.45129. The true bearing between the 2 points was calculated from the measured co-ordinates. Two independent RTK measurements were taken at each of the 2 control points and compared to ensure the accuracy of the derived bearing. A Leica TC1010 Total Station was then used to take simultaneous readings to the centres of the stern and bow of the vessel and the UTC time of each observation recorded. Gyro readings onboard were recorded and later compared between the surveyed azimuths and hence a difference was derived. This difference was then applied to both gyros in Spectra as a correction. The Gyro Calibration was performed in a southwesterly direction.

Gyro calibration results for the 05th of November 2002.

Gyro 1 Primary

Ship Heading @ 192°: *-0.90 Degree C-O*

Applied Ships gyro Correction: ***(minus) -0.90 Degrees***

Gyro 2 Secondary

Ship Heading @ 192°: *-1.80 Degree C-O*

Applied Ships gyro Correction: ***(minus) –1.80 Degrees***

2.3 DGPS Monitoring

DGPS verification was carried out after the gyro calibration. The primary and secondary GPS antennas were checked before and after a 20 minute logging session using the Differential GPS systems onboard the vessel. The mean of the 2 RTK measured positions for each antenna was compared to the mean of the Differential GPS position logged over the 20-minute period to verify the GPS systems.

The results are shown below:

GPS1	*Latitude*	*Longitude*
Differential GPS Position	*-16.927426*	*145.780393*
RTK Surveyed Position	*-16.927410*	*145.780393*
Difference	*0.000016 (~1.7m)*	*0.00m*

GPS2	*Latitude*	*Longitude*
Differential GPS Position	*-16.927427*	*145.780392*
RTK Surveyed Position	*-16.9274135*	*145.7804085*
Difference	*0.0000135 (~1.5m)*	*0.0000165 (~1.8m)*

2.4 rGPS Monitoring

While alongside in Cairns, an integrity check of the rGPS pods was carried out. A coordinated point was established on the quayside, which was surveyed by taking the mean of 3 independent RTK measurements. Each pod was then positioned upon this point with range/bearing data to each pod being recorded for 10 min sessions. dGPS data was simultaneously recorded during each session. The range/bearing was computed between the vessel's dGPS position and the coordinated point, and then compared with the observed range/bearing to each rGPS pod. The C-O difference for each pod is shown below:

Pods in use	*C-O Difference (Range/Bearing)*
Pod 689	*0.49m / 1.11°*
Pod 869	*0.98m / 0.49°*
Pod 870	*0.12m / 0.68°*

Spare	*C-O Difference (Range/Bearing)*
Pod 1065	*1.10m / 1.12°*
Pod 864	*1.99m / 3.18°*

3 Navigation Processing

Navigation post-processing was carried out on-board through to UKOOA P1/90 final data format.

3.1 The *SeisPos* System

Created and Supported by Fast Geophysical Positioning Solutions (FGPS) in Swanley, Kent, UK.

SeisPos is a Windows NT/2000/98/95 software program, which enables processing of raw navigation data for marine seismic streamer surveys from UKOOA P2 raw data format to UKOOA P1/90 final data format. ***SeisPos*** supports simultaneous multiple projects and background processing. Data formats supported are UKOOA P2/91 and P2/94. The following Modules are used:

Input: reads the data stored in UKOOA P2 format and compiles a log of warnings. Implicitly alerts the user of format integrity problems. Stores all data in a proprietary format relational database.

Precondition: applies user defined gating, filtering and interpolation/extrapolation parameters to all data and presents interactive time series plots enabling quality appraisal and manual editing and rejection. All raw data is *read only*.

Adjust Network: performs a fully integrated weighted least squares adjustment of the positioning network. This includes LS estimates of streamer rotation and stretch and revised compass offsets and bearings for the interpolation of receiver group positions based on the concatenation of circular arcs between all nodes (compass or other) along the streamers.
The adjustment computation outputs final node coordinates and corrected compass positions and bearings along with QC data using a staged process enabling the survey line to be processed in as many sections as may be required according to data quality.

Output: interpolates receiver group positions and outputs selected records to file in UKOOA P1/90 format.

QC: allows analysis and manipulation (comparisons, rate of change etc.) of time series plots of all data and adjustment statistics (coordinates, error ellipse semi-major axes, processed observations, SD's, residuals, rotation, stretch, unit variance, redundancy, number of iterations. Shot time and distance interval).

Database: allows analysis, editing and textual output of all header and data tables stored in the database at all stages of the process.

3.2 Quality Control – *P1Tools*

P1Tools is a quality appraisal and utilities package for the QC of final data stored in UKOOA P1/90 format. The package operates on the Windows platforms. The modules incorporated are:

QC Nodes: enables time series analysis of shot to shot user specified node movement along orthogonal and radial axes. Outputs summary statistics to .csv file.

QC Offsets: enables time series analysis of shot to shot user specified node offsets along orthogonal and radial axes. Also provides integrity check for the type and number of nodes, the source firing sequence and the shot point range. Outputs summary statistics to .csv file.

Compare: enables time series analysis of position differences for user specified nodes between two P1/90 data sets along orthogonal and radial axes. Outputs summary statistics to .csv file.

Extract: outputs user selected data to ascii file for further analysis and third party software use.

Replay: two-dimensional replay of the vessel, source, receiver groups and tailbuoy.

4 Observations

4.1 Navigation Summary

All systems performed well throughout the survey period except for ramp in Position Dilution of Precision (PDOP) during periods when there was a reduced number of satellites in view.

4.1.1 DGPS

V1G1 Primary dGPS System using SCF corrections from stations Melbourne SF (385), Bathurst (336), Brisbane (275), Dunedin (026) and Broome SF (185) performed well throughout the whole survey.

V1G2 Secondary dGPS System using corrections from Melbourne (385), Bathurst (336), Kalgoorlie (315), Townsville (195) and Darwin (125) performed well throughout the whole survey.

Both systems had periods of high PDOP from 1630 to 1730 hours local time due to the occurrence of poor satellite geometry and low number of satellites in view.

4.1.2 rGPS

Throughout the survey the active tailbuoy and source positioning rGPS units were in use and performed without any problems.

5 Conclusions

In total there were 47 sequences shot, with all navigation systems working well throughout the survey. This survey area was time-shared with the Western Monarch and hence lines were sometimes aborted early to give the other vessel priority. Some sequences were aborted due to loss of air pressure or gun downtime. Sequences 028, 031 and 033 required the input of the water depth from the seismic record for the navigation processing due to marginal sea conditions causing loss of echosounder returns.

The Universal Transverse Mercator projection utilised for this survey was centred around 141° E with the Survey Datum being GDA-94 in the GRS-80 spheroid. Final P190's were provided in the GDA-94 datum.

6 Navigation System

The navigation system is made up of two GPS (Global positioning system) units with differential corrections and an integrated navigation package (Spectra). The GPS are Trimble 4000SSi units. Differential corrections are supplied by Spot satellite for the primary system whereas the secondary system consists of corrections from Inmarsat. The navigation package allows a great deal of flexibility and reliability.

6.1 Spectra Integrated Navigation System

6.1.1 General

Spectra, a real-time navigation system, sends and receives information via two acquisition systems referred to as Runts which contain interfaces to communicate with the vessel's navigation system. Using triggers (both internal and external), Spectra can synchronize systems with events generated inside and outside of Spectra. Hence data can be conveyed for successful acquisition.

6.1.2 File and Menu Structure

Spectra logs a p294 raw data file and a processed p190 data file, along with quality control and audit files, to a directory that is user selected via a system boot file which, when manually started, instructs Spectra which configuration files to use in the boot process. These configuration files are contained in a user created directory.

6.1.3 Displays

Spectra enables operator-configurable displays that are adjustable in size and content. The display system enables the operator to monitor all attached devices, data quality in real-time as well as multiple video displays of lines being tracked and online statistics. Spectra offers a real-time steering display, which is utilized by the bridge and is a direct representation of the current location.

6.1.4 Survey Line Tracking

Survey pre-plots were supplied using GDA-94 co-ordinates.
The projection used:

Transverse Mercator
Origin Longitude 141°E
Origin Easting: 500000.000
Origin Latitude 000°
Origin Northing: 10000000
Scale factor: 0.9996

Semi-major Axis: 6378137.000
Inverse Flattening: 298.257222100
(No datum shifts were incurred from WGS-84 to GDA-94).

Spectra used a cocktail of the positions from both navigation systems to derive a weighted real-time position, which can be compared to a predictive position, for the next successive position for the shotpoint.

6.1.5 Data Logging

Spectra was configured to generate a data logging event mark based on a distance of 25 meters spacing. Spectra is configurable to record either all possible records or selected position records. Data is stored in a directory in standard comma delimited ASCII format, allowing files to be easily read by any popular spreadsheet or text editor. Primary media for data storage is hard disk whilst the secondary system consists of a Mammoth Exabyte tape drive.

6.1.6 System Timing

Timing is achieved via independent, stand-alone GPS receivers that are directly interfaced to each of the Runts. Each separate GPS receiver also offers a stand-alone (non-differential) position input in circumstances where either primary or secondary position systems are unavailable. During this survey, a differentially corrected position was available all the time.

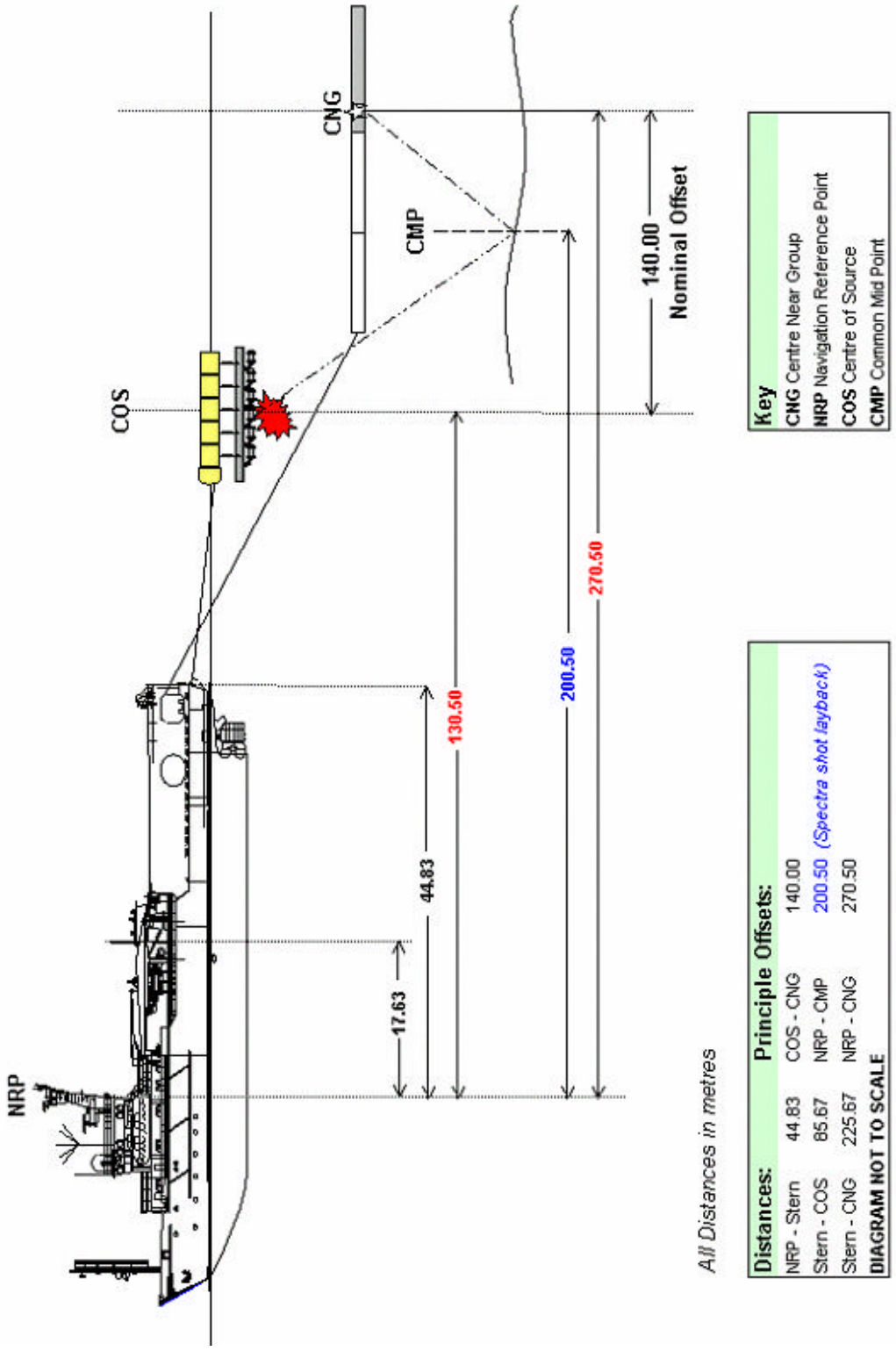
6.1.7 Streamer Modelling

Spectra is able to perform streamer modelling in real time and calculate the associated P190 format for direct logging to disk or output via serial port. The streamer is shown on the graphics window in real time.

6.1.8 Compass Device

The current streamer modelling capability requires the interface to the Digicourse 293A bird surface unit. The configuration of the interface is a typical serial port configuration. Communication can be bi-directional enabling Spectra to query the Digicourse unit as well as receive data from it.

7 Offset Diagram



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1 Instrumentation and QC System Description

System	Hardware	Description
Recording System	Syntrak 960-24 Bit	Version 3.60B
System Controller	Processor	80486DX4
	CPU Memory	32 Mbytes
	Disk Storage	1.0 Gigabyte
	Input Voltage	90-132 Vac or 180-264 Vac
	Frequency	47-63 Hz
	VME Link	DSP-Controller, 55-mbps serial Link
	Graphics Display, High Res.	Two 1280x1024 Graphic Card
	Graphics Display, VGA Res.	One 800x600 Graphic Card
Tape drives	IBM 3590 (10 Gb)	
Plotter	OYO 624 & 622	
Onboard QC	ProMAX	
		Version 4.76
Source Controller	GCS90	Intel 486DX @ 33 MHz
	Processor	32 Mb
	DRAM	40 Megabytes, IDE
	Hard Disk	
Bird Controller		Version 2.72A
	DigiSCAN Model 293	Am5x86-P75-S @ 133 MHz
	Processor	64 Mbytes
	DRAM	1.0 Gigabyte
	Hard Disk	
SAGE Gravity Data Acquisition System.	LaCoste & Romberg Gravity Meter / Gyro stable platform.	
	Hard Disk Drive	
SeaSPY Marine Magnetometer		
	Proton Precession Marine Magnetometer Sensor	

2 Instrumentation and QC Start up Tests

At start of survey, a complete set of instrument tests were performed and all tests were well inside the manufacturer's specifications.

Date	DCR	CGA	HD	CMR	IR	CIO	CIE	HL	RMS	COMMENTS
24/11	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	CH # 137 Leakage CH # 571 Dead

2.1 Daily and Monthly Tests

The daily test produced 9 files and the Monthly test 36 files.
Abbreviations used for test names in the test sequence tables:

- ✓ **DCR DCO/Noise/Range**: Performs three tests. DC offset checks the value of the residual voltage remaining across the amplifier's output terminal when the input voltage is zero. Internal Noise Test checks the value of the internal noise level in the module with inputs grounded. Dynamic Range Test checks the ratio of the maximum to the minimum signal input power levels over which the amplifier can operate.

- ✓**CGA** **Channel Gain Accuracy** introduces a known square wave into the amplifier and compares the sampled output signal with the known input.

- ✓**HD** **Harmonic Distortion** test measures amplitude versus frequency characteristics and checks for any undesired harmonics introduced by the modules.

- ✓**CMR** **Common Mode Rejection** test provides synthesized sine waves to both inputs of the preamplifier and measures the rejection of this common signal by the amplifier. The amplitude of the sine wave is 0.8 full scale.

- ✓**IR** **Impulse Response** test measures the response of the system to the low-cut and high-cut as well as the mid-band pass.

- ✓**CIO** **Crosstalk Isolation** (Odd Channels are grounded) test measures the noise appearing in one signal path as the result of coupling from other signal paths.

- ✓**CIE** **Crosstalk Isolation** (Even Channels are grounded) – same as above.

- ✓**HL** **Hydrophone Leakage** test measures the electrical resistance in the phone.

- ✓ **RMS** Checks the noise level in the streamer.

2.2 Daily Tests

Date	DCR	CGA	HD	CMR	IR	CIO	CIE	HL	RMS	COMMENTS
25/11	OK	OK	OK	OK	OK	OK	OK	OK	OK	CH # 137 Lkg #571 Dead
26/11	OK	OK	OK	OK	OK	OK	OK	OK	OK	CH # 137 Lkg #571 Dead
28/11	OK	OK	OK	OK	OK	OK	OK	OK	OK	CH # 137 Lkg #571 Dead
29/11	OK	OK	OK	OK	OK	OK	OK	OK	OK	CH # 137 Lkg #571 Dead
30/11	OK	OK	OK	OK	OK	OK	OK	OK	OK	CH # 137 Lkg #571 Dead
1/12	OK	OK	OK	OK	OK	OK	OK	OK	OK	CH # 137 Lkg #571 Dead
2/12	OK	OK	OK	OK	OK	OK	OK	OK	OK	CH # 137 Lkg #571 Dead
3/12	OK	OK	OK	OK	OK	OK	OK	OK	OK	CH # 137 Lkg #571 Dead
4/12	OK	OK	OK	OK	OK	OK	OK	OK	OK	CH # 137 Lkg #571 Dead
5/12	OK	OK	OK	OK	OK	OK	OK	OK	OK	CH # 137 Lkg #571 Dead
6/12	OK	OK	OK	OK	OK	OK	OK	OK	OK	CH # 137 Lkg #571 Dead
7/12	OK	OK	OK	OK	OK	OK	OK	OK	OK	CH # 137 Lkg #571 Dead
8/12	OK	OK	OK	OK	OK	OK	OK	OK	OK	CH # 137 Lkg #571 Dead
9/12	OK	OK	OK	OK	OK	OK	OK	OK	OK	CH # 137 Lkg #571 Dead
10/12	OK	OK	OK	OK	OK	OK	OK	OK	OK	CH # 137 Lkg #571 Dead
11/12	OK	OK	OK	OK	OK	OK	OK	OK	OK	CH # 137 Lkg #571 Dead
12/12	OK	OK	OK	OK	OK	OK	OK	OK	OK	CH # 137 Lkg #571 Dead
13/12	OK	OK	OK	OK	OK	OK	OK	OK	OK	CH # 137 Lkg #571 Dead
14/12	OK	OK	OK	OK	OK	OK	OK	OK	OK	CH # 137 Lkg #571 Dead
15/12										CH # 137 Lkg #571 Dead

2.3 End of Job Test

Date	DCR	CGA	HD	CMR	IR	CIO	CIE	HL	RMS	COMMENTS
15/12	OK	OK	OK	OK	OK	OK	OK	OK	OK	CH # 137 Lkg #571 Dead

2.4 Instrument Summary

The Recording instruments suffered no Technical down time during the survey.

Full System tests were carried out and recorded to tape at the start and finish of the contract. Further daily tests were carried out when the opportunity arose, to verify continued system performance. The tests showed that the Syntrak system was stable and well in specification throughout the contract. At the beginning of the job there was one bad hydrophone group in the streamer, channels 137, with hydrophone leakage and Channel 571 was dead.

Nominal streamer/gun offset distance was confirmed using a test shot from a single gun in the centre of the array. Distance to the centre of the first active group was near 140m. These measurements were made regularly to confirm consistent offset positioning throughout the survey.

3 QC Products and Processing Sequence

3.1 General

The stand-alone ProMAX system was used for QC purposes. The system was not connected on line. Therefore data for each sequence was read from the tapes. Two 3590 drives were used for this purpose. The processing sequence was followed in order to produce raw and brute stacks plots, near trace displays and RMS plots.

3.2 Raw/Brute Stacks

Raw and brute stacks were produced for each line. Paper plots of both stacks were made at the end of line.

3.3 Processing Sequence for Raw Stack:

Input 1 cmp line per sail line:	*576 channels*
Data reduction	*Resampled from 2ms to 4ms; Marine Trace Decimation (2:1 trace summation)*
Edits:	*Exclude bad shots, noisy/spiking channels*
Filter:	*Single band-pass filter: Ormsby 4-8-90-120 Hz*
Gain recovery:	*Spherical divergence: 1dB/s from water bottom to 6.0 s*
Normal Moveout Correction:	*Velocities picked for each line every 4km and written to velocity database*
Pre-stack mute:	*Tied to water bottom times*
Stack:	*Mean method for trace summing*
Stack Root N scaling	*96 fold*
Bulk shift static	*9 ms*
Output:	*To disk file*
Method of scaling:	*Un-scaled*
Display:	*Paper plots: 5 cm/s, 20 traces/cm*

3.4 Processing Sequence for Brute Stack:

Input 1 cmp line per sail line:	*576 channels*
Data reduction	*Resampled from 2ms to 4ms; Marine Trace Decimation (2:1 trace summation)*
Edits:	*Exclude bad shots, noisy/spiking channels*
Filter:	*Band-pass filter:* *Ormsby 4-8-90-120 Hz*
Gain recovery:	*Spherical divergence: 1dB/sec from water bottom to 10.0 s*
Pre-stack mute:	*Pre-decon mute; Tied to water bottom times*
Minimum phase predictive deconvolution	*Operator length = 240 ms* *Operator prediction distance = 32 ms* *Deconvolution gate, tied to water bottom times*
Filter:	*Band-pass filter:* *Ormsby 4-8-90-120 Hz*
Normal Moveout Correction:	*Velocities picked for each line every 4km and written to velocity database*
Pre-stack mute:	*Post NMO mute;* *Tied to water bottom times*
Stack:	*Weighted method for trace summing, based on square root of offset*
Stack Root N scaling	*96 fold*
Bulk shift static	*9 ms*
Output:	*To disk file*
Method of scaling:	*AGC with operator of 1000ms*
Display:	*Paper plots:* 5.5 cm/s, 40 traces/cm

3.5 FK, FT and Spectral Analysis

This helped to identify noise sources and QC data. The analysis was performed in a window of 500-10000ms. Although FK and FT plots/displays were produced for a number of lines, the spectral analysis proved to be the most useful to determine the frequency range for noise and data.

3.6 RMS Analysis

3.6.1 Shallow RMS Window

RMS values from 1000ms to 1500ms of the record were calculated for every trace and each shot. These values were displayed for identification of noise sources and noisy traces. Filtered shot vs. trace RMS values were produced by applying a band-pass filter prior to the RMS calculation. Cable averaged RMS values were stored on disk for the later use.

3.6.2 Processing Sequence:

1.	Data Input:	All shots, all channels, window 1000-1500ms.
2.	Scaling:	By 50 to convert amplitudes from millivolts to microbars.
3.	RMS analysis:	RMS values calculated for each channel over the range of all shots.
4.	Output:	To disk file.
5.	Bandpass Filter:	Ormsby: 4-8-90-120 Hz
6.	Output:	To disk file.

3.7 Near Trace Displays, Offline Plots

Near trace data were displayed and annotated with direct arrival times.

1. Collect near traces:	576 channels
2. Display:	0-5000 ms 10 cm/s, 20 traces/cm.

3.8 Attributes, Online Analysis

ProMAX was set up as an off-line system; therefore real-time data feed was not available.

4 Data Quality / Observations

4.1 Quality Control Summary

The ProMAX system proved to be extremely reliable for checking data quality. The content of all field tapes was checked for each line. Different types of noise were identified and noted in the Observer's Logs where appropriate.

- ✓ Ship Noise
- ✓ Spikes and noisy channels
- ✓ Geological effects (water bottom multiples)
- ✓ Swell Noise
- ✓ Source problems (autofires, misfires, changes in gun volume)
- ✓ Parities Problems
- ✓ Earth Leakage

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1 Introduction

Seismic processing was carried out in order to QC the seismic data acquired by the vessel ***Polar Duke*** on behalf of **Santos**. Acquisition was implemented using a source array of 3500 cu in. volume and a single streamer with 576 primary and 12 auxiliary channels.

Acquisition started on the 23rd November 2002, and was completed on the 15th December 2002. A total of 47 sequences and approximately 1136 km of full fold seismic data were acquired. Raw and Brute 2D Stacks were processed for all of these lines. On board processing maintained an average processing throughout of 51 kilometres per day of 2D, 10000ms record length, 96 fold data.

The data quality was generally very good throughout the survey, with extraneous noise coming primarily from swell and seismic interference. Seismic reflections were easily visible throughout the sections and sharply defined. Multiple energy was also readily apparent. Brute stack processing included an offset weighted stack. The weather conditions were generally good during the survey.

The deliverables for this project were paper copies of QC plots including Raw Stacks, Brute Stacks, Near Trace Displays and RMS plots. 8mm Exabyte tape copies of raw stacks and brute stacks were made in SEG-Y format. Velocities were saved as ASCII files, which were then UNIX tarred to Exabyte tape as well as copied to floppy disk at the end of the survey.

The ProMAX system was a stand-alone machine, with a single operator and two 3590 tape drives. The system performed well throughout the survey with no system or processing problems. Field tape copies were generated in SEG-D format on 3590 tapes, using the ProMAX tape copying utility.

Although the ProMAX was not set up as an on-line system, it was still possible to process every sequence through to brute stack, and produce all the necessary QC plots at a fast enough rate to keep close behind the data acquisition. The two 3590 tape drives proved to be adequate for both tape copying and data loading operations.

The ProMAX system and QC processing consultants were provided by Exploration Partners International Ltd of Mannez Alderney, Channel Islands, UK. Eurotech Computer Services Ltd of Cranleigh, Surrey, UK, set up the computer system and Landmark Graphics Corporation Ltd installed the ProMAX software.

2 Acquisition Parameters

Recording Instruments

Recording System	:	Syntrak
Source controller	:	Syntron GCS-90
Recording format	:	3590 SEG-D 8058 Rev 1
Record length	:	10000 ms
Sample rate	:	2 ms
Low cut filter	:	Out
High cut filter	:	206Hz - 276 dB/oct
Channel set 1	:	576 Seismic channels
Channel set 2	:	12 Auxiliary channels

Streamers

Streamer type	:	Syntron
Number of streamers	:	1
Active length	:	7200 m
Number of groups	:	576
Group interval	:	12.5 m
Near trace	:	576
Streamer depth	:	7.0-10.0 m +/- 1 m
Near trace offset from source	:	140 m

Source

Array type	:	Airgun
Total volume	:	3500 cu in
Air pressure	:	2000 psi
Gun depth	:	5.0 m +/- 0.5 m
Number of sub arrays	:	4
Shotpoint interval	:	37.5 m

Navigation

Primary Navigation	:	Fugro MRDGPS: Starfix+ Dual frequency
Secondary Navigation	:	Fugro MRDGPS Inmarsat Direct Injection

3 Personnel and ProMAX QC System

EPI Consultant Processing Geophysicists

23rd November 2002 to 11th December 2002:	Stuart Kelly
11th December 2002 to 15th December 2002:	Adam Gebarski

Onboard Processing Hardware

Machines	*:*	*1 SUN Ultra 60 (2xUltraSPARC-II 450MHz)*
Memory	*:*	*1024 Mb*
Monitor	*:*	*Iiyama*
Hard Disk Drives	*:*	*70 GB*
Tape Drives	*:*	*2 x 3590 IBM tape drives*
	:	*2 x 8mm, Exabytes, Artecon*
CD Drives	*:*	*1 x DVD*
Plotters	*:*	*1 OYO GS-624 thermal plotter (24 inch)*

Software

ProMAX 2D	:	Version 1998.6
IBM Operating System	:	UNIX (SunOS Rel 5.6)

Data loading was accomplished entirely via 3590 copy tapes. There was no on-line connection of the ProMAX to the data acquisition system.

As there was no on-line SEGD tape copying, the ProMAX system had to be used for all the Tape Copying operations. Copy tapes were generated in SEG-D format on 3590 tapes using the ProMAX tape copy utility. Copy tapes were used for data loading and seismic processing for verification of original as well as copy tapes.

4 Raw Stack Processing Sequences:

SEG-D Input From Tape
Reformat to ProMAX internal format — Read 576 channels + 12 auxiliary channels. Input 10000ms
↓
Resample / Desample — From 2 to 4 ms. Hi-Fi antialias filter applied in module
↓ —→ **Auxiliary Channel QC** — On screen QC. All auxiliary channels
↓ —→ **Near Trace Display** — On screen QC. Ch 576
Pick WBT
↓ —→ **HARDCOPY (with direct arrival RMS)**
Marine Trace Decimation — 2:1 trace summation after differential NMO
2D Marine Geometry — Spreadsheet / Database preparation
Bulk Shift Static — 0ms for instrument filter delay
↓ —→ **RMS Shot Analysis** — Shot RMS, Av. RMS for channels 134-154
↓ Shallow RMS window 100-600ms
↓ Conversion factor from µV to µbar=50
↓ —→ **STACK HEADERS & PLOT**
↓ —→ **Raw Shots Display** — Every 4 km, 10000 ms, 576 channels
↓ —→ **ON SCREEN QC DISPLAY**
Trace / Shot Kill — Edits based on Observer's Logs
Band-pass Filter
Type of filter specification — Ormsby band-pass
Details of filter — Minimum Phase, 4-8-90-120 Hz
True Amplitude Recovery
Apply dB/sec corrections — Spherical Div. 1 dB/sec from water bottom to 10000ms
Maximum application time — 10000 ms
↓ —→ **Velocity Analysis** — Every 4 km, Semblance,Gathers,Function Stack
↓ —→ **ASCII FILE**
Normal Move-out Correction
↓ —→ **NMO Corrected Gathers** — Every 4 km, 10000 ms
↓ —→ **ON SCREEN QC DISPLAY**
NMO Stretch Mute — Top mute picked from CDP gathers and tied to WBT
CDP / Ensemble Stack
METHOD for trace summing — Mean
Root power scalar for stack normalisation — 0.5
Gun and Cable Static — + 9 ms
Display Stack —→ **Raw Stack** — 10000 ms. Unfiltered, Unscaled.
—→ **SEG-Y TAPE**
—→ **HARDCOPY PLOT** + Shot RMS values

5 Brute Stack Processing Sequences:

SEG-D Input From Tape
Reformat to ProMAX internal format — Read 576 channels + 12 auxiliary channels. Input 10000ms
↓

Resample / Desample	From 2 to 4 ms. Hi-Fi antialias filter applied in module
Spike to Median Ratio editor	Automatic spike / Noise Burst edit. Used only when needed.
Marine Trace Decimation	2:1 trace summation after differential NMO
2D Marine Geometry	Spreadsheet / Database preparation
Bulk Shift Static	0ms for instrument filter delay
Trace / Shot Kill	Edits based on Observer's Logs
Band-pass Filter	
Type of filter specification	Ormsby band-pass
Details of filter	Minimum Phase, 4-8-90-120 Hz
True Amplitude Recovery	
Apply dB/sec corrections	Spherical Div. 1 dB/sec from water bottom to 10000ms
Maximum application time	10000 ms
Pre-deconvolution First Break Mute	Picked from CDP gathers + tied to Water Bottom Times
Spiking / Predictive Deconvolution	
TYPE of deconvolution	Minimum phase predictive
Decon operator length	240 ms
Operator prediction distance	32 ms
Operator white noise level	0.1 %
Design gate	Single gate & tied to WBT
Band-pass Filter	
Type of filter specification	Ormsby band-pass
Details of filter	Minimum Phase, 4-8-90-120 Hz

↓ —→ **Velocity Analysis** Every 4 km, Semblance,Gathers,Function Stack
↓ —→ **ASCII FILE**

Normal Move-out Correction
↓ —→ **NMO Corrected Gathers** Every 4 km, 10000 ms
↓ —→ **ON SCREEN QC DISPLAY**

NMO Stretch Mute	Top mute picked from CDP gathers and tied to WBT
Inner Trace Mute	Bottom Mute picked from CDP gathers and tied to WBT
CDP / Ensemble Stack	
METHOD for trace summing	Weighted. Weight factor = sqrt(offset)
Gun and Cable Static	+ 9 ms

Display Stack —→ **Brute Stack** 10000 ms. Unfiltered. Unscaled.
—→ **SEG-Y TAPE**
—→ **HARDCOPY PLOT** 10000ms, 1000ms op AGC

6 Start of Line RMS Noise Analysis (Appendix C)

Using the start of line noise record, channel RMS values were computed for all 576 channels.

The data was not re-sampled, and no filter was applied. The RMS values for each individual channel were computed using a gate of 500-6000ms to look at the ambient noise levels.

The plots were analysed in conjunction with the colour RMS displays to check for dead or noisy channels, and these were then crosschecked with the edits in the Observer's logs.

These RMS values also gave a good indication as to the amount of swell noise at the start of each line, and the results could be analysed as soon as the first tape was available.

The average ambient noise from this unfiltered RMS analysis was normally around 2-5 µbar on the noise record, and similar values were observed on the shot records. A 3-6-100-120Hz filter was applied to the data before prior to this RMS analysis.

A scaling factor of 50 was used to convert from millivolts to microbars, and hardcopy plots were included in each of the line files.

7 Auxiliary Channel QC (Appendix D)

All 12 auxiliary channels were input from tape during the SEGD tape loading procedure. The auxiliary channels were then separated from the data channels and stored in a separate data file, which could have been used for on screen analysis.

Unfortunately not all the gun hydrophone channels were connected during this survey. Auxiliary channels 1 (Gun 1-1), 2 (Gun 2-1), 5 (Gun 3-1) and 6 (Gun 4-1) were good, and were quality controlled on screen using colour amplitude displays, to monitor gun volumes and pressures. Gun performance was also monitored using a direct arrival RMS QC on the near trace displays. Appendix D shows the example of drop in pressure/volume due to the gun air leak.

8 Near Trace Displays (Appendix E)

Near traces were displayed on screen routinely at the end of each line. This proved to be useful in quickly determining any possible errors with acquisition. They revealed gun volume changes, bad records, internal time break problems and any auto-fires not reported by the recording system.

In addition to looking at the entire near trace display, an averaged direct arrival RMS was computed over the 10 nearest traces. An RMS window of 12-30ms was used after the 10 near traces were LMO corrected. The direct arrival RMS was plotted along the top of all the near trace displays. Variations in source volume and pressure were visible on the direct arrival graph, but the amplitude of the direct arrival was often variable due to vessel speed, feather angle and cable jerk. This display was really only useful when used in conjunction with the gun hydrophone channels to QC any undetected source anomalies.

RMS amplitude and dominant frequency statistics were also calculated for the direct arrival. These were viewed on screen whenever further investigations were required.

The near traces also provided a good indication of the geological conditions including strength of the water bottom multiples, remnant multiple interference and reflection data.

Hardcopy plots of the near trace displays were made for all lines. Plots were generated using a high level of gain, which helped to show up any amplitude variations in the direct arrival, and also assisted in the assessment of the level of swell noise whenever the weather condition deteriorated.

9 Shot vs Channel Colour RMS Displays for 576 channels (Appendix F)

RMS and trace statistics were calculated for every shot and all 576 channels. A shallow analysis window of 1000-1500 ms was used, and RMS values were computed for both unfiltered and filtered data. The band-pass filter was a 4-8-90-120 Hz Ormsby.

Colour RMS amplitude displays were made for all 576 channels for the entire line. These displays were used as channel QC, and also to identify noise trends as the line progressed. For example swell noise deterioration, water currents or external seismic interference. In each case the affected shot point range was listed in the comments section in the Observer's Log. Only shots that were significantly affected were listed as bad shots.

In addition to the RMS computations further trace statistics included:

Trace amplitude	*- Average trace energy.*
Spikiness	*- Ratio of max magnitude sample to trace signal amplitude.*
Dominant Frequency	*- Based on a count of zero crossings within signal window.*
Frequency Deviation	*- Based on statistical scatter of frequency estimates.*
Amplitude Decay	*- Estimated late trace energy decay rate (in dB/sec).*

These statistics were averaged within the ProMAX database for the source, CDP and channel domains, where they could be viewed in the various different domains using the ProMAX database display tools.

In addition to a colour plot being generated for all shots for every sequence, a sequence-by-sequence RMS display was also generated. This involved extracting 200 shots from each sequence, and then displaying the colour RMS side by side. These displays enabled a direct comparison of bad traces and noise conditions from sequence to sequence.

All filtered colour RMS displays were saved to disk as GIF image files, and these were Unix tarred to Exabyte tape. The images were included in the data shipments and a final copy tape was generated at the end of the survey.

10 Shot RMS

Shot RMS values were calculated by averaging the RMS values for the central 21 channels (after 2:1 summation) from the streamer. RMS values were calculated using a fixed shallow window at 100-600 ms to look at ambient noise. The central 21 channels were chosen to avoid contamination by the direct arrival and any shallow water bottom events.

Ambient noise RMS values were also calculated using 3 different filters. A band-pass filter of 3-6-70-90 Hz was used to look at ambient noise levels within the signal bandwidth, and a 6-9 Hz high cut filter was used to look at the amplitude of the lower frequency swell noise. A further low cut filter of 50-70 Hz was used to look at ambient noise levels at the high frequency end of the spectrum. The ambient noise remained around 3-6 µbar.

This shallow window RMS provided a good estimation of the background ambient noise levels for each line. Increases in swell noise could be clearly identified on the ambient noise RMS plots above the raw stack, which also had a more spiky appearance whenever the swell noise picked up.

Noise levels in microbars provided a good statistical means of confirming the amount of swell noise interference visible on both the raw shot records and stack. One of the main advantages of using these RMS values to assess the swell noise, was that they could be processed during the SEGD tape loading operation if necessary, and were therefore available well before the raw stack could be processed.

A scaling factor of 50 was used to convert from millivolts to microbars. This is the conversion factor used for the recording system, which has a sensitivity of 20 Volts per Bar.

Noise (6-70Hz), Noise (<6Hz), Noise (>70Hz), Signal (6-70Hz) and signal to noise ratio RMS graphs were plotted above all Raw stacks, so any noise contamination on the stack could be verified statistically on the RMS plots. All CDP averaged RMS values were written into the SEGY brute stack headers as a backup.

11 Raw Shot Displays

Shot records were filtered to the signal bandwidth and balanced with a true amplitude gain recovery. Shot records were displayed at 3 km intervals for each line. Hardcopy displays were produced when necessary, and individual records were examined on screen if there was felt to be a problem with acquisition, or to investigate the source of anomalous seismic energy. This was useful in confirming the start of any seismic interference or for confirming auto-fires, which could be identified on the near trace displays.

The raw shot displays were used to estimate the amplitude and amount of swell noise on the raw shot records, prior to further processing. Consistently noisy channels were also identified on the raw shot displays, and any edited channels on the observer's logs were verified.

12 Velocity Analysis (Appendix G)

Velocities were picked at regular 4 km intervals along every line, using one of the ProMAX's on screen interactive velocity picking utilities.

The ProMAX velocity-picking module included a semblance display; CDP super gather, which could have NMO applied instantly, a series of Function Stack Panels and an interval velocity graph. To improve the signal to noise ratio super-gathers were formed by combining 5 adjacent CDP gathers, and these CDP's also made up the Stack panels.

A regional velocity function was used as the central guide function for the stack panels. A total of 11 stack panels were processed using a +/- 10% velocity variation.

To speed up the on screen velocity picking procedure the velocity analysis displays were pre-computed. When primary velocities were clearly defined they were normally picked off the semblance display, and normal move-out was applied to the gather to check that the events were lining up well. Velocities could also be picked off the Function stacks whenever the velocities were poorly defined on the Semblance display.

Velocities were generally poorly defined, with multiple energy being dominant below a couple of seconds. For final velocity analysis an FK de-multiple or Radon demultiple filter may be required in order to pick reliable velocities. Unfortunately the increased run times required for the radon filter, meant that it was not a practical option for normal QC processing.

Velocity functions were output to ASCII file for every line, and then put on 8mm Exabyte tapes as well as floppy disk for data shipments.

13 CDP Gather Displays

These displays were essentially used to verify the velocity picking. On screen displays and sometimes hardcopy plots were made of NMO corrected gathers with an NMO stretch mute applied. The gathers were displayed at 4 km intervals. When swell noise levels were high they also provided a good indication as to whether the swell noise would stack out or not. They were also useful for identifying consistently spiking traces.

All mutes and time gates were picked interactively on screen using CDP gathers sorted into water bottom time order. By picking all the mutes and time gates in this manner it was possible to tie them all to water bottom depth, and therefore make the gates and mutes extremely accurate. As all the gates were tied to water bottom depth, this in turn speeded up the picking of mutes considerably and enabled the mutes and gates to be carried over from one line to the next. All gates were carefully quality controlled on screen before running the stack processing flows.

14 Raw and Brute Stack Processing (Appendix H)

The main objective of onboard QC processing is to stack each line with minimal processing to enable a thorough QC of the data onboard.

Normally, the general aim of the QC processing is not to attenuate noise but to show the data as it is recorded, or how it would be presented to a shore or vessel based processing centre. This means that band-pass filtering is normally confined to the anti-alias filter prior to re-sampling to 4ms, and a wide band-pass filter at the signal bandwidth after deconvolution to clean up the high frequency noise introduced by the deconvolution operator. It is also important to avoid using an AGC as this tends to soften and hide background noise, so raw stacks were always plotted out without any AGC scaling.

For all lines a basic raw stack with minimal processing, and a brute stack with deconvolution and some de-multiple attenuation were processed. The raw stack was essentially used for QC purposes only and the brute stack was used more to look at the geological structure.

The SEG-D data was input from 3590 copy tapes, re-sampled to 4ms and output to hard disk as 16 bit data. An anti-alias filter was applied internally within the ProMAX resample module to prevent aliasing of frequencies above 125 Hz.

Minimum Phase Predictive Deconvolution and True Amplitude Recovery tests were carried out on the first sequence, and the parameters for the entire survey were set up at this time. Deconvolution parameters were picked off CDP gathers, with corresponding autocorrelations plotted along the bottom of the display. Analysis of the results indicated that an operator length of 240ms and gap of 32ms would provide a good average for the entire survey. Due to the length of the lines, further more detailed testing will reveal more optimal spatially variable de-convolution parameters. The deconvolution gates were picked from the CDP gathers and tied to water bottom times, the start of the gate being approximately 20ms below the water bottom and the end of the gate being close to the bottom of the record. Deconvolution was only used for the brute stack processing, and no deconvolution was applied to the raw stack.

True Amplitude Recovery tests indicated that the data was better balanced when the dB/sec amplitude recovery started at the water bottom, rather than at T0. The optimal parameters were Spherical Divergence correction followed by a 1dB/sec correction tied to the water bottom time. These parameters resulted in a reasonably well-balanced stack, however as the water depth became shallower the amplitudes of the deeper data often dropped off significantly. For QC purposes the True Amplitude of the stacked data was preferred, but for interpretation purposes a post-stack AGC would be very beneficial to suppress the high amplitude events near the water bottom and bring up the amplitudes of the weaker events at depth.

As for the band-pass filter, it was decided to leave this as open as possible for QC purposes. For this reason little testing was carried out apart from some initial spectral analyses, and the band-pass filter was set at 4-8-90-120 Hz. Spectral Analysis of the data revealed that this filter would not affect the data in any way, and would remove only a minimal amount of swell noise contamination.

Section 6: **Onboard Processing**

A filter was applied prior to TAR and deconvolution to clean up any high amplitude low frequencies, and then again after deconvolution to remove any noise that might be introduced by the deconvolution process itself.

Noisy and dead traces were killed, as well as bad shots noted in the Observer's Logs. The brute stack was run after QC had been completed and the data had been thoroughly analysed. Any additional shots with time-break errors, gun problems and any new noisy traces were edited from the brute stacks.

Full details of all the processing flows and parameters are listed in section 4 of this report.

An un-scaled, unfiltered raw stack was plotted out on board of the vessel for every line. A fairly high level of gain was sometimes applied to the raw stack plot to boost up the amplitudes of the deep data, but this had the adverse effect of over scaling the water bottom and near surface events. Trace equalisation was occasionally added to the plotting routine to improve the brute stack plots. Shot ambient noise RMS values were plotted above the raw stack, as already discussed in the shot RMS part of this report. The raw stack plot was intended solely for QC purposes.

In addition to the un-scaled raw stack plot generated for every sequence, a brute stack was plotted out with an AGC operator of 1000ms, to look at the geological structures along the line.

All shot points with misfires, spread errors or timing errors over 1.0 millisecond were killed. In addition to this all dead or noisy channels were eliminated from the stack.

The CDP to station tie used for brute stacks in this prospect was

Station= first SP + ((CDP-288)/3).

The results of all stacked sections were discussed with the onboard Santos representative. A processing log was maintained throughout the survey with notes concerning noise problems and data quality (Appendix A).

All raw stacks and brute stacks were backed on 8mm Exabyte tapes in SEGY format, and shipped to the client office at the end of the survey. The SEGY headers include the shot point numbers, CDP numbers and complete listing of the acquisition and data processing parameters. The water bottom times and CDP averaged RMS values are also included in the SEGY trace headers for convenience.

15 Additional QC Displays (Appendix I)

Spectral analysis displays were generated for several lines to evaluate the power and frequency content of the data.

FK plots and FT displays were also occasionally displayed, but the spectral analysis displays were found to be more useful for analysing the frequency range of both noise and data.

16 Tape Copying

As there were insufficient 3590 tape-drives available on the Syntrak recording system, it was necessary to use the ProMAX system to generate copy tapes. Tape copies were generated by the ProMAX system in SEG-D format on 3590 tapes.

17 Summary

Many potential problems were analysed using ProMAX including checking bad field tapes or whether a tape had closed properly; checking shot records for noise bursts, swell noise or auto-fires; confirming bad or noisy channels, etc. It was also useful for investigating data problems whilst acquisition was still in progress.

Although the ProMAX was not an online system, it still managed to carry out a full and thorough QC of every sequence. Tape loading was a time consuming procedure, but the benefits were that every single field tape could be independently verified and checked. In addition to this, any errors in the Observer's Logs such as incorrect file numbers or incomprehensible logs were detected, and corrected.

Data quality was good in this area but swell noise was the major concern. Multiple energy and other extraneous sources of noise were not considered to be a major problem. Factors affecting data quality included the following:

- ✓ Ship noise
- ✓ Spikes / noisy channels
- ✓ Geological noise
- ✓ Swell noise
- ✓ External seismic noise

Ship noise - Although the centre of source to centre of first group was 140m, ship noise was visible on the noise records. Spectral analysis and FK analysis of this noise revealed what was thought to be propeller noise with 5Hz harmonics, within the 10-70Hz frequency range. FK analysis revealed that the move-out of this noise was 1500m/s. As would be expected for ship noise, the strength of these frequencies was strongest on the near offset traces and minimal at the far offsets.

Spikes / noisy channels - Most of the time all 576 channels were good. The spiking/noisy channel was dealt with by editing in processing and later in acquisition by replacing streamer sections.

Geological noise - Water bottom multiples were apparent on the shot records.

Diffractions were often visible and were probably caused by the prodigious faulting apparent in many of the sections.

Swell Noise – Was the major cause of noise and affected most of the sequences. This low frequency noise was peaking up to 10-20μbars on the most sequences.

External Seismic interference – A 3D survey on the edge of the prospect was a major cause of sometimes high intensity seismic interference. Sometimes this interference was manifested in the raw stacks but generally, it was easily attenuated just by the stacking process.

18 Conclusion

The ProMAX system proved to be extremely reliable and performed extremely well. There was not a single system crash or hardware malfunction that could have resulted in loss of processed data on the hard disk.

The survey averaged approximately 1136 km per day. Data processing also averaged approximately 51 km per day. The ProMAX system was more than capable of keeping pace with these acquisition rates, and as a result it was possible to thoroughly QC and stack every line.

19 APPENDICES

Appendix A

PROMAX PROCESSING LOG

Seq	Line	Dir	Date	First SP	Last SP	FFID	CDP's Processed	Noise Record RMS	SOL FK Analysis	SOL Spectral Analysis	Tape Copy	SEG-D Input	2D Geom S/Sheet	Near Trace	Plot Near Traces	2:1 Sum / Geom Assign	Near Trc WBT Pick	Database Fill WBT	WBT to Trc Headers	480 Chan Col RMS	Aux QC	Delete Raw Shots	Pick Decon / Mute Gates	Velocity Analysis	RMS for Stack	Pick NMO Mute	Raw Stack	Brute Stack + Decon	Plot Raw Stack + RMS	Merge Stacks	Plot Brute Stack	Delete Geom Shots	Stack to Archive	Vel to ASCII	Archive / Delete Line	Segy Stack to Tape	Shipment date	Notes
001	OS02-06	122	23/11	1001	1887	1001-1887	1-2934	x	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	11/12/02	**Fair-Good.** Streamer bent at SOL producing peak RMS values up to 12 µbar down the cable. The rest of the cable is at 2-4µbar. Seismic interference is also visible from the rear of the streamer. This would be easy to filter out, and the simple process of stacking attenuate a lot of this noise. The records are otherwise very clean with little swell noise and the stacked sections show obvious multiples but well-resolved primary horizons. Line stopped owing to air leak in guns.
002	OS02-06	122	24/11	1759	2507	1759-2507	2275-4806	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	11/12/02	**Fair.** Streamer at SOL has ambient noise levels of 3-6µbar, peaking in swell at 10-16µbar. This swell noise is very low frequency and can be seen in the raw stack at depth. Simple filtering removes much of this noise. There is also low-level seismic interference which is attenuated by stacking.
003	OS02-43	35	24/11	1001	1805	1001-1805	1-2700	x	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	-	x	x	x	x	x	x	11/12/02	**Fair.** Ambient noise levels at SOL are 3-6µbar, peaking randomly at 12µbar owing to the swell. Seismic interference in the shot records is apparent and is hitting the streamer from abeam.

004	OS02-45	215	24/11	1950	897	1950-897	1-3447	x	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	-	x	x	x	x	x	x	11/12/02	**Fair.** SOL noise levels are between 1-4µbar, with swell peaking at 10-15µbar. Seismic interference in the shot records is apparent and veers from abeam to astern as the line progresses. It is attenuated by stacking easily.
005	OS02-41	35	24/11	1001	2084	1001-2084	1-3537	x	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	-	x	x	x	x	x	x	11/12/02	**Fair.** SOL noise levels are between 3-5µbar. The centre of the cable is at 20µbar caused by the cable being bent. Swell noise is omnipresent. Processing through to stack does attenuate much of the noise, and the geology is well defined.
006	OS02-39	215	25/11	1683	897	1683-897	313-2646	x	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	-	x	x	x	x	x	x	11/12/02	**Fair.** SOL noise levels are approximately 7µbar. Seismic interference and swell noise are both present and manifested in the raw stack section at depth.
007	OS02-35	36	25/11	1001	1859	1001-1859	1-2862	x	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	-	x	x	x	x	x	x	11/12/02	**Fair.** SOL noise levels are between 2-5µbar, with swell peaking at 15µbar owing to the swell.
008	OS02-37	215	25/11	2094	897	2094-897	1-3897	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	-	x	x	x	x	x	x	11/12/02	**Fair-Poor.** SOL noise levels are between 5-10µbar. Very bad seismic interference of over 30-35µbar. This level of noise is not completely attenuated in the stacks and can be seen throughout the sections. Confident that further processing would remove most of this noise.
009	OS02-33	36	26/11	1001	2016	1001-2016	1-3333	x	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	-	x	x	x	x	x	x	11/12/02	**Fair.** SOL noise levels are between 2-5µbar, with a bent end of the streamer increasing levels to 25µbar in the far end of the cable. Swell noise is present but isn't a problem for processing.

010	OS02-14	123	26/11	2182	2506	2182-2506	3544-4803	x	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	-	x	x	x	x	x	x	11/12/02	**Fair.** SOL noise levels are between 2-6µbar. Swell noise visible in the records and the raw stacked section.
011	OS02-12	302	26/11	2373	897	2372-897	1-4716	x	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	-	x	x	x	x	x	x	11/12/02	**Fair.** SOL noise levels are between 2-5µbar. Swell noise visible in the records and the raw stacked section.
012	OS02-08	123	27/11	1001	2496	1001-2496	3019-4743	x	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	-	x	x	x	x	x	x	11/12/02	**Fair.** SOL noise levels are between 14-16µbar, peaking at 24µbar in the heavy swell. Seismic interference is present again but is incident from astern and is readily attenuated by the stacking process.
013	OS02-10	302	27/11	2382	1901	2382-1901	1-3630	x	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	11/12/02	**Fair.** SOL noise levels are between 1-5µbar. Air leak caused loss of pressure - LGSP 1906, processed to SP 1901. Swell noise and seismic interference present in the sections as usual down to 10s.
014	OS02-10		27/11	2011	897	2011-897	760-2517	x	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	11/12/02	**Fair.** SOL noise levels are between 2-10µbar. Swell noise visible in the records and the raw stacked section. Merged successfully with sequence 013.
015	OS02-04	302	27/11	1640	1150	1640-1150	1-1386	x	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	11/12/02	**Fair.** SOL noise levels are between 6-10µbar, peaking at 20µbar randomly owing to the swell. SP 1150-1157 are bad owing to an air-leak, with gun delta errors from SP 1583-1586. These bad shots were edited out for processing. LGSP 1158. Seismic interference present from SOL and random swell - visible down to 10s in the raw stack.

016	OS02-04	302	28/11	1263	897	1263-897	1-1386	x	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	11/12/02	**Fair.** SOL noise levels are between 2-5µbar. Swell noise visible in the records and the raw stacked section. Seismic interference also present but attenuated in the stacks. Merged successfully with sequence 015.
017	OS02-02	121	28/11	1001	2844	1001-2844	1-5817	x	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	-	x	x	x	x	x	11/12/02	**Fair.** SOL noise levels are between 2-5µbar, peaking up to 12-18µbar in the far end of the cable, owing to a bent cable coming onto the line. Swell noise affecting the cable randomly and appearing in the raw stacks at depth.
018	OS02-14	303	29/11	2198	897	2198-897	1-4191	x	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	-	x	x	x	x	x	11/12/02	**Fair.** SOL noise levels are between1-4µbar, peaking up to 12µbar. Swell noise affecting the cable randomly and appearing in the raw stacks at depth. Seismic interference appears at low-levels.
019	OS02-01	209	29/11	1728	897	1728-897	1-2781	x	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	-	x	x	x	x	x	11/12/02	**Fair.** Cable lowered to counter swell noise. SOL noise levels are between1-8µbar, peaking up to over 100µbar in the near sections of the cable. Seismic interference from astern is visible at low amplitudes and is stacked out.
020	OS02-03	30	29/11	1001	1383	1001-1383	1-1434	x	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	-	x	x	x	x	x	11/12/02	**Fair.** Swell noise at the SOL produces noise levels of 5-15µbar, peaking randomly up to 20-30µbar. Swell noise visible on raw stack at depth. Line stopped for the Western Monarch.
021	OS02-03	30	30/11	1278	2347	1278-2347	832-4326	x	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	-	x	x	x	x	x	11/12/02	**Poor.** High swell noise at the SOL producing noise levels of 40-70µbar, peaking up to>100µbar in the near cable. Swell noise easily visible on stacked sections. Merged satisfactorily with sequence 020.

022	OS02-05	211	30/11	1897	1663	1897-1663	2299-3288	x	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	11/12/02	**Poor.** High swell noise at the SOL producing noise levels of 60-100µbar down the cable. Swell noise easily visible through the stacked sections. Line aborted d/t air-leak LGSP=1669.
023	OS02-05	211	30/11	1776	897	1776-897	1-2919	x	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	11/12/02	**Poor.** Heavy swell at the SOL producing noise levels peaking randomly at 100µbar down the cable but with an ambient level of 5-10µbar. Streamer depth down to 10m. Swell noise easily visible through the stacked sections. Seismic interference visible on records from astern. Merged successfully with previous sequence 022.
024	OS02-07	31	30/11	1001	1871	1001-1871	1-2898	x	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	-	x	x	x	x	x	11/12/02	**Fair.** SOL noise levels of 2-10µbar, peaking randomly up to 20-30µbar. Swell noise and seismic interference at low levels and not visible on the raw stacked sections.
025	OS02-09	34	01/12	2160	2874	2160-2874	6478-8907	x	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	11/12/02	**Fair.** Cable not straight at SOL therefore noise record taken at the EOL. Noise levels of 2-10µbar. Minimal swell and SI with records relatively clean and stacked sections clear.
026	OS02-09	34	01/12	1860	2355	1860-2355	5578-7350	x	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	11/12/02	**Fair.** No SOL noise record owing to turning to come onto line. EOL RMS 2-8µbar, peaking at 18µbar in the swell. Swell noise evident in the raw stacks. LGSP 2249. Merged successfully with sequence 025. Line still incomplete.

027	OS02-11	215	01/12	1688	897	1688-897	1-2661	x	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	-	x	x	x	x	x	x	11/12/02	**Fair.** SOL RMS noise levels 2-8µbar, peaking at 14µbar in the swell. Seismic interference is also evident from astern in the shot records but is mainly attenuated by stacking. Some swell noise evident at depth in the stacks.
028	OS02-09	34	01/12	1001	2080	1001-2080	3001-6525	x	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	11/12/02	**Fair.** SOL RMS levels at 1-8µbar, peaking at 20µbar. Swell noise omnipresent but is not too heavy, nor intrusive on the stacked sections.
029	OS02-15	35	02/12	1001	1469	1001-1469	1-1692	x	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	11/12/02	**Poor.** SOL noise levels of 3-8µbar. Heavy seismic interference from ahead becoming progressively worse as the line progresses. LGSP 1469 d/t SI. This interference stacks in very well and is dominant in the raw and brute stacked sections, especially below 6s.
030	OS02-13	215	02/12	1492	1001	1492-1001	313-2073	x	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	-	x	x	x	x	x	11/12/02	**Fair.** No SOL noise record owing to turning to come onto line. EOL RMS 5-10µbar, peaking randomly in the swell. Line aborted d/t SI from astern. This noise is not as destructive as the previous sequence and is stacked out after processing.
031	NTBP							-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
032	OS02-15	35	02/12	1364	2045	1364-2045	1090-3420	x	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	11/12/02	**Good.** Small levels of swell noise no impinging upon the records or stacks. SOL noise records at 2-12µbar.
033	OS02-29	216	03/12	2020	897	2020-897	1-3657	x	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	-	x	x	x	x	x	11/12/02	**Fair.** Small levels of swell and seismic interference from astern. SOL noise levels from 4-8µbar, randomly peaking at 12µbar. S/I is visible on the stacked sections below 3 seconds.

034	OS02-31	035	03/12	1001	1772	1001-1772	1-2601	x	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	11/12/02	**Fair.** Seismic interference moving from abeam to astern as the line progressed. SOL noise levels from 1-4µbar, randomly peaking at 7-12µbar. Stacked sections remain fairly clear of noise.
035	OS02-21	215	03/12	2034	1652	2034-1652	1-1434	x	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	11/12/02	**Fair.** SOL noise levels from 2-5µbarpeaking at 20-50µbar near the centre of the cable - caused by turning onto line. LGSP 1652 d/t seismic interference. SI is plainly visible on the stacked sections towards the end of the line where it stacks-in very well, especially below 5 seconds depth. Some swell noise is also apparent.
036	NTBP							-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	'	
037	OS02-13	215	08/12	2190	1284	2190-1293	850-3882	x	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	11/12/02	**Fair.** No seismic interference, medium swell levels occurring randomly. SOL noise levels at 2-8µbar, peaking at over 50µbar. Swell noise visible on raw stacks. LCSP 1973. 11 missing shotpoints consecutively producing a drop in fold over the affected area but not a visible degradation of data quality. Merged Successfully with sequence 030.
038	OS02-23	37	08/12	1001	1894	1001-1894	1-2967	x	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	-	x	x	x	x	11/12/02	**Fair.** No seismic interference but some swell noise down the cable. SOL RMS values of 2-10µbar, peaking at over 40µbar down the length of the streamer. Raw stacks show swell noise at depth.
039	NTBP							-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	'	

040	OS02-19	36	09/12	1210	2051	1210-2051	1-2811	x	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	-	x	x	x	x	x	x	11/12/02	**Poor.** Swell noise at SOL peaking randomly at 40-80µbar down the cable. Swell noise evident upon the raw stacks. No seismic interference.
041	OS02-27	216	09/12	1696	897	1696-897	1-2685	x	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	-	x	x	x	x	x	x	11/12/02	**Very Poor.** No SOL RMS recorded owing to a short run-in because of a fishing boat. EOL RMS values of 5-30µbar, peaking at over 250µbar. Raw stacks show high intensity noise throughout, and especially evident below 4seconds. Difficulties encountered when trying to pick velocities accurately.
042	OS02-17	215	14/12	2099	1954	2099-1954	5860-6582	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	-	x	x	x	x	x	x		**Very Poor**. SOL RMS 3-14µbar, peaking up to 195µbar d/t strong swell. Strong noise on: SOL - SP 2084, channels 475-576, SP 2083 - SP 2058, gradually decreasing from channel 477 to 576. Very strong swell noise up to 1.5s visible on the raw stack. Line terminated d/t time sharing with 3-D vessel.
043	OS02-17	215	14/12	2059	897	2059-897	2689--6462	x	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		**Very Poor.** RMS noise at the beginning of line 3-10ubar with peaks up to 135ubar d/t strong swell. Swell noise breaking through the water bottom at 1.5s on the raw stack. Stacks for seq. 42 and 43 merged together OK.
044	OS02-25	216	15/12	1644	897	16777215 - 16776468	1-2529	x	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	-	x	x	x	x	x	x		**Very Poor.** Ambient RMS noise at SOL 3-10ubar with peak up to 280ubar on channel 253 d/t strong swell. 3-D vessel causes slight noise on the streamer between SP 955 and EOL. FFID numbers are 8 digit long d/t Syntrak error. Swell noise breaking through the events at 2.5s.

045	OS02-21	216	15/12	1757	1335	1757-1335	4003-5556	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	-	x	x	x	x	x	x			**Very Poor.** RMS noise at the beginning of line 3-9ubar peaking up to 45ubar on channel 372 d/t strong swell. Swell noise breaking through the water bottom at 2.5s on the raw stack. Seismic interference from the Western Monarch present from SP 1445 to EOL. Line terminated at SP 1335 d/t strong seismic interference from the 3-D vessel. Line processed up to SP 1335.
046	OS02-21	216	15/12	1440	1026	1440-1026	3076-4605	x	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x			**Fair.** RMS noise at SOL 2-10ubar with peak up to 71ubar on channel 372 d/t swell. Seismic interference (peaking up to 70ubar in some places) from the 3-D vessel present from SP 1142 towards EOL. Stacks for sequences 35, 39, 46 and 45 merged together OK.
047	OS02-19	036	15/12	1001	1315	1001-1315	1-1230	x	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	-	x	x	x	x	x			**Fair-Good.** RMS noise at SOL 0.5-5ubar peaking up to 21ubar on the far end of the streamer. Occasional swell bursts visible up to 3.0s on the raw stack. Stacks for sequences 40 and 47 merged OK.

Appendix B

DATA SHIPMENTS

Appendix B - List of Deliverable Products

.

The following data shipment was sent at crew change on 11 December 2002.

1. Paper Displays for Otway Basin OS02 Survey (Sequences 001-041):
Start of line RMS noise, Near Trace displays, Raw Stacks and Brute Stacks.

2. 1 x 8mm tape containing SEGY format Raw Stacks for Otway Basin OS02 Survey.
Seq. 001-041 (SEGY files 1-039)

3. 1 x 8mm tape containing SEGY format Brute Stacks for Otway Basin OS02 Survey.
Seq. 001-041 (SEGY files 1-039)

4. 1 x 8mm tape for seq. 001-041 of Otway Basin OS02 Survey containing:
Velocities (ASCII files, UNIX tar –cvf format).
Colour RMS, Start of Line RMS Noise (GIF files, UNIX tar –cvf format).

5. 1 x 8mm tape for seq. 001-041 of Otway Basin OS02 Survey containing:
Master flows, Stacks, Near Traces, Shot vs. Chan RMS
(ProMAX archive format).

6. 1 x floppy disk for seq. 001-041 of Otway Basin OS02 Survey containing:
Velocity files (ASCII format).

The following final data shipment was sent in January 2003.

1. Paper Displays for Otway Basin OS02 Survey (Sequences 042-047):
Start of line RMS noise, Near Trace displays, Raw Stacks and Brute Stacks.

2. 1 x 8mm tape containing SEGY format Raw Stacks for Otway Basin OS02 Survey.
Seq. 042-047 (SEGY files 1-6)

3. 1 x 8mm tape containing SEGY format Brute Stacks for Otway Basin OS02 Survey.
Seq. 042-047 (SEGY files 1-6)

4. 1 x 8mm tape for seq. 001-047 of Otway Basin OS02 Survey containing:
Velocities. (ASCII files, UNIX tar –cvf format).
Colour RMS, Start of Line RMS Noise. (GIF files, UNIX tar –cvf format).

5. 1 x 8mm tape for seq. 001-047 of Otway Basin OS02 Survey containing:
Master flows, Near Traces, Shot vs. Chan RMS (ProMAX archive format).

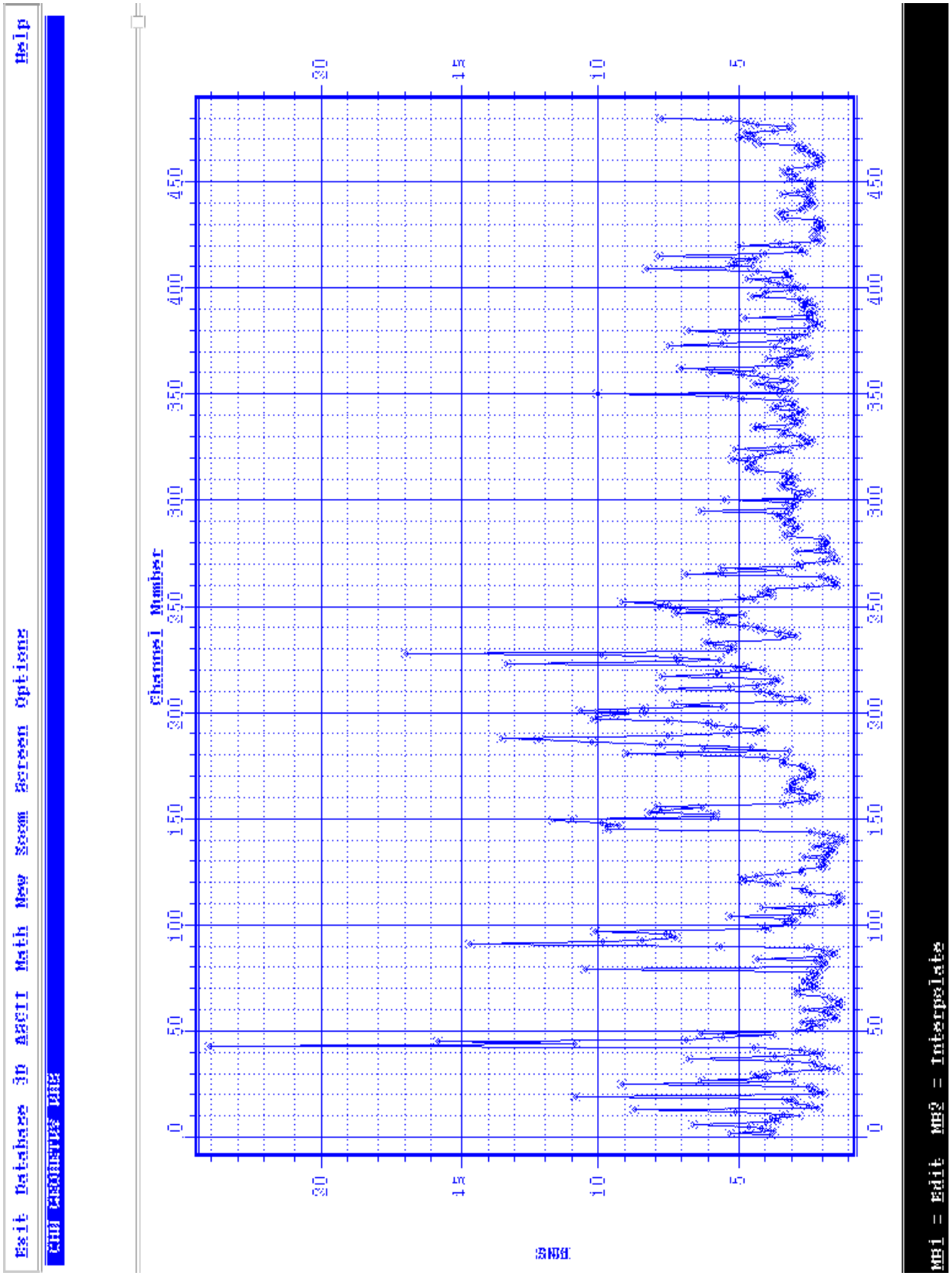
6. 1 x 8mm tape for seq. 001-047 of Otway Basin OS02 Survey containing:
Stacks (ProMAX archive format).

7. 1 x floppy disk for seq. 001-047 of Otway Basin OS02 Survey containing:
Velocity files (ASCII format).

Appendix C

START OF LINE NOISE RECORD RMS ANALYSIS

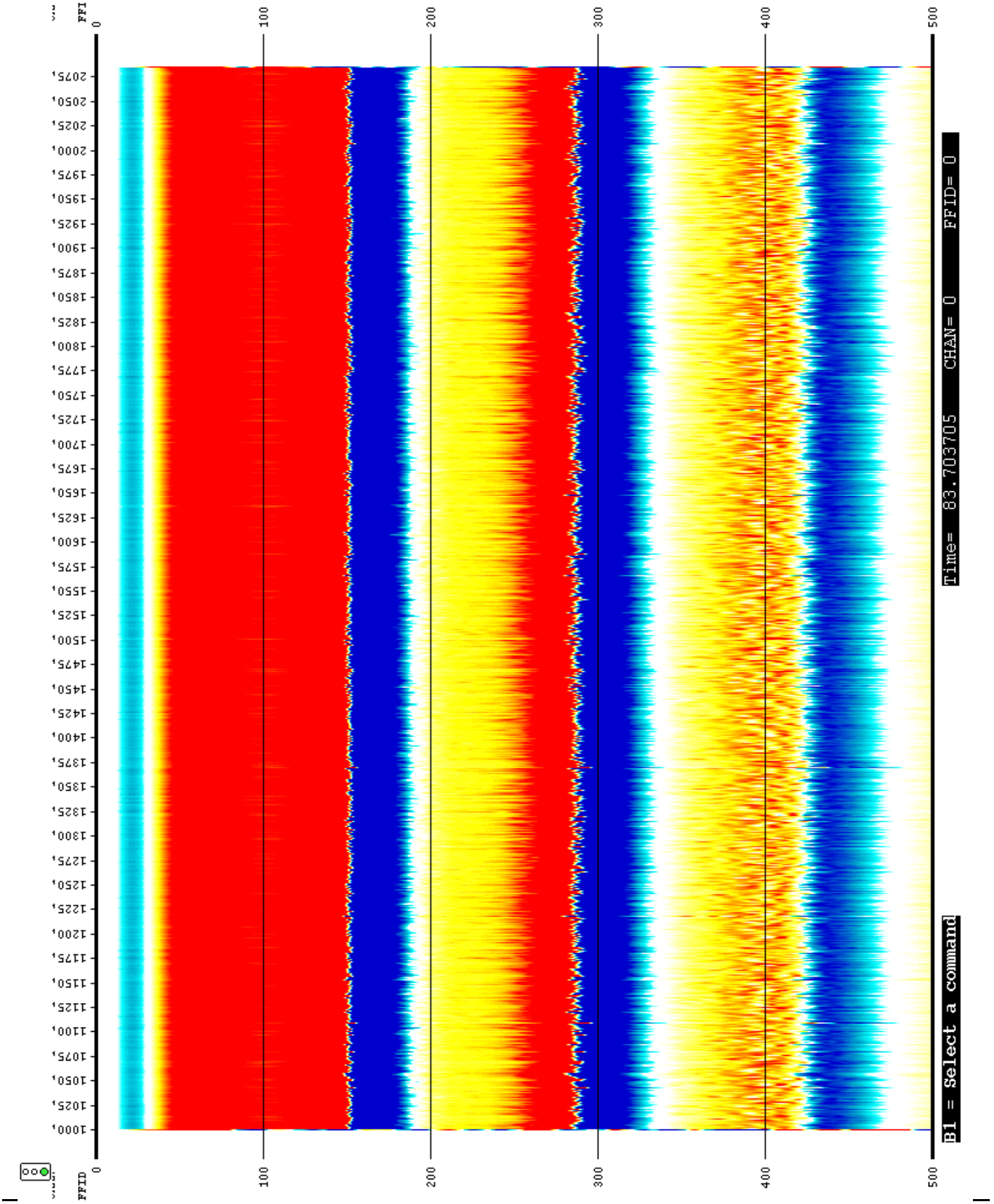
Line:OS02-35-007



Appendix D

AUXILIARY CHANNELS DISPLAY

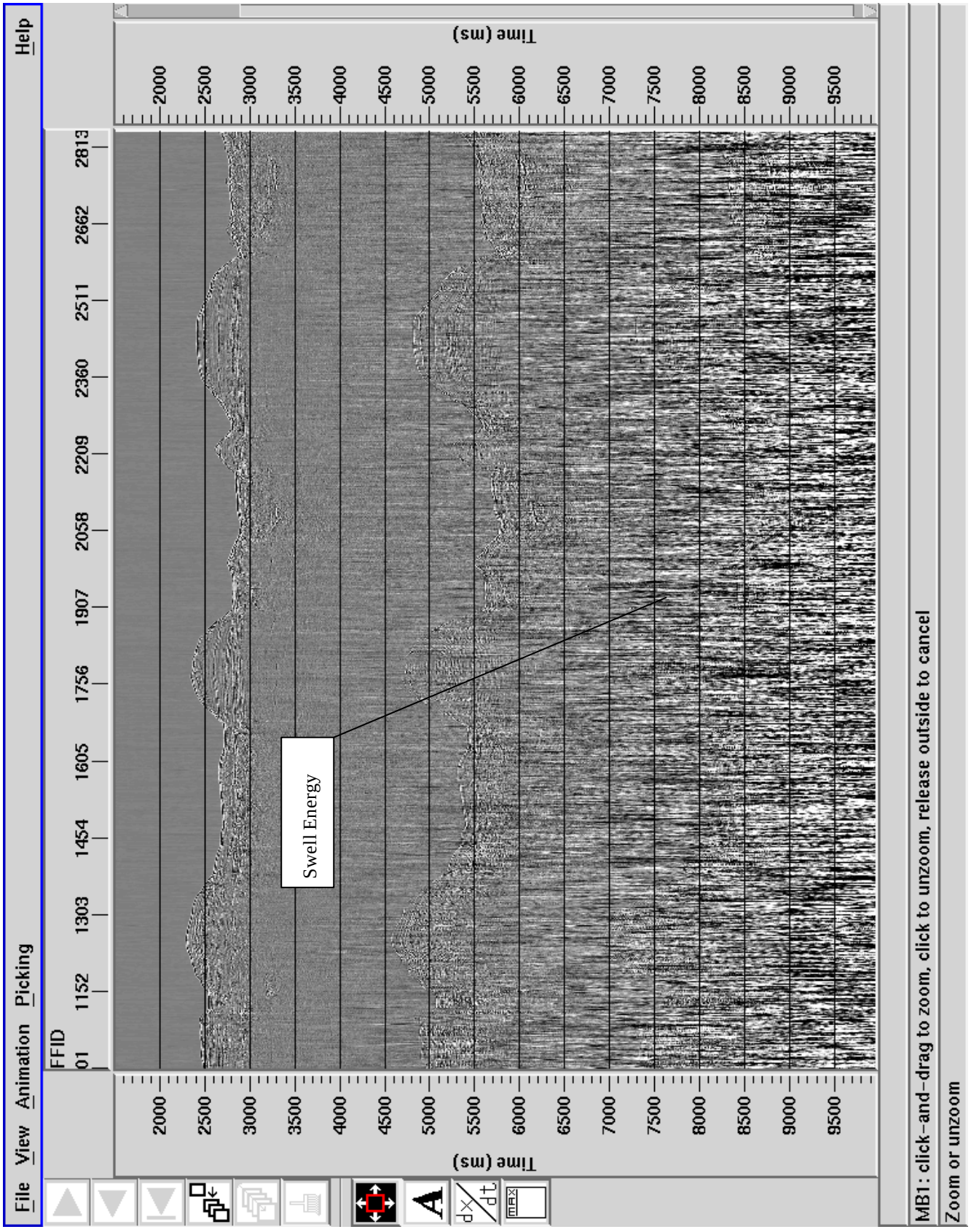
Display of auxiliary channel mounted on Gun 1-1. Line: OS02-41-005.



Appendix E

NEAR TRACE DISPLAY

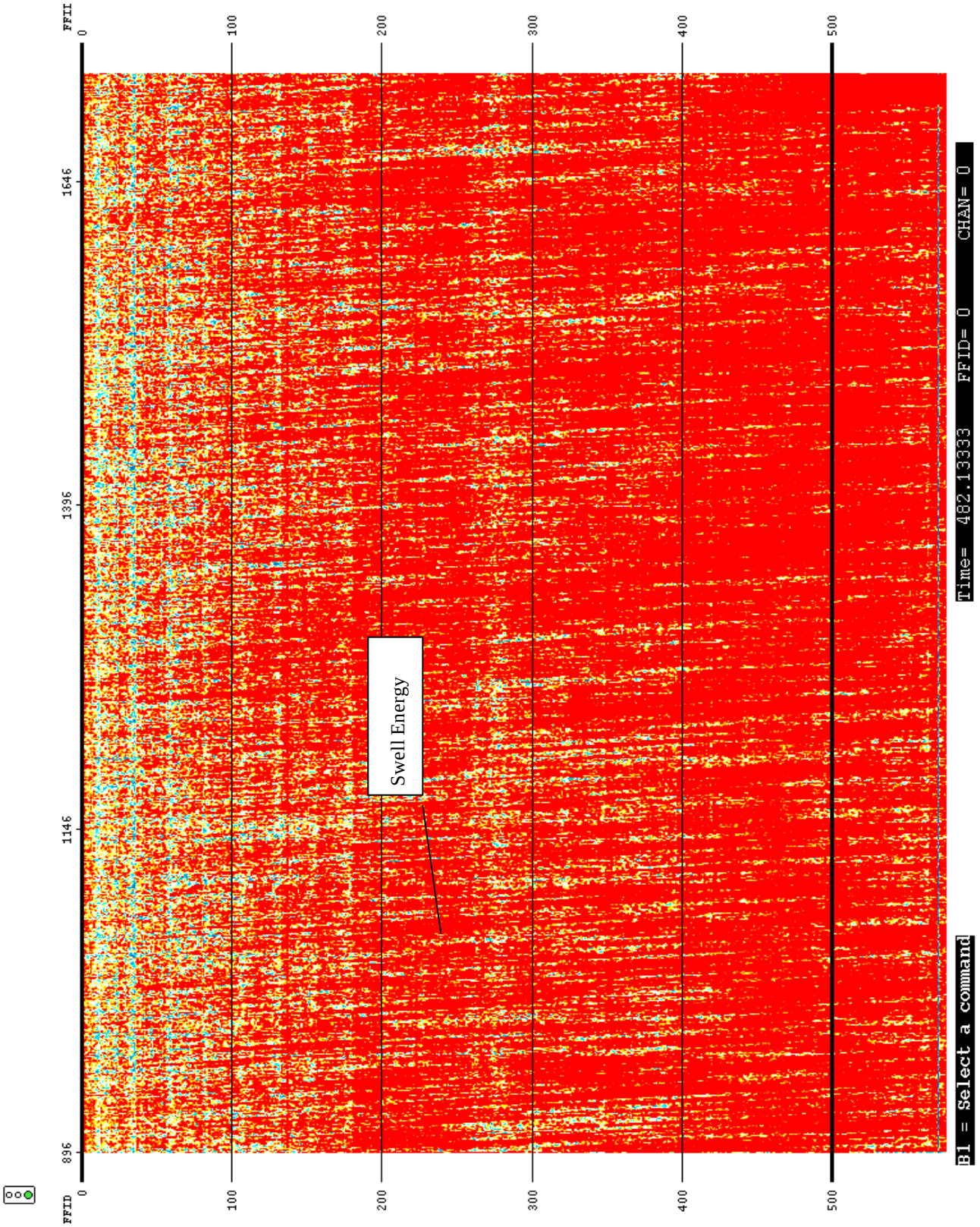
Near trace gather; Line: OS02-02-017



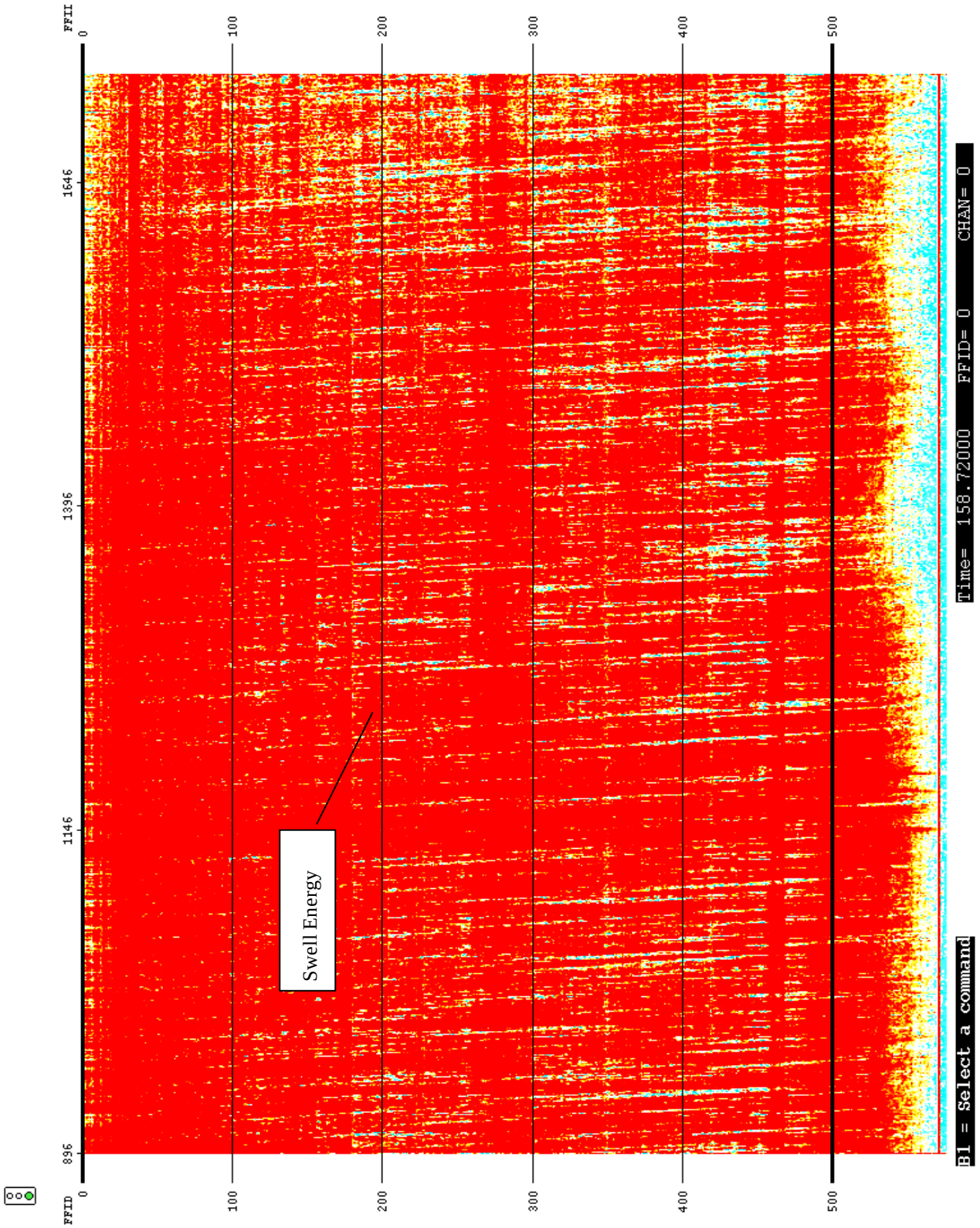
Appendix F

SHOT vs. CHANNEL COLOUR RMS

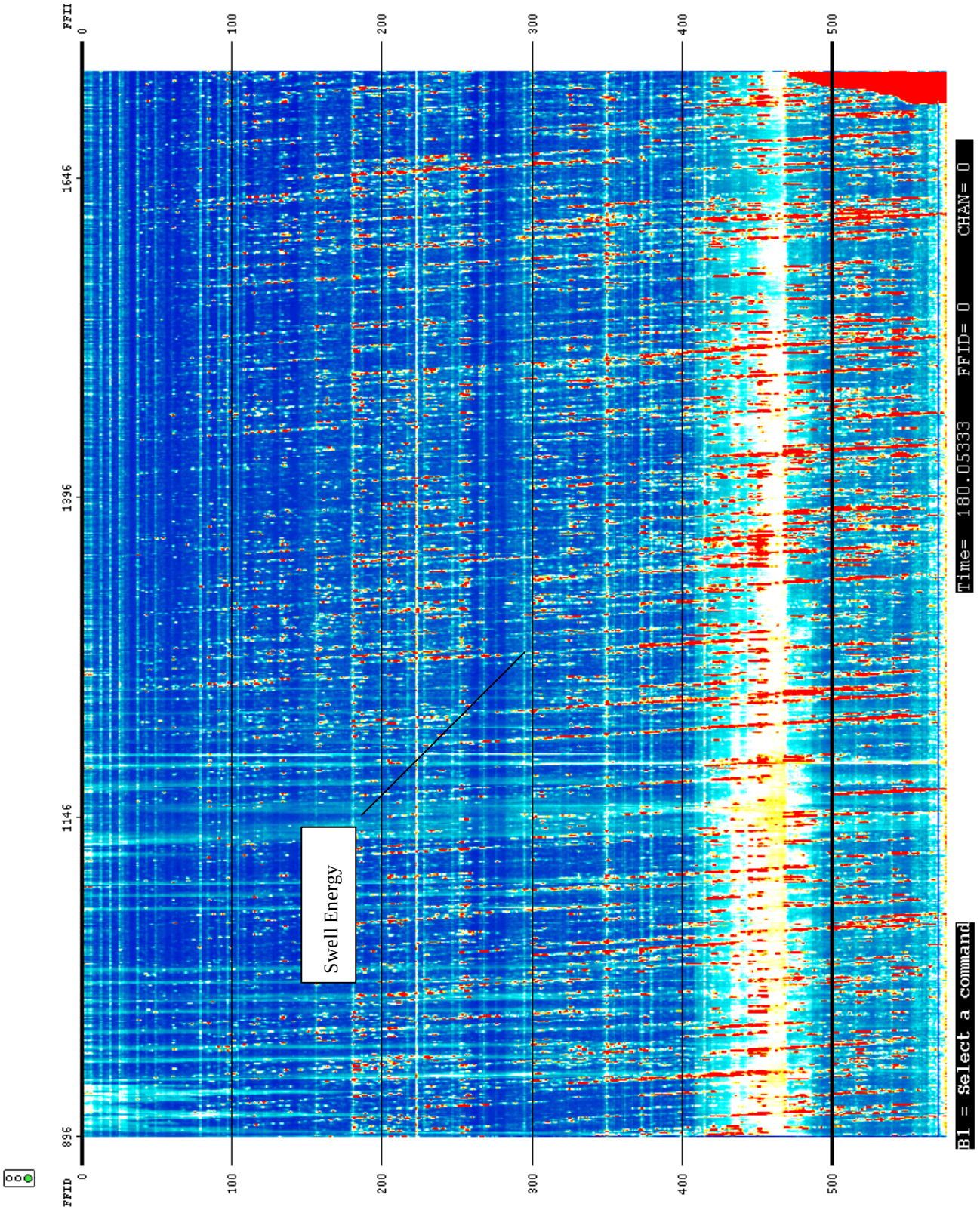
Shot vs. Channel RMS, No filter applied; Line: OS02-41-005.



Shot vs. Channel RMS, Dominant frequency; Line: OS02-41-005.



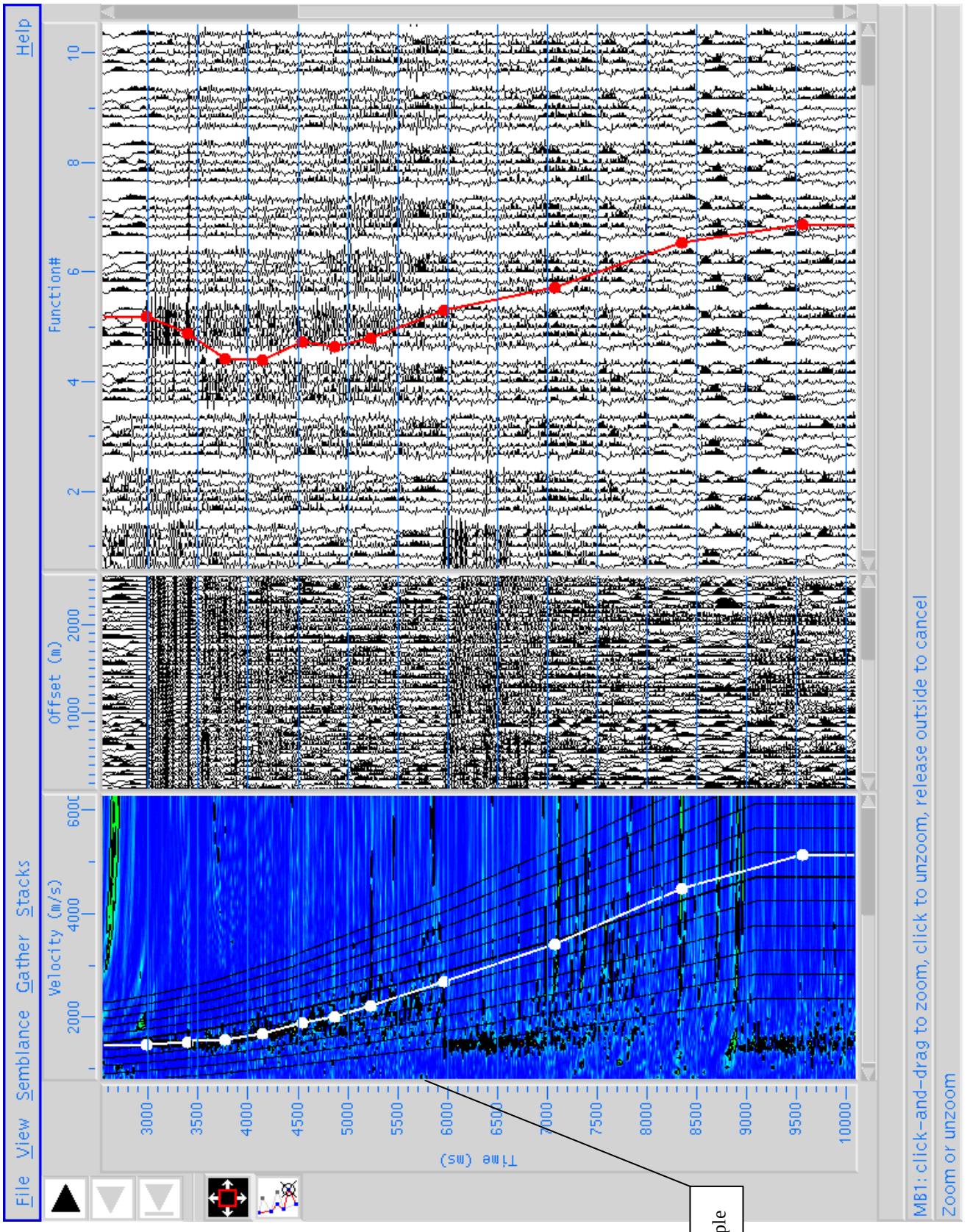
Shot vs. Channel RMS, Ormsby band-pass filter 4-8-90-120 Hz applied; Line: OS02-41-005.



Appendix G

VELOCITY ANALYSIS

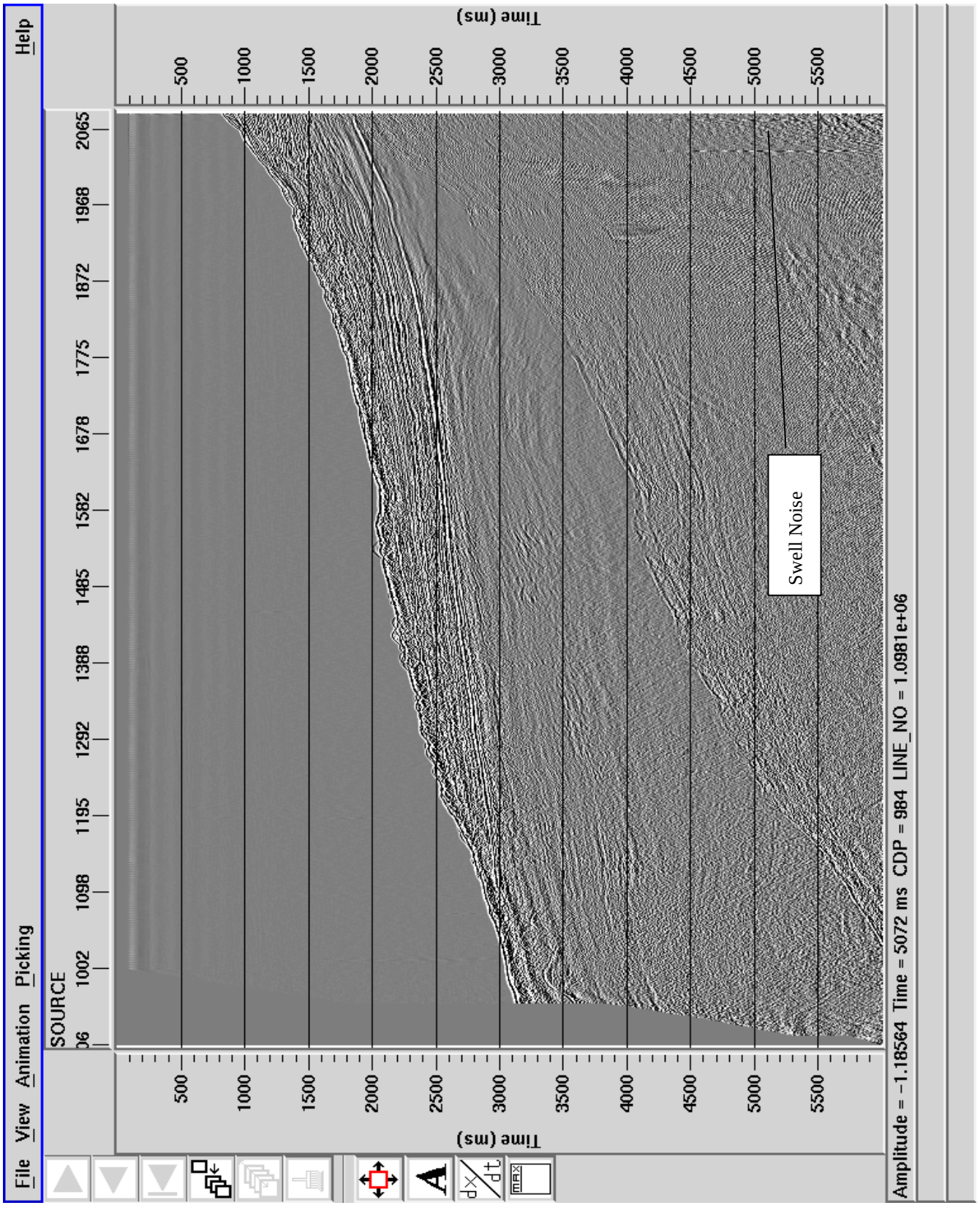
Line OS02-03-020



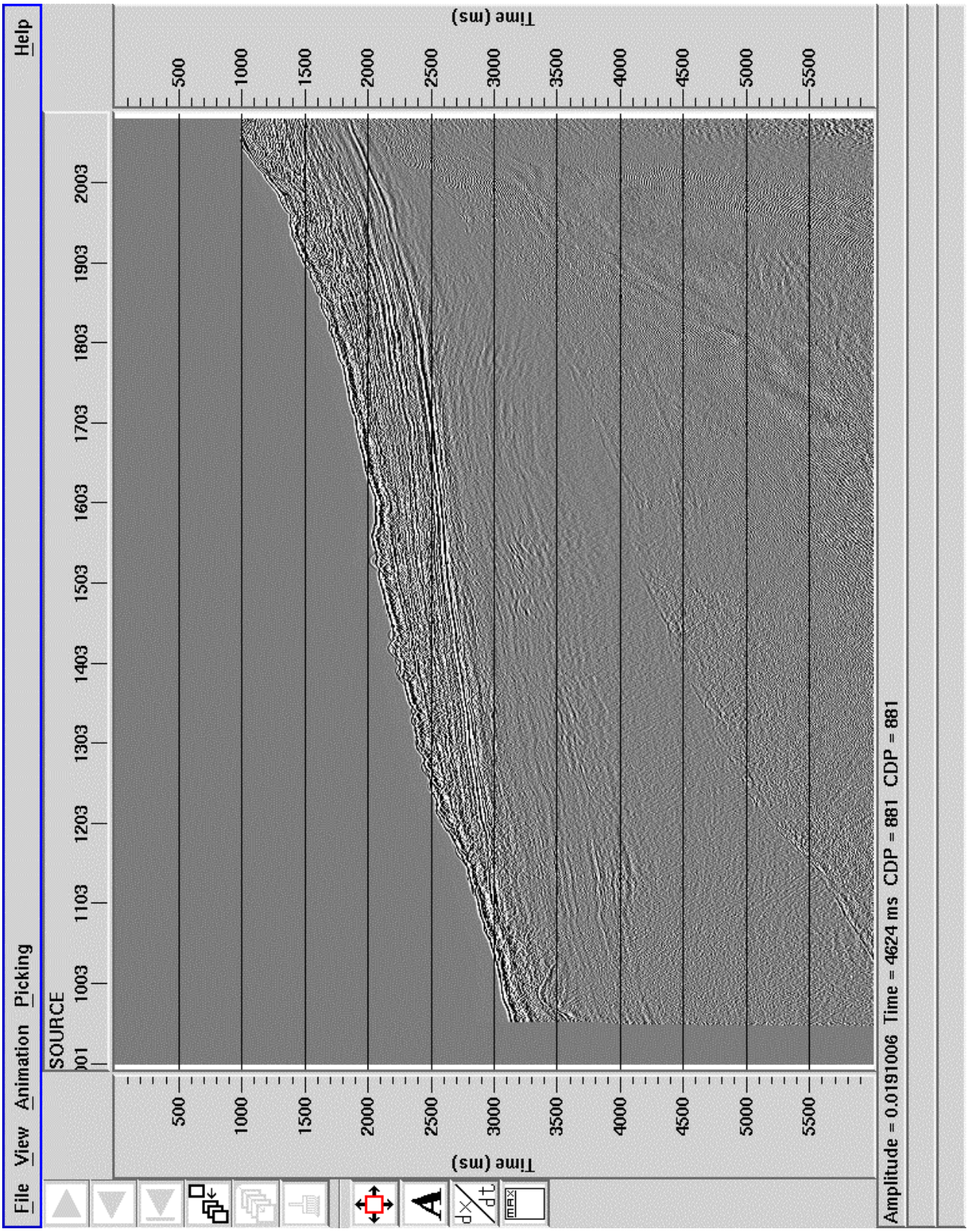
Appendix H

STACKS

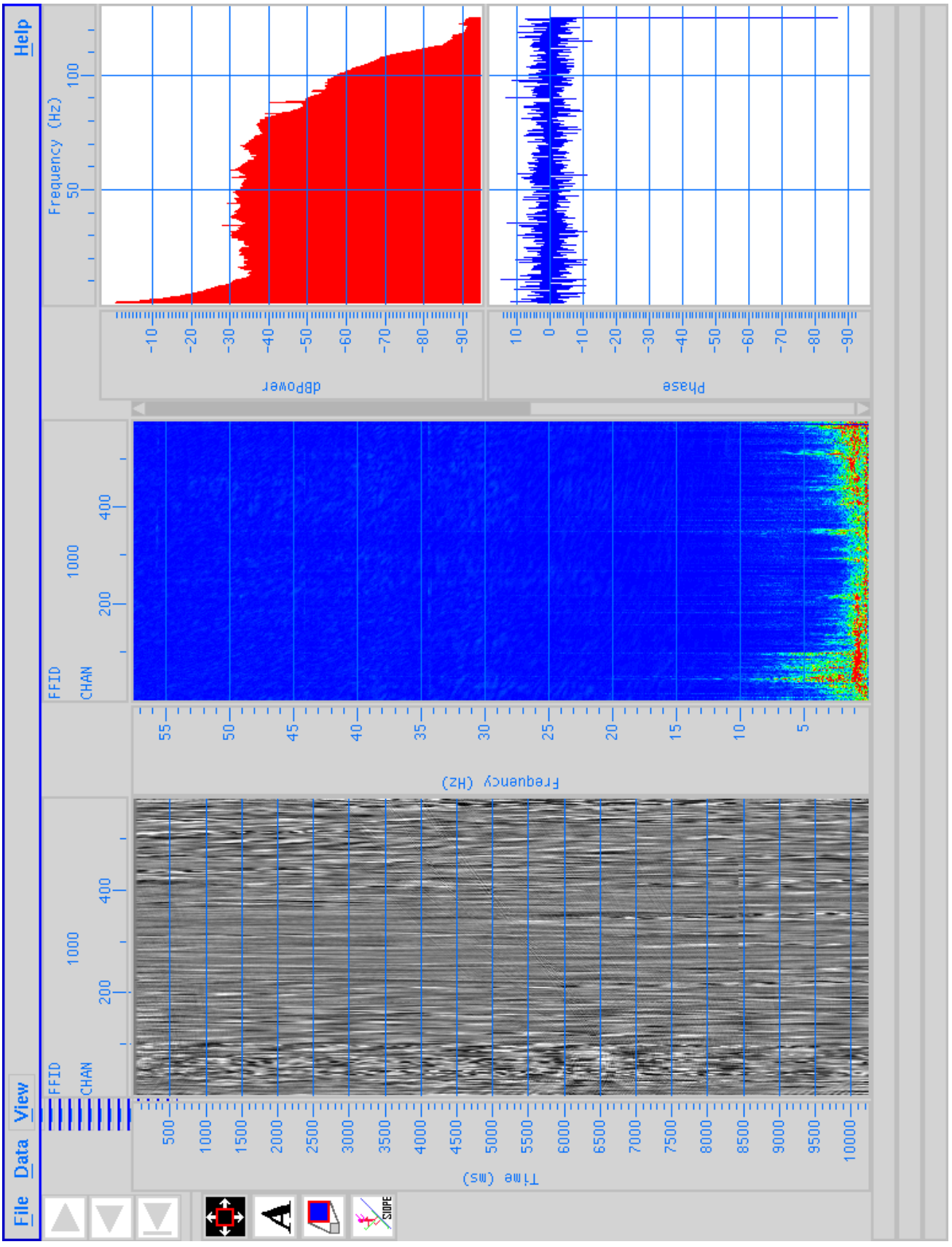
Raw stack: Ormsby band-pass 4-8-90-120 Hz filter applied; Line: OS02-41-005.



Brute stack: Ormsby band-pass filter, inside trace mute and predictive deconvolution applied; Line: OS02-41-005.



Appendix I

SPECTRAL ANALYSIS

Line OS02-02-017