

## Section 1: **General Information**

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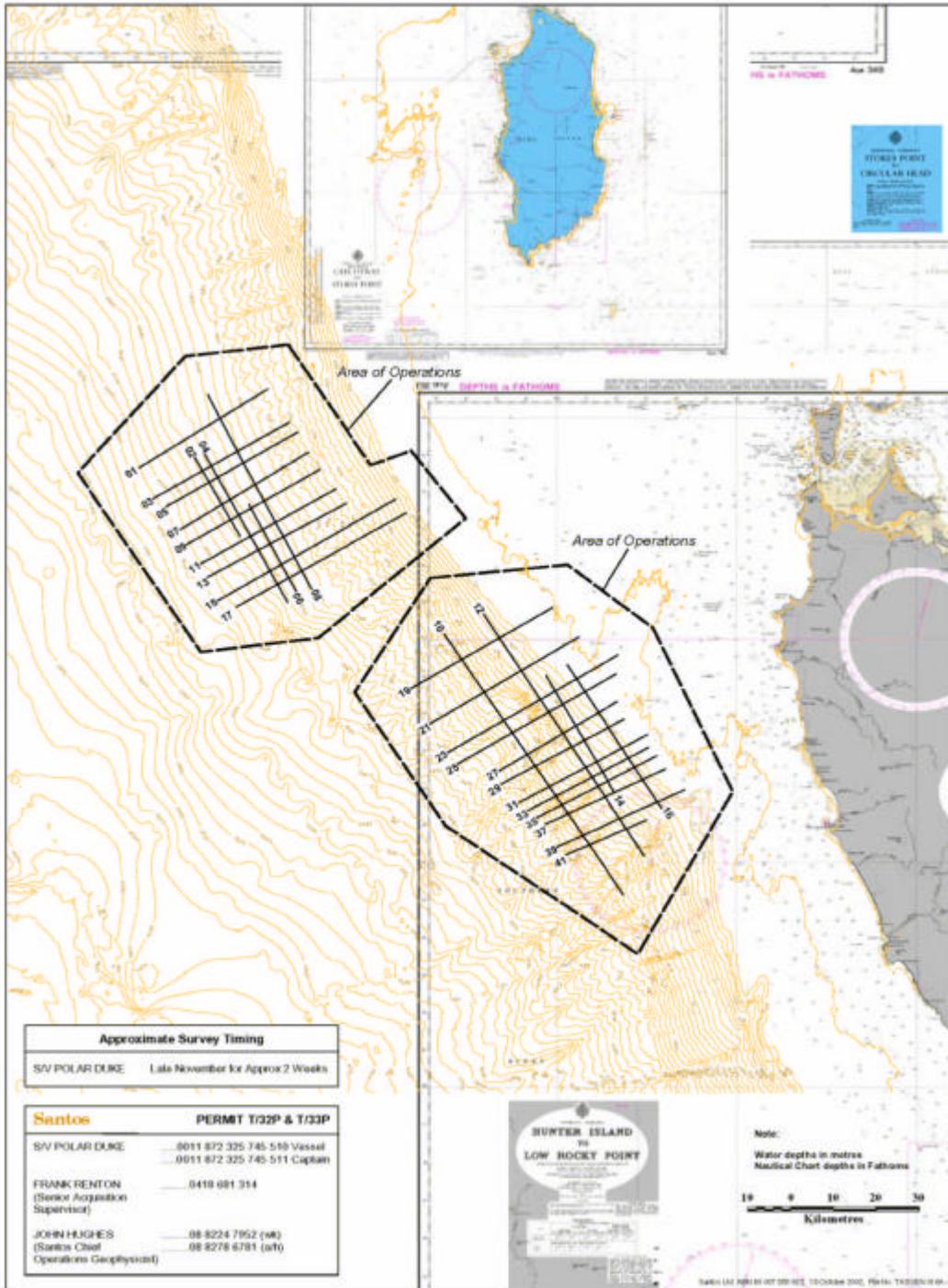
## **1 Survey Information and Objectives**

This program for **Santos Limited** (Australia) comprised approx. 1143 km of full fold 2D seismic in Tasmanian waters of Blocks T/32P and T/33P. Water depths range from 200 to 3000m. This area is approximately 50 nautical miles due south of King Island, and 50 nautical miles due west of the NW tip of Tasmania. The programme consisted of 8 strike lines, 21 dip lines. The dip lines ran SW to NE with the NE ends of lines running up the edge of the Continental Shelf.

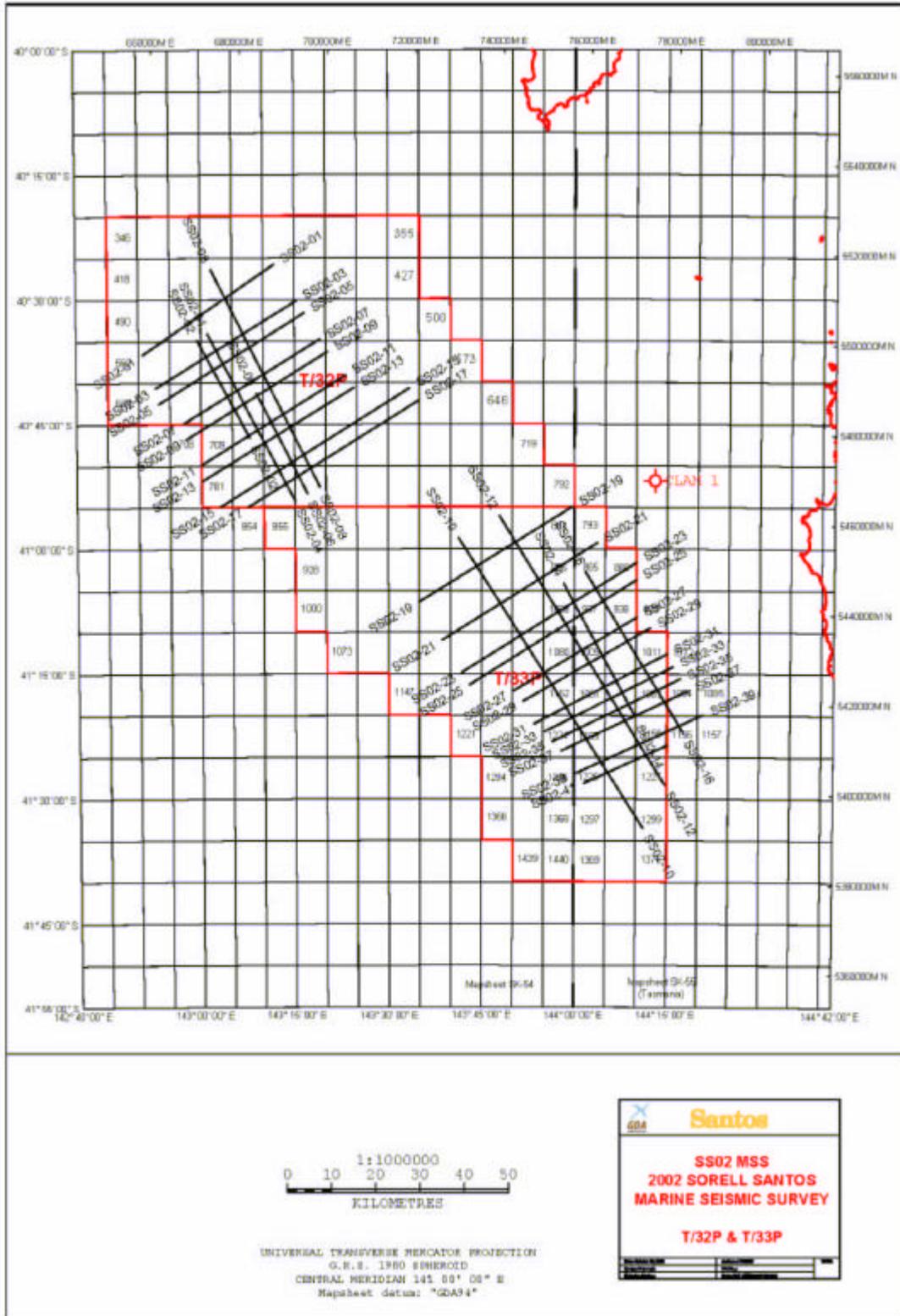
The ***Polar Duke*** carried out the acquisition for **Multiwave Geophysical Company ASA**. Acquisition equipment included a sleeve air gun source array of 3500 cubic inches and a single digital streamer, configured for 576 data traces and a length of 7200m. Positioning was by Differential GPS and onboard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

The vessel initially mobilized for Santos Limited in Cairns, Australia on 5<sup>th</sup> November and carried out two prior surveys off Victoria. She then proceeded directly to the survey area and commenced production on 16<sup>th</sup> December. The 29 lines of seismic data acquisition were completed in 34 line sequences by 30<sup>th</sup> December 2002.

## 2 Area Location Map



### 3 Prospect Map



## Section 1: General Information

# 4 Survey Parameters and Original Line Coordinates

### Survey Report

Date Generated: 09/10/2002  
Time Generated: 13:28:13

#### 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

2D Line Name:	SS02-01		
FSP:	1001	LSP:	2441
Segment: 1			
Start Easting:	656010.01	Start Longitude:	360°E
Start Northing:	5502872.98	Start Latitude:	90°N
End Easting:	686342.58	End Longitude:	143°11'48.354"E
End Northing:	5522259.54	End Latitude:	40°25'46.002"S
Azimuth/Bearing:	56.2176		
Distance:	36000 m		

2D Line Name:	SS02-02		
FSP:	1001	LSP:	1990
Segment: 1			
Start Easting:	668458.0	Start Longitude:	142°59'25.505"E
Start Northing:	5505848.0	Start Latitude:	40°34'51.676"S
End Easting:	679749.28	End Longitude:	143°7'48.151"E
End Northing:	5483852.59	End Latitude:	40°46'35.976"S
Azimuth/Bearing:	151.529		
Distance:	24725 m		

## Section 1: General Information

2D Line Name: SS02-03  
FSP: 1001 LSP: 2498  
Segment: 1  
Start Easting: 658763.02 Start Longitude: 142°52'42.820"E  
Start Northing: 5495405.03 Start Latitude: 40°40'37.078"S  
End Easting: 691202.96 End Longitude: 143°15'23.364"E  
End Northing: 5514065.59 End Latitude: 40°30'07.578"S  
Azimuth/Bearing: 58.8685  
Distance: 37425 m

2D Line Name: SS02-04  
FSP: 1001 LSP: 2691  
Segment: 1  
Start Easting: 670822.97 Start Longitude: 143°1'04.717"E  
Start Northing: 5507207.97 Start Latitude: 40°34'05.851"S  
End Easting: 689655.34 End Longitude: 143°15'06.300"E  
End Northing: 5469387.29 End Latitude: 40°54'16.718"S  
Azimuth/Bearing: 152.212  
Distance: 42250 m

2D Line Name: SS02-05  
FSP: 1001 LSP: 2549  
Segment: 1  
Start Easting: 659351.02 Start Longitude: 142°53'11.090"E  
Start Northing: 5491865.05 Start Latitude: 40°42'31.414"S  
End Easting: 692840.4 End Longitude: 143°16'35.958"E  
End Northing: 5511258.42 End Latitude: 40°31'37.186"S  
Azimuth/Bearing: 58.697  
Distance: 38700 m

2D Line Name: SS02-06  
FSP: 1001 LSP: 2007  
Segment: 1  
Start Easting: 681549.97 Start Longitude: 143°8'54.654"E  
Start Northing: 5493687.0 Start Latitude: 40°41'15.835"S  
End Easting: 692480.01 End Longitude: 143°17'05.104"E  
End Northing: 5471035.35 End Latitude: 40°53'20.940"S  
Azimuth/Bearing: 152.837  
Distance: 25150 m

2D Line Name: SS02-07  
FSP: 1001 LSP: 2450  
Segment: 1  
Start Easting: 664833.01 Start Longitude: 142°57'08.867"E  
Start Northing: 5487351.04 Start Latitude: 40°44'53.840"S  
End Easting: 696264.96 End Longitude: 143°19'07.990"E  
End Northing: 5505359.05 End Latitude: 40°34'45.466"S  
Azimuth/Bearing: 58.9182  
Distance: 36225 m

2D Line Name: SS02-08  
FSP: 1001 LSP: 3170  
Segment: 1  
Start Easting: 671968.01 Start Longitude: 143°1'39.410"E  
Start Northing: 5521505.97 Start Latitude: 40°26'21.570"S  
End Easting: 695244.1 End Longitude: 143°19'01.438"E  
End Northing: 5472529.79 End Latitude: 40°52'30.158"S  
Azimuth/Bearing: 153.259  
Distance: 54225 m

## Section 1: General Information

2D Line Name: SS02-09  
FSP: 1001 LSP: 2502  
Segment: 1  
Start Easting: 665399.99 Start Longitude: 142°57'36.407"E  
Start Northing: 5483806.04 Start Latitude: 40°46'48.331"S  
End Easting: 697923.25 End Longitude: 143°20'21.671"E  
End Northing: 5502524.49 End Latitude: 40°36'15.898"S  
Azimuth/Bearing: 58.7996  
Distance: 37525 m

2D Line Name: SS02-10  
FSP: 1001 LSP: 4073  
Segment: 1  
Start Easting: 726229.97 Start Longitude: 143°41'20.069"E  
Start Northing: 5460259.03 Start Latitude: 40°58'38.971"S  
End Easting: 765788.41 End Longitude: 144°11'13.762"E  
End Northing: 5394399.63 End Latitude: 41°33'28.487"S  
Azimuth/Bearing: 147.234  
Distance: 76800 m

2D Line Name: SS02-11  
FSP: 1001 LSP: 2529  
Segment: 1  
Start Easting: 668754.98 Start Longitude: 143°00'04.993"E  
Start Northing: 5478120.96 Start Latitude: 40°49'50.135"S  
End Easting: 701872.61 End Longitude: 143°23'15.770"E  
End Northing: 5497161.24 End Latitude: 40°39'06.250"S  
Azimuth/Bearing: 58.7976  
Distance: 38200 m

2D Line Name: SS02-12  
FSP: 1001 LSP: 3823  
Segment: 1  
Start Easting: 735610.98 Start Longitude: 143°47'54.737"E  
Start Northing: 5464848.01 Start Latitude: 40°56'00.776"S  
End Easting: 770997.64 End Longitude: 144°14'43.094"E  
End Northing: 5403782.61 End Latitude: 41°28'18.426"S  
Azimuth/Bearing: 148.063  
Distance: 70550 m

2D Line Name: SS02-13  
FSP: 1001 LSP: 2608  
Segment: 1  
Start Easting: 668719.04 Start Longitude: 143°00'07.031"E  
Start Northing: 5474459.99 Start Latitude: 40°51'48.816"S  
End Easting: 703627.27 End Longitude: 143°24'33.703"E  
End Northing: 5494348.05 End Latitude: 40°40'35.854"S  
Azimuth/Bearing: 59.0211  
Distance: 40175 m

2D Line Name: SS02-14  
FSP: 1001 LSP: 2350  
Segment: 1  
Start Easting: 749690.97 Start Longitude: 143°58'18.736"E  
Start Northing: 5449250.04 Start Latitude: 41°4'10.891"S  
End Easting: 764921.75 End Longitude: 144°9'57.352"E  
End Northing: 5419144.52 End Latitude: 41°20'08.347"S  
Azimuth/Bearing: 151.206  
Distance: 33725 m

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2D Line Name:	SS02-15	LSP:	3013
FSP:	1001		
Segment: 1			
Start Easting:	672757.97	Start Longitude:	143°3'05.245"E
Start Northing:	5468674.95	Start Latitude:	40°54'53.276"S
End Easting:	716269.5	End Longitude:	143°33'32.249"E
End Northing:	5493917.45	End Latitude:	40°40'38.222"S
Azimuth/Bearing:	58.54		
Distance:	50300 m		
2D Line Name:	SS02-16	LSP:	2684
FSP:	1001		
Segment: 1			
Start Easting:	754752.01	Start Longitude:	144°1'51.701"E
Start Northing:	5451670.97	Start Latitude:	41°2'46.846"S
End Easting:	775631.49	End Longitude:	144°17'43.962"E
End Northing:	5415119.54	End Latitude:	41°22'05.729"S
Azimuth/Bearing:	148.265		
Distance:	42075 m		
2D Line Name:	SS02-17	LSP:	2803
FSP:	1001		
Segment: 1			
Start Easting:	679044.99	Start Longitude:	143°7'34.032"E
Start Northing:	5468486.01	Start Latitude:	40°54'54.533"S
End Easting:	718069.11	End Longitude:	143°34'52.478"E
End Northing:	5491002.11	End Latitude:	40°42'10.969"S
Azimuth/Bearing:	58.6261		
Distance:	45050 m		
2D Line Name:	SS02-19	LSP:	2625
FSP:	1001		
Segment: 1			
Start Easting:	716906.01	Start Longitude:	143°34'59.221"E
Start Northing:	5446268.04	Start Latitude:	41°6'21.341"S
End Easting:	752208.38	End Longitude:	143°59'41.359"E
End Northing:	5466343.37	End Latitude:	40°54'54.526"S
Azimuth/Bearing:	58.6788		
Distance:	40600 m		
2D Line Name:	SS02-21	LSP:	2649
FSP:	1001		
Segment: 1			
Start Easting:	721854.0	Start Longitude:	143°38'42.400"E
Start Northing:	5437617.98	Start Latitude:	41°10'56.744"S
End Easting:	757610.86	End Longitude:	144°3'44.316"E
End Northing:	5458110.3	End Latitude:	40°59'15.083"S
Azimuth/Bearing:	58.4439		
Distance:	41200 m		
2D Line Name:	SS02-23	LSP:	2859
FSP:	1001		
Segment: 1			
Start Easting:	726054.02	Start Longitude:	143°41'52.220"E
Start Northing:	5430303.0	Start Latitude:	41°14'49.517"S
End Easting:	766358.14	End Longitude:	144°10'05.383"E
End Northing:	5453426.21	End Latitude:	41°1'36.646"S
Azimuth/Bearing:	58.3808		
Distance:	46450 m		

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2D Line Name: SS02-25  
FSP: 1001 LSP: 2777  
Segment: 1  
Start Easting: 727672.02 Start Longitude: 143°43'05.466"E  
Start Northing: 5427471.95 Start Latitude: 41°16'19.585"S  
End Easting: 766189.7 End Longitude: 144°10'04.145"E  
End Northing: 5449588.38 End Latitude: 41°3'41.112"S  
Azimuth/Bearing: 58.346  
Distance: 44400 m

2D Line Name: SS02-27  
FSP: 1001 LSP: 2288  
Segment: 1  
Start Easting: 737625.99 Start Longitude: 143°50'15.104"E  
Start Northing: 5425831.02 Start Latitude: 41°17'02.414"S  
End Easting: 765909.79 End Longitude: 144°10'05.236"E  
End Northing: 5441194.78 End Latitude: 41°8'13.222"S  
Azimuth/Bearing: 59.6188  
Distance: 32175 m

2D Line Name: SS02-29  
FSP: 1001 LSP: 2320  
Segment: 1  
Start Easting: 739679.04 Start Longitude: 143°51'46.620"E  
Start Northing: 5423457.03 Start Latitude: 41°18'17.118"S  
End Easting: 768909.98 End Longitude: 144°12'17.590"E  
End Northing: 5438746.34 End Latitude: 41°9'28.940"S  
Azimuth/Bearing: 60.5001  
Distance: 32975 m

2D Line Name: SS02-31  
FSP: 1001 LSP: 2356  
Segment: 1  
Start Easting: 742004.98 Start Longitude: 143°53'33.832"E  
Start Northing: 5418354.0 Start Latitude: 41°20'59.888"S  
End Easting: 772603.55 End Longitude: 144°15'05.155"E  
End Northing: 5432921.02 End Latitude: 41°12'33.106"S  
Azimuth/Bearing: 62.6329  
Distance: 33875 m

2D Line Name: SS02-33  
FSP: 1001 LSP: 2294  
Segment: 1  
Start Easting: 744310.98 Start Longitude: 143°55'15.568"E  
Start Northing: 5416539.98 Start Latitude: 41°21'56.131"S  
End Easting: 773739.15 End Longitude: 144°15'58.633"E  
End Northing: 5429948.34 End Latitude: 41°14'07.969"S  
Azimuth/Bearing: 63.5757  
Distance: 32325 m

2D Line Name: SS02-35  
FSP: 1001 LSP: 2284  
Segment: 1  
Start Easting: 746026.97 Start Longitude: 143°56'32.586"E  
Start Northing: 5414312.99 Start Latitude: 41°23'06.371"S  
End Easting: 775399.05 End Longitude: 144°17'14.230"E  
End Northing: 5427235.42 End Latitude: 41°15'33.772"S  
Azimuth/Bearing: 64.3088  
Distance: 32075 m

## Section 1: General Information

2D Line Name:	SS02-37	LSP:	2267
FSP:	1001		
Segment: 1			
Start Easting:	747857.02	Start Longitude:	143°57'54.472"E
Start Northing:	5412143.97	Start Latitude:	41°24'14.591"S
End Easting:	777014.99	End Longitude:	144°18'28.048"E
End Northing:	5424490.32	End Latitude:	41°17'00.654"S
Azimuth/Bearing:	65.0909		
Distance:	31650 m		

2D Line Name:	SS02-39	LSP:	2274
FSP:	1001		
Segment: 1			
Start Easting:	750711.0	Start Longitude:	144°00'05.008"E
Start Northing:	5406927.03	Start Latitude:	41°27'00.346"S
End Easting:	780167.01	End Longitude:	144°20'52.397"E
End Northing:	5419015.24	End Latitude:	41°19'53.983"S
Azimuth/Bearing:	65.702		
Distance:	31825 m		

2D Line Name:	SS02-41	LSP:	1825
FSP:	1001		
Segment: 1			
Start Easting:	752750.98	Start Longitude:	144°1'36.084"E
Start Northing:	5404752.97	Start Latitude:	41°28'08.443"S
End Easting:	771834.02	End Longitude:	144°15'04.932"E
End Northing:	5412536.09	End Latitude:	41°23'34.015"S
Azimuth/Bearing:	65.8076		
Distance:	20600 m		

**Total 2D Line Length: 1149.25 km**

Section 1: General Information

5 Contract Work Order

		<b>CONTRACT WORK ORDER</b>
<b>GENERAL</b>		
<b>CONTRACT</b>		
Client:	Santos	
Vessel(s):	Polar Duke	
Job number:	6151	
Bid number:		
Client contract number/ref:		
Location:	Sorell Basin Blocks T/32P and T/33P	
Area:	W. Tasmania	
Type of survey:	2D	
Area, or total kms:	1150 km	
Line heading:	Various	
Number of lines:	29 lines	
Line length:	Various	
Acquisition method:	Single streamer / single source	
Estimated start date:	16th December 2002	
Estimated duration:	7-10 days	
QHSE checklists completed		
<b>STREAMER</b>		
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	7 m +/- 1 m Allowed deeper in poor swell conditions.	
Water Depth	100-3000m	
<b>RECORDING</b>		
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 reqd?	No	
<b>SOURCE</b>		
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

## Section 1: General Information

	<b>CONTRACT WORK ORDER</b>
<b>NAVIGATION</b>	<b>Side 1</b>
<b>Geodetic Parameters</b>	
Spheroid	GRS 80
Semi-Major Axis	6378137
Inverse Flattening	298.2572221
Work Datum	GDA 94
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°
<b>Datum Transformation Test-Coordinate</b>	
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.	-
<b>Geoidal Height</b>	
Location of Prospect Centre: Lat	4 different areas, see audit folder
Location of Prospect Centre: Lon.	
Source of Geoidal Height Data	
<b>Navigation System</b>	
Navigation/QC System	SPECTRA
<b>Vessel Positioning Systems</b>	
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

## Section 1: General Information

	<b>CONTRACT WORK ORDER</b>	
<b>NAVIGATION</b>		<b>Side 2</b>
<b>Streamer / Source Positioning Systems</b>		
Tailbuoy positioning	rGPS	
Streamer positioning	compasses recorded	
Source Positioning	rGPS	
<b>Line and Shot Point Numbering</b>		
Line Name Format:	Prefixes SS02- 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	-	
<b>Line and Shot Point Geometry</b>		
Shot Fire Interval	37.5m	
Receiver Group Interval	12.5 m	
Run out	104 shots	
Number of Streamers	1	
Acquisition Geometry Type	single/single	
Offset CS - CFG	140 m	
<b>Water Depth Processing</b>		
Echosounder standard settings	VP=1500ms <sup>-1</sup> , draft=0	
Vertical datum	MSL	
Tidal corrections		
Tidal correction source		
Echosounder frequency	12 kHz	
Power output	More than 1kW	
Sea depth	More than 6000m	
<b>Gravity and Magnetics</b>		
Gravity Meter Type	n/a	
Gravity Recording Interval	n/a	
Interface to Navigation systems	n/a	
Interface to Echosounder	n/a	
Gravity Sub-Contractor	n/a	
Magnetometer Type	n/a	
Magnetometer Recording Interval	n/a	
Magnetometer Sub-Contractor	n/a	
Tape Media	n/a	
UKOOA P1/90 required	n/a	
Delivery Address		
<b>Sub Bottom Profiler</b>		
SBP Type	n/a	
SBP Sub-Contractor	n/a	
Frequency	n/a	
Transmitter Power	n/a	
Sea depth	n/a	
Notes:		
Signed:	Navigation Manager	





## 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	Demultiplexed		
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	

## Section 1: General Information

### 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 hydrographical 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

## Section 1: General Information

### 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

### Icegoing

DnV "Sealer class", hull strength as icebreaker.  
Proven icegoing 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.

## Section 2: Operation Summary

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## Section 2: Operation Summary

### 1 List of Key Personnel

#### 1.1 Onboard Personnel

POSITION	CREW 1	CREW 2
Party chief	John Hennessey	
Captain	Peter Brandal	
Chief Engineer	Anders Fosse	
Chief Observer	Bjorn-Erik Melum	
Chief Navigator	Leif Olav Saetenes	
Chief Mechanic	Gary Herritt	
QC leader	Adam Gebarski	
Client Representative	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 79
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

## Section 2: Operation Summary

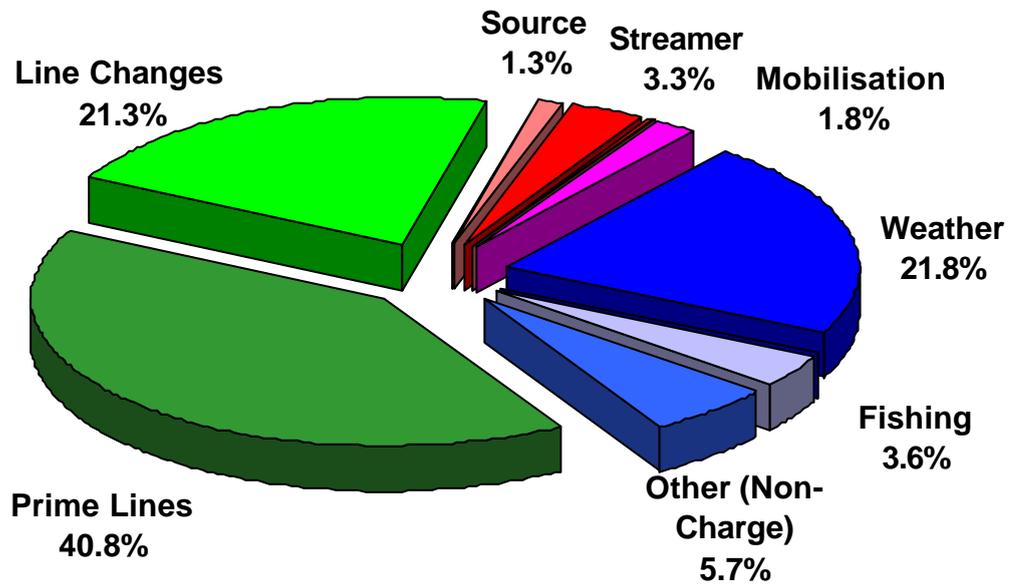
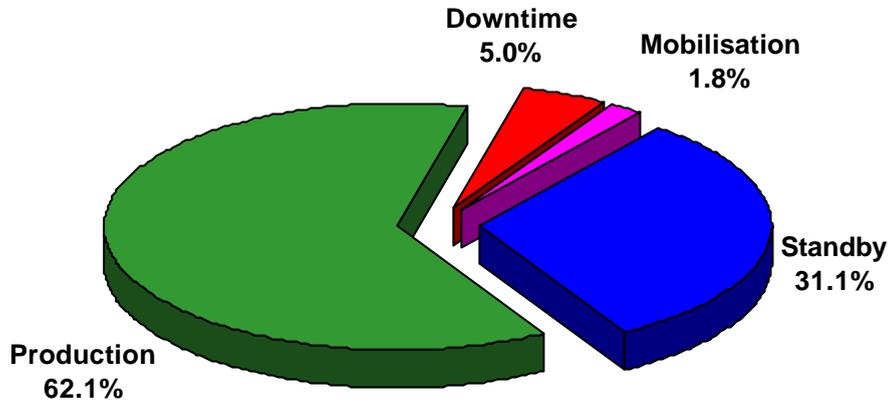
### 2 Field Information and Observations

#### 2.1 Timing Summary

VESSEL		<i>M/V Polar Duke</i>		<b>TIMING SUMMARY</b>																
AREA		<i>SS02</i>																		
JOB No's.		<i>6151</i>																		
CLIENT		<i>Santos - Australia</i>																		
	OPERATIONAL		TECHNICAL DOWN TIME						STAND BY (external downtime)						PRODUCTION			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	Meeting & Drills	
16.Dec	3.37									20.63						24.00	29.5875	4.74		
17.Dec	15.00	9.00														24.00	117.1500	4.22		
18.Dec	9.74	5.56			4.66									4.04		24.00	80.9625	4.49		
19.Dec	15.20	8.70				0.10										24.00	124.9875	4.44		
20.Dec	10.69	8.93												4.38		24.00	87.8625	4.44		
21.Dec	14.95	9.05														24.00	119.5125	4.32		
22.Dec	3.42	2.15									18.43					24.00	21.0375	3.32		
23.Dec											24.00					24.00				
24.Dec	17.48	2.42									4.10					24.00	145.8750	4.51		
25.Dec	0.60	3.80									19.60					24.00	1.5375	1.38		
26.Dec	9.01	2.72									12.27					24.00	70.0875	4.20		
27.Dec	8.50	3.73				11.77										24.00	53.0625	3.37		
28.Dec	15.76	8.24														24.00	119.2875	4.09		
29.Dec	13.44	9.18						1.38								24.00	96.2625	3.87		
30.Dec	9.82	3.12							6.43					4.63		24.00	75.8635	4.17		
31.Dec																0.00				
01.Jan																0.00				
Wk 51	72.37	43.39	0.00	0.00	4.66	0.10	0.00	0.00	0.00	20.63	18.43	0.00	0.00	8.42	0.00	168.00	581.10	4.28	0.00	
Wk 52	51.35	20.91	0.00	0.00	0.00	11.77	0.00	0.00	0.00	0.00	59.97	0.00	0.00	0.00	0.00	144.00	410.89	3.48	0.00	
Wk 1	23.26	12.30	0.00	0.00	0.00	0.00	0.00	1.38	6.43	0.00	0.00	0.00	0.00	4.63	0.00	48.00	172.13	4.02	0.00	
	Lines	Changes	Instr.	Nav.	Mech.	Streamer	Towing	Maritime	Demob	Transit	Weather	Change	Interfer.	Fishing	Other	Hours	Line Km	Speed	Drills	
Total	146.98	76.60	0.00	0.00	4.66	11.87	0.00	1.38	6.43	20.63	78.40	0.00	0.00	13.05	0.00	360.00	1143.0760	3.93	0.00	
	<b>223.58</b>		<b>17.91</b>						<b>27.06</b>			<b>91.45</b>								

## Section 2: Operation Summary

### 2.2 Timing Summary - Graphical



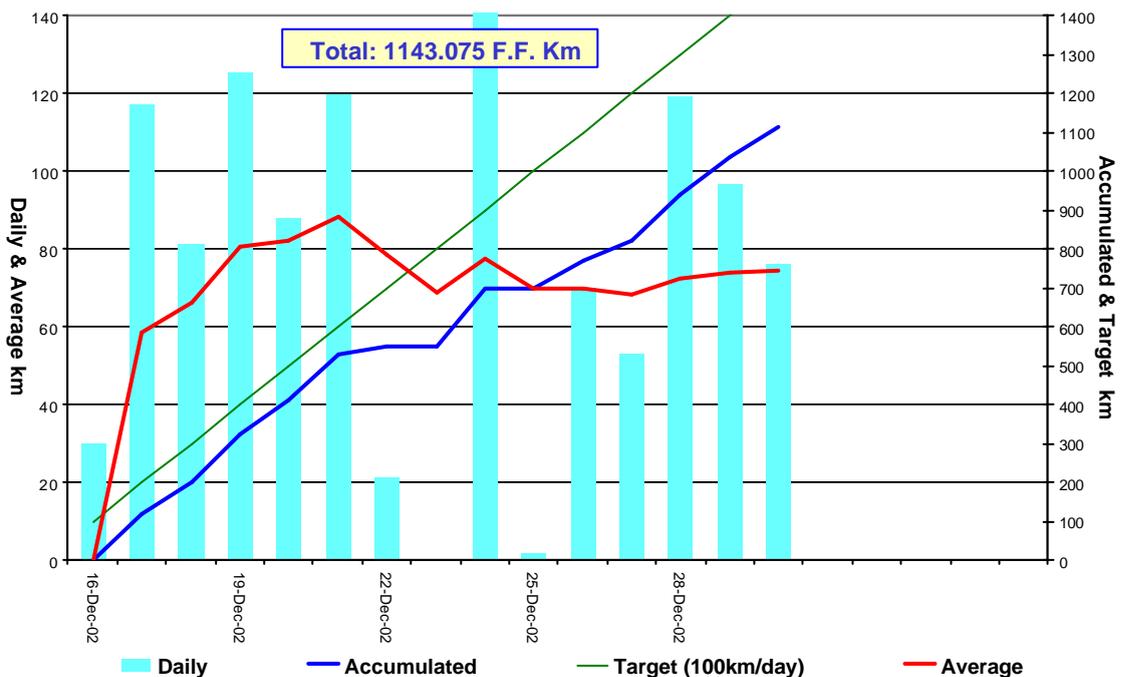
## Section 2: Operation Summary

**Hours**  
**360**

**Percent**  
**100%**

147.0	Prime Lines	40.8%
76.6	Line Changes	21.3%
0.0	Instruments	0.0%
0.0	Navigation	0.0%
4.7	Source	1.3%
11.9	Streamer	3.3%
1.4	Maritime	0.4%
0.0	Crew Change	0.0%
6.4	Mobilisation	1.8%
78.4	Weather	21.8%
0.0	Seismic Interference	0.0%
13.1	Fishing	3.6%
20.6	Other	5.7%
223.6	Production	62.1%
17.9	Downtime	5.0%
6.4	Mobilisation	1.8%
112.1	Standby	31.1%

### 2.3 Production Statistics - Graphical



## Section 2: Operation Summary

### 2.4 Production Log

Seq	Line	Dir	Start Date	First SP	Last SP	Shots	Km's	Notes
001	SS02-01	056	16/12	1001	1961	961	36.0375	Line complete
001	SS02-01	056	16/12	1962	2065	104	3.9000	Full-fold run-out shots
002	SS02-03	238	17/12	1999	1001	999	37.4625	Line complete
002	SS02-03	238	17/12	1000	897	104	3.9000	Full-fold run-out shots
003	SS02-05	058	17/12	1001	2033	1033	38.7375	Line complete
003	SS02-05	058	17/12	2034	2137	104	3.9000	Full-fold run-out shots
004	SS02-07	238	17/12	1920	1001	920	34.5000	Line complete
004	SS02-07	238	17/12	1000	897	104	3.9000	Full-fold run-out shots
005	SS02-09	058	18/12	1001	2001	1002	37.5750	Line complete
005	SS02-09	058	18/12	2003	2106	104	3.9000	Full-fold run-out shots
006	SS02-11	238	18/12	2020	1726	295	11.0625	Line aborted d.t. sudden appearance of WHALES
007	SS02-11	238	18/12	1830	1726	105		Over-Lap
007	SS02-11	238	18/12	1725	1168	558	20.9250	Line aborted d.t. source air leak
008	SS02-11	238	18/12	1273	1168	106		Over-Lap
008	SS02-11	238	18/12	1167	1001	167	6.2625	Line complete
008	SS02-11	238	18/12	1000	897	104	3.9000	Full-fold run-out shots
009	SS02-13	058	19/12	1001	1926	926	34.7250	Line complete
009	SS02-13	058	19/12	1927	2030	104	3.9000	Full-fold run-out shots
010	SS02-15	238	19/12	2342	1001	1342	50.3250	Line complete
010	SS02-15	238	19/12	1000	897	104	3.9000	Full-fold run-out shots
011	SS02-17	058	19/12	1001	2202	1202	45.0750	Line complete
011	SS02-17	058	19/12	2203	2306	104	3.9000	Full-fold run-out shots
012	SS02-08	333	20/12	2447	1001	1447	54.2625	Line complete
012	SS02-08	333	20/12	1000	897	104	3.9000	Full-fold run-out shots
013	SS02-06	152	20/12	1001	1672	672	25.2000	Line complete
013	SS02-06	152	20/12	1673	1776	104	3.9000	Full-fold run-out shots
014	SS02-02	333	20/12	1660	1001	660	24.7500	Line complete
014	SS02-02	333	21/12	1000	897	104	3.9000	Full-fold run-out shots
015	SS02-04	152	21/12	1001	2128	1128	42.3000	Line complete
015	SS02-04	152	21/12	2129	2232	104	3.9000	Full-fold run-out shots
016	SS02-19	058	21/12	1001	2084	1084	40.6500	Line complete
016	SS02-19	058	21/12	2085	2188	104	3.9000	Full-fold run-out shots

## Section 2: Operation Summary

Seq	Line	Dir	Start Date	First SP	Last SP	Shots	Km's	Notes
017	SS02-21	238	21/12	2100	1001	1100	41.2500	Line complete
017	SS02-21	238	22/12	1000	897	104	3.9000	Full-fold run-out shots
018	SS02-10	147	24/12	1001	3049	2049	76.8375	Line complete
018	SS02-10	147	24/12	3050	3153	104	3.9000	Full-fold run-out shots
019	SS02-12	328	24/12	2882	1001	1882	70.5750	Line complete
019	SS02-12	328	25/12	1000	897	104	3.9000	Full-fold run-out shots
020	SS02-23	238	26/12	2240	1001	1240	46.5000	Line complete
020	SS02-23	238	26/12	1000	897	104	3.9000	Full-fold run-out shots
021	SS02-25	058	26/12	1001	2010	1010	37.8750	Line aborted d.t. streamer telemetry problems
022	SS02-25	058	27/12	1905	2010	106		Over-Lap
022	SS02-25	058	27/12	2011	2185	175	6.5625	Line complete
022	SS02-25	058	27/12	2186	2289	104	3.9000	Full-fold run-out shots
023	<b>NTBP</b>							Line aborted and scratched d.t. streamer telemetry problems
024	SS02-27	238	27/12	1859	1001	859	32.2125	Line complete
024	SS02-27	238	27/12	1000	897	104	3.9000	Full-fold run-out shots
025	SS02-29	060	28/12	1001	1880	880	33.0000	Line complete
025	SS02-29	060	28/12	1881	1984	104	3.9000	Full-fold run-out shots
026	SS02-31	242	28/12	1904	1001	904	33.9000	Line complete
026	SS02-31	242	28/12	1000	897	104	3.9000	Full-fold run-out shots
027	SS02-33	064	28/12	1001	1863	863	32.3625	Line complete
027	SS02-33	064	28/12	1864	1967	104	3.9000	Full-fold run-out shots
028	SS02-35	244	28/12	1856	1001	856	32.0900	Line complete
028	SS02-35	244	29/12	1000	897	104	3.9000	Full-fold run-out shots
029	SS02-37	064	29/12	1001	1845	845	31.6875	Line complete
029	SS02-37	064	29/12	1846	1949	104	3.9000	Full-fold run-out shots
030	SS02-39	245	29/12	1850	1001	850	31.8750	Line complete
030	SS02-39	245	29/12	1000	897	104	3.9000	Full-fold run-out shots
031	SS02-41	065	29/12	1001	1550	550	20.6250	Line complete
031	SS02-41	065	29/12	1551	1654	104	3.9000	Full-fold run-out shots
032	SS02-16	328	30/12	2123	1001	1123	42.1125	Line complete
032	SS02-16	328	30/12	1000	897	104	3.9000	Full-fold run-out shots
033	<b>NTBP</b>							Line aborted and scratched d.t. appearance of WHALES
034	SS02-14	151	30/12	1001	1900	900	33.7500	Line complete
034	SS02-14	151	30/12	1901	2004	104	3.9000	Full-fold run-out shots

## Section 2: Operation Summary

### 2.5 Daily Summary

#### Monday 16<sup>th</sup> December 2002

The day began with the vessel engaged in the recovery of streamer prior to its transit from the Otway Basin survey area (OS02) to the Sorell Basin survey area (SS02). Streamer was recovered with subsequent transit at full speed to the vicinity of the nearest lines, at which time the streamer was redeployed. Production commenced at 20:38 hrs local on Line SS02-01-001 and continued uninterrupted through to midnight.

#### Tuesday 17<sup>th</sup> December 2002

The day commenced with the vessel engaged in production on Line SS02-01-001. This line was shot through to completion and followed by a standard line change. This routine was repeated for lines SS02-03-002; SS02-05-003 and SS02-07-004. Note: Due to a recording system hangup at start of Line SS02-07-004 the first 47 shots were not recorded to tape (i.e.: SP's 1967-1921): this line is considered to be "Complete".

#### Wednesday 18<sup>th</sup> December 2002

The day began with the vessel on line change to Line SS02-09-005. Production commenced on this line and continued through to its end without problems, followed by a standard line change. Production then began on Line SS02-11-006 but the line was terminated part way due to the sudden appearance of a pod of whales. Production later resumed (line SS02-11-007) but the line was again terminated - only this time due to a massive air leak on the starboard outer gun umbilical. After circling for repairs line SS02-11-008 was finally shot through to its conclusion. A standard line change was followed by the resumption of production on Line SS02-13-009, which continued through until midnight.

#### Thursday 19<sup>th</sup> December 2002

The day began with the vessel engaged in production on Line SS02-13-009. The line was terminated prematurely due to streamer telemetry errors – line is considered "Complete" pending client approval. Lines SS02-15-010 and SS02-17-011 were subsequently shot from start to finish without incident. The day ended with the vessel on a long line change to line SS02-18-012 (the first of the lines oriented from S.E. to N.W.)

#### Friday 20<sup>th</sup> December 2002

The day began with the vessel on line change to Line SS02-08-012. Production commenced on this line and continued through to its end without problems, followed by a standard line change. Production then began on Line SS02-06-013 which also continued to its completion, followed by a line change. On the run-in to the next line a whale sighting just before commencement forced the vessel to circle for another attempt. During this second attempt a further sighting of more whales precipitated the decision to head for another line rather than circle and try the same line again. Production commenced on line SS02-02-014 at 23:03 Hrs local and continued unhindered through to midnight.

N.P. Client has confirmed acceptance of Lines SS02-07-004 as well as SS02-13-009 as "Complete / Process".

## Section 2: Operation Summary

### **Saturday 21<sup>st</sup> December 2002**

The day began with the vessel in production on Line SS02-02-014 which continued through to its end without problems, followed by a standard line change. Lines SS02-04-015 and SS02-19-016 were subsequently shot from start to finish without incident. The day ended with the vessel in production on Line SS02-21-017 through to midnight. Sea conditions had begun to deteriorate slightly by the end of the day, exhibiting mild swell noise breakout on the camera records.

### **Sunday 22<sup>nd</sup> December 2002**

The day commenced with the vessel in production on Line SS02-21-017 which continued through to its end as sea conditions continued to deteriorate. This was followed by a standard line change but before the line change was completed the sea conditions had worsened to the point where it was necessary to recover the guns (to avoid damage or loss) and steer into the sea with streamer deployed until necessary to turn the vessel. The day ended with the vessel jogging back and forth across the prospect block awaiting an improvement in sea conditions.

### **Monday 23<sup>rd</sup> December 2002**

The day began with the vessel still down for weather. Just after midday the sea conditions had moderated enough to retrieve the front end of the streamer for some required maintenance (during the weather downtime the heavy seas had dislodged Bird # 20 from its collars and broken the Safety lanyard, losing the bird). This included replacing Bird # 20 and replacing two patches which were in poor shape. By midnight the seas had continued to settle enough that shooting would be possible in the trough directions and deployment of source arrays began.

### **Tuesday 24<sup>th</sup> December 2002**

The day commenced with the vessel still down for weather. However, sea conditions had moderated to the point where the source arrays could be deployed and production began on those lines in the trough direction only. Line SS02-10-018 began and was shot through to completion with acceptable levels of swell noise breakout. Following a line change Line SS02-12-019 commenced and again continued uninterrupted through to midnight.

### **Wednesday 25<sup>th</sup> December 2002**

The day began with the vessel in production on Line SS02-12-019 which continued through to its end as sea conditions continued to deteriorate. This was followed by a standard line change but on the run-in to the next line the attempt was aborted when streamer control was lost and the cable floated to the surface. A later attempt in an alternate line direction was also aborted due to excessive swell noise breakout, etc. The day ended with the vessel awaiting improvement in weather.

### **Thursday 26<sup>th</sup> December 2002**

The day commenced with the vessel still down for weather. However, the seas began to moderate and continued to improve to the point where production began on Line SS02-23-020 at 1216 Hours local and continued through to the conclusion of the line.

## Section 2: Operation Summary

Following a regular line change production commenced on Line SS02-25-021 which continued through to midnight. Swell noise breakout was visible on both lines at an acceptable level, and continued to improve as the day progressed.

### Friday 27<sup>th</sup> December 2002

The day began with the vessel in production on Line SS02-25-021 which was terminated due to streamer telemetry problems. The vessel circled while crew attempted to troubleshoot the problem and production resumed on SS02-25-022 and continued to the line conclusion. Following a standard line change production started on SS02-27-023 but was aborted shortly after the start due to further streamer telemetry errors. This entire line was deemed as "Non-processable" or NTBP. Once again the vessel circled while several adjustments were made to the towing position (and offset) to inhibit further streamer errors. Production began on SS02-27-024 and continued without problems through to midnight.

Note: All lines from sequence no. 024 onwards were acquired with a slightly shorter offset (changed from 140 metres to 125 metres).

### Saturday 28<sup>th</sup> December 2002

The day began with the vessel on line change to Line SS02-29-025. Production commenced on this line and continued through to its end without problems, followed by a standard line change. This was repeated for Lines SS02-31-026 and SS02-33-027 which also continued to their completion. The day ended with the vessel in production on Line SS02-35-028 up until midnight.

### Sunday 29<sup>th</sup> December 2002

The day began with the vessel in production on Line SS02-35-028 which continued through to its end without problems, followed by a standard line change. This was repeated for Lines SS02-37-029 and SS02-39-030 which also continued to their completion. However, the line change after Line SS02-39-030 was extended slightly to allow repairs to a broken sea-water cooling pipe for the compressor system. Production was resumed on Line SS02-41-031 and also progressed to completion without difficulty. The day finished with the vessel on line change.

### Monday 30<sup>th</sup> December 2002

The day began with the vessel on line change to Line SS02-16-032. Production commenced on this line and continued through to its end without problems, followed by a standard line change. Production commenced again on Line SS02-14-033 but was terminated after a short period due to the appearance of whales in close proximity. This entire line sequence was considered to be non-processable (NTBP). The vessel circled for another attempt and Line SS02-14-034 was shot through to conclusion without any difficulties.

The day ended with the vessel engaged in the retrieval of the streamer prior to its transit to the next survey in Gippsland.

## 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 range from 100-3000 m. There were no known physical obstructions. The dip lines ended in shallower water.

### 2.6.2 Traffic / Shipping Lanes

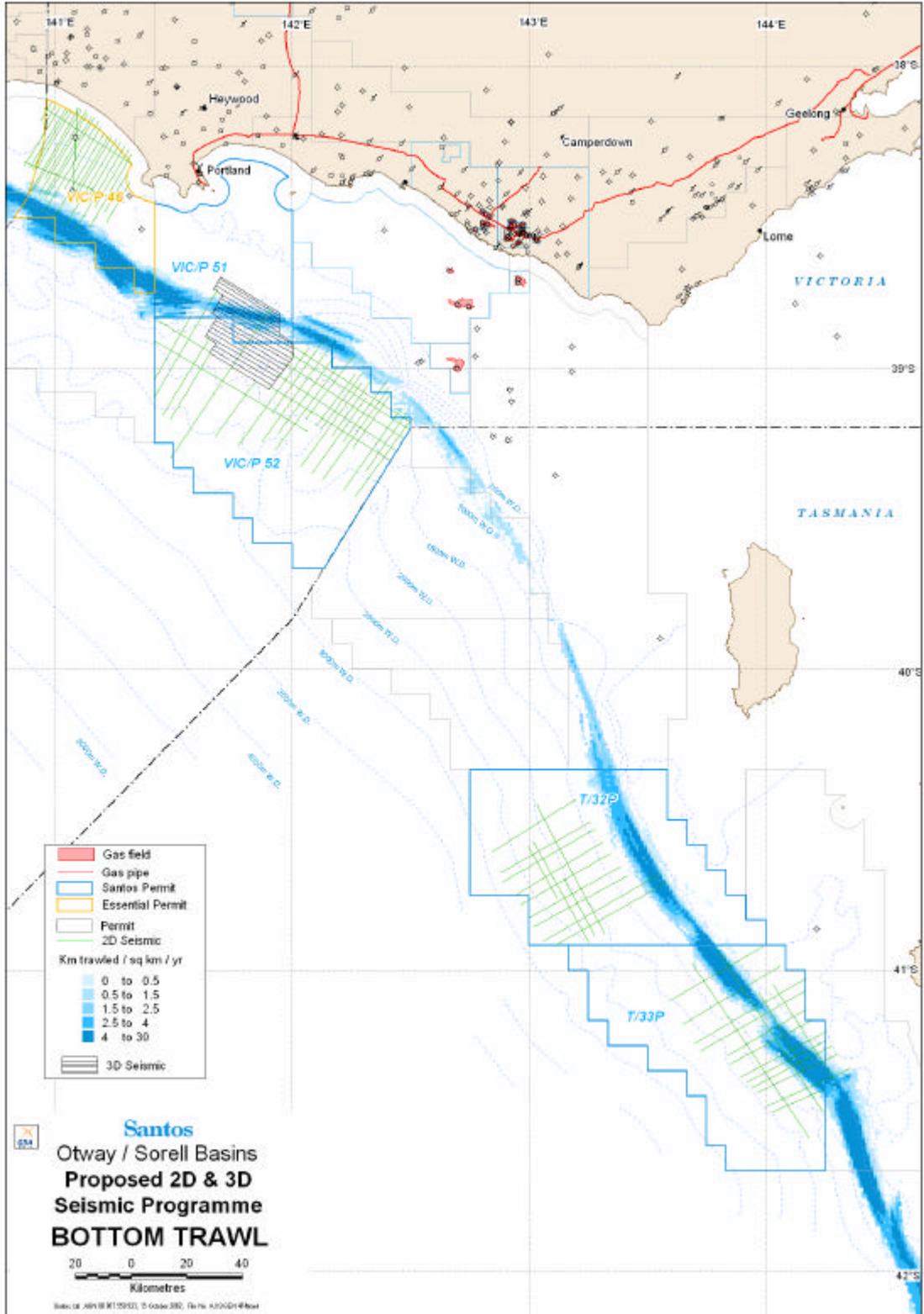
There were no designated shipping lanes in the prospect area. Any shipping encountered responded quickly to the VHF radio and there were no problems at all.

### 2.6.3 Fishing Activity

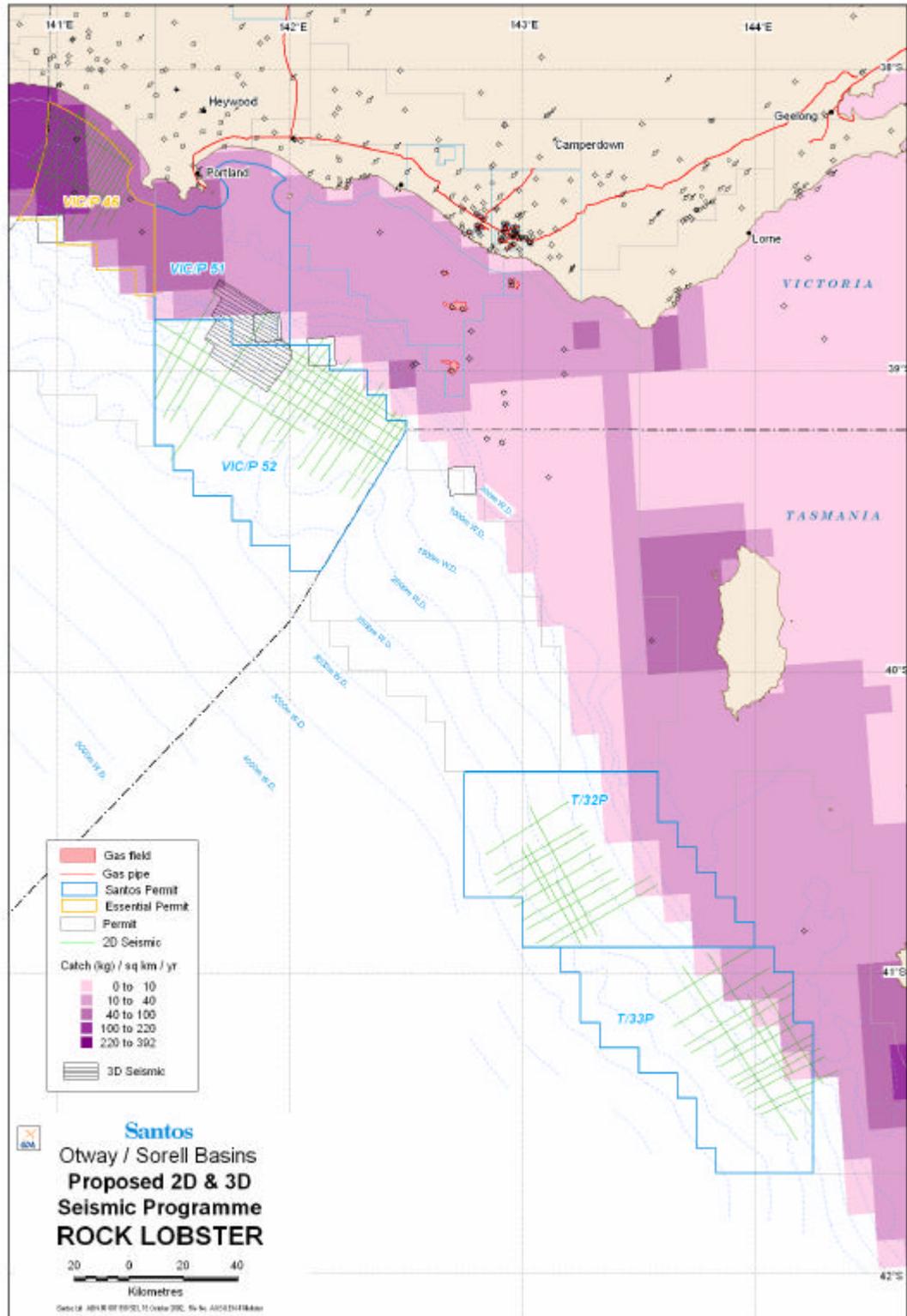
Fishing activity in the northern prospect area (Block T/32P) was non-existent. Some small boats, using static buoyed pots for crab and lobster fishing, worked inside of the 200m-depth contour and were encountered on the southern block (Block T/33P). In addition a small number of local trawlers operated along the eastern boundary of the southern block. Santos had prepared the prospect well in advance, and there was very good cooperation with the fishing fleets. A local fishing vessel, the **Edward J. Farnie**, accompanied the **Polar Duke** during this survey and was a great help in scouting and relocating obstructions ahead, as well as liasing with local fishermen.

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

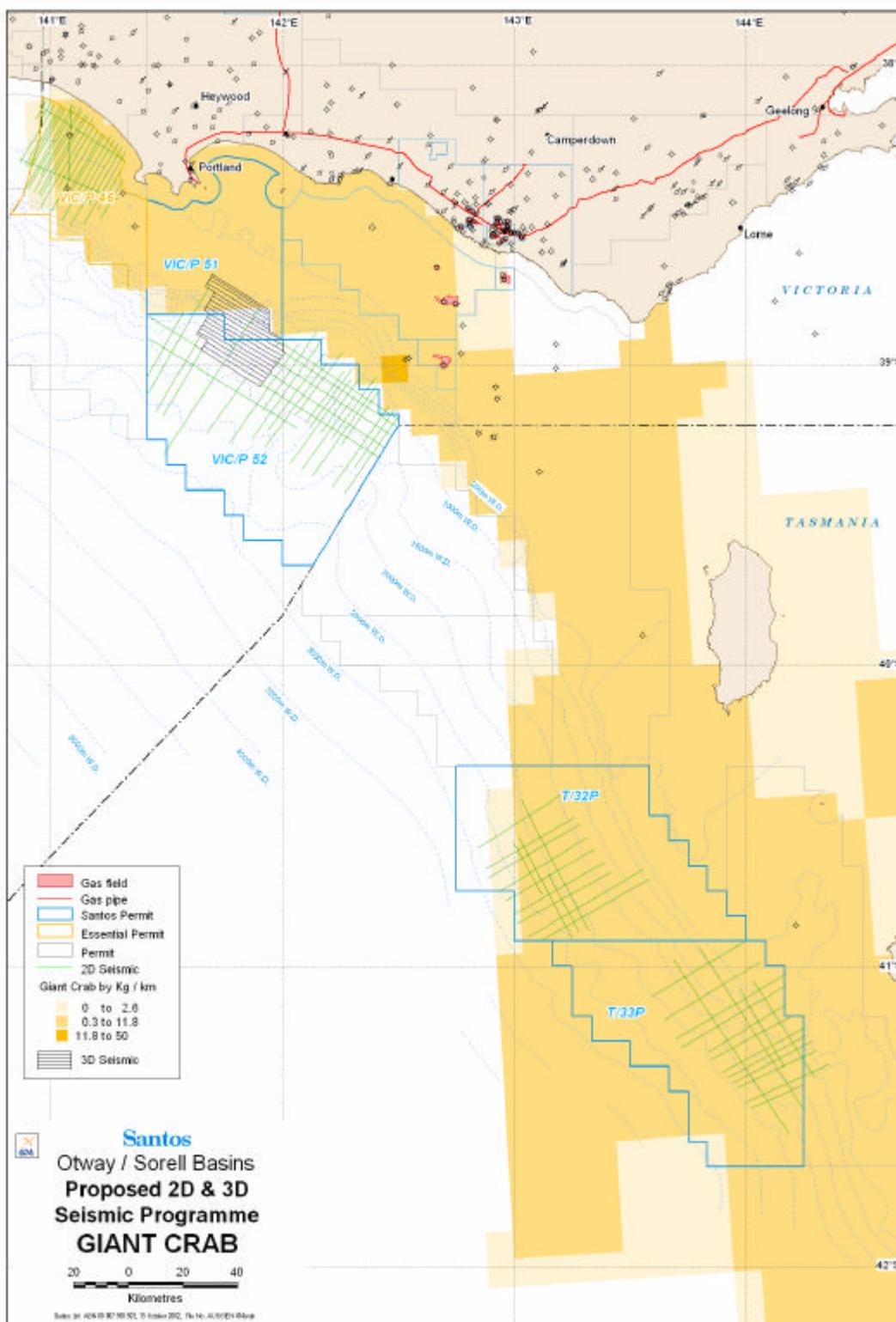
## Section 2: Operation Summary



## Section 2: Operation Summary



## Section 2: Operation Summary



## Section 2: Operation Summary

### 2.6.4 Seismic Interference and Time Share

No seismic interference was encountered on this prospect and subsequently there was no need for time sharing operations with any other vessels.

### 2.6.5 Environmental Obstacles

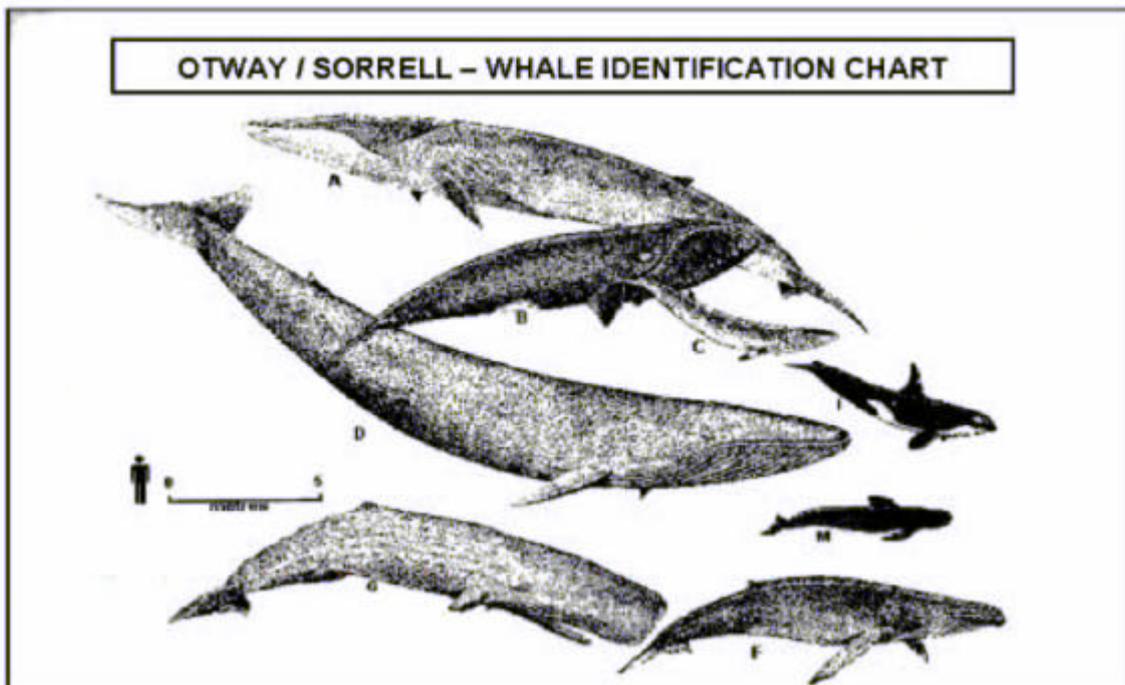
The survey area is strongly affected by oceanic swells from the SW. Large, long period swells usually preceded active weather systems, and their effect remained for up to several days after the storm system dissipated.

### 2.6.6 Operational Observations

Daily production rates were good during calmer weather periods. The strike lines on the prospect (which were oriented perpendicular to the prevailing swell direction) provided some opportunity for production when sea and swell conditions began to build from the south-west, although some downtime was encountered when production was simply not possible due to the severity of the sea conditions.

### 2.6.7 Cetacean Activity

The survey area appears to be in an area of moderate whale activity. Standard company precautions were taken to minimise any disturbance, as set out in the flow diagram below.



## Section 2: Operation Summary

### **FIN WHALE (A)**

24m long; triangular 0.5m dorsal fin set well back near the tail; series of folds or pleats under the throat; short, flat head; small mouth with shorter baleen; sharp ridge down the back; colouring asymmetrical - right side of lower jaw is white, left side is dark, tongue and baleen are also bicoloured; fast swimmers.

### **SOUTHERN RIGHT WHALE (B)**

Usually found close to shore; seen "sailing" by holding their tails at right angles to the wind; breaching; 15m long; newborn calves up to 6m long; very large head and robust body; long turned-down mouth and long baleen plates between the jaws; large white bumps or collosities on the top of the head and below the jaws which form a different pattern for each individual; no dorsal fin; twin blowholes producing an easily identifiable "V" shaped spout; black colour.

### **MINKE WHALE (C)**

Triangular, high and curved dorsal fin, set well back near the tail; series of folds or pleats under the throat; short, flat head, small mouth with less baleen which is yellowish/white fringed; fast swimmers; 6m long; blue-grey above and white below; distinctive white patch on the outer side of each flipper; pointed snout; small schools.

### **BLUE WHALE (D)**

30m long, females slightly longer than males; gigantic head a quarter of total length; streamlined body; column-like spout 10m high; solitary and easily frightened; slate-blue above and lighter below, underside is often yellowish due to growths of distoms on the pleated or grooved undersurface (100 or more pleats); small triangular dorsal fin set well back near the tail.

### **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)**

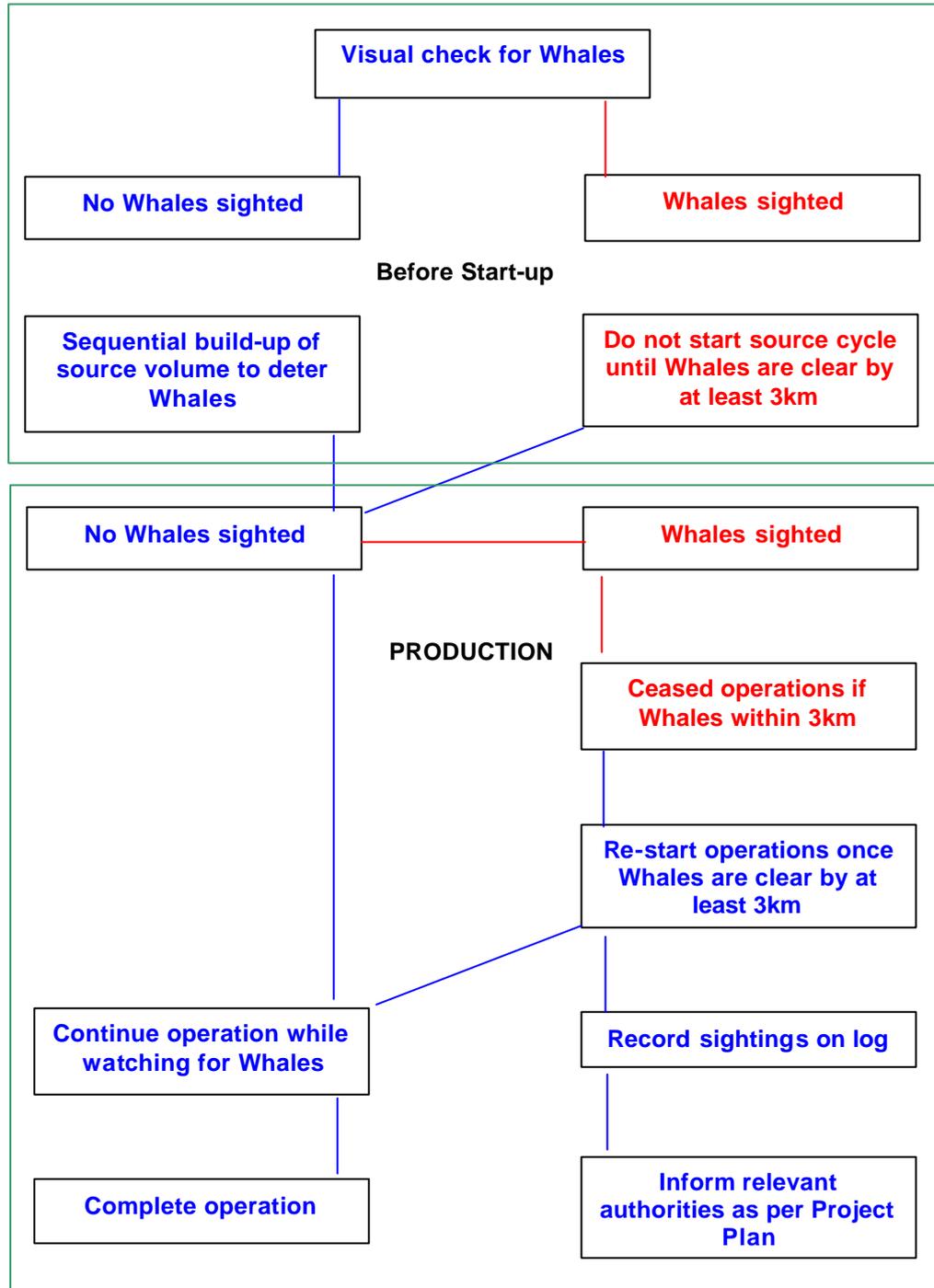
Predator which travels in packs; can "stand" on its tail sticking its head out of the water; 10m long (females a third smaller); very large dorsal fin - 2m; flippers are blunt; flukes are very broad; black colour with lens-shaped white spot behind each eye and patches of white under the chin, on the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

### **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 slim and melon-like bulge; travel in schools.

## Section 2: Operation Summary

### Cetacean Encounter Procedure



## Section 2: Operation Summary

### 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 any HSE activities in chronological order during this short survey period.

Date	Action	Hours	Number of crew
18 Dec	Boat-to-boat transfer of a crew member and Supplies initiated. Toolbox meetings held prior.	0.5	10
19 Dec	Safety Induction tour of vessel for new crewman.	0.5	2
23 Dec	Abandon Ship drill held for crew. Drill included the inspection and donning of lifejackets and Immersion suits.	0.5	28
29 Dec	SOLAS Emergency Equipment Training session was held for entire crew.	0.5	29

There were no Near Misses, Incidents or cases requiring medical treatment during the survey period.

## Section 2: Operation Summary

### 4 Shipment List

PI Number	Description	Shipped to	Department	Date shipped	Shipped from
<a href="#">PD-2002-106</a>	<a href="#">NAV Data Santos SS02 Sorell Basin, Tasmania</a>	WesternGeco Perth	NAV	10-Jan-03	Eden, Vic.
<a href="#">PD-2002-107</a>	<a href="#">NAV Data Santos SS02 Sorell Basin, Tasmania</a>	MGC, Bergen	NAV	10-Jan-03	Eden, Vic.
<a href="#">PD-2002-108</a>	<a href="#">Processing Plots &amp; Stack Tapes Job 6151 OS02/SS02</a>	Robertson Perth	PROC	10-Jan-03	Eden, Vic.
<a href="#">PD-2002-109</a>	<a href="#">Promax Backups: OEP02/OS02/SS02/GBS02/GS02</a>	MGC, Bergen	PROC	10-Jan-03	Eden, Vic.
<a href="#">PD-2002-110</a>	<a href="#">Seismic Data Job 6151 SS02 Santos Original</a>	WesternGeco Perth	INS	10-Jan-03	Eden, Vic.
<a href="#">PD-2002-111</a>	<a href="#">Seismic Data Job 6151 SS02 Santos Copy</a>	Santos, Adelaide	INS	10-Jan-03	Eden, Vic.

## Section 2: Operation Summary

### 4.1 Seismic Data

#### Original Tapes



PD-2002-110

31/ 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:**  
 WesternGeco  
 Level 5, 256 St. Georges Terrace,  
 Perth,  
 Western Australia 6000  
**Attention: Lawrence Cho**

**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. 250-279	3	\$700
2	2	n/a	Box containing 33 seismic Data Cartridges Reel Nos. 280-312	3	\$700
3	3	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, syntrak printouts and Daily QC Test		
			<b>*** Santos Sorell Basin SS02 Survey : Line Sequences No. 001 - 034 ***</b>		

Total weight: 8 kg  
 Total value: \$1,400.00

Total boxes: 3

**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 Shipment Addresses**

### **Original Tapes:**

WesternGeco  
Level 5, 256 St. Georges Terrace,  
Perth,  
Western Australia 6000  
Attn: Lawrence Cho

### **Copy Tapes:**

Santos Australia Ltd.,  
Level 29, Santos House,  
91 King William Street,  
Adelaide, S.A. 5000  
Attn: John Hughes

Section 2: Operation Summary

6 Tape Logs

Polar Duke Data Tape Log							
Prospect	Santos SS02						
Box	001						
Original/Copy	Original						
Shipment No.	PD-2002-110						
Line Name	Seq	Reel	FSP	LSP	FF	LF	Status
SS02-01-001	001	250	1001	1824	999	1824	SOL
SS02-01-001	001	251	1825	2065	1825	2066	EOL/Complete
SS02-03-002	002	252	1999	1175	2000	1175	SOL
SS02-03-002	002	253	1174	897	1174	896	EOL/Complete
SS02-05-003	003	254	1001	1825	1000	1825	SOL
SS02-05-003	003	255	1826	2137	1826	2138	EOL/Complete
SS02-07-004	004	256	1920	1095	1920	1095	SOL
SS02-07-004	004	257	1094	897	1094	896	EOL/Complete
SS02-09-005	005	258	1001	1825	1000	1825	SOL
SS02-09-005	005	259	1826	2106	1826	2107	EOL/Complete
SS02-11-006	006	260	2020	1726	2021	1725	SOL/EOL Incomp.
SS02-11-007	007	261	1831	1154	1832	2510	SOL/EOL Incomp.
SS02-11-008	008	262	1273	1250	1274	1251	SOL/tape error
SS02-11-008	008	263	1249	897	1250	897	EOL/Complete
SS02-13-009	009	264	1001	1825	1000	1825	SOL
SS02-13-009	009	265	1826	2055	1826	2030	EOL/Pending.
SS02-15-010	010	266	2342	1517	2343	1518	SOL
SS02-15-010	010	267	1516	897	1517	897	EOL/Complete
SS02-17-011	011	268	1001	1825	1000	1825	SOL
SS02-17-011	011	269	1826	2306	1826	2307	EOL/Complete
SS02-08-012	012	270	2447	1623	2448	1623	SOL
SS02-08-012	012	271	1622	897	1622	896	EOL/Complete
SS02-06-013	013	272	1001	1776	1000	1777	SOL/EOL/Complete
SS02-02-014	014	273	1660	897	1661	896	SOL/EOL/Complete
SS02-04-015	015	274	1002	1826	1000	1825	SOL
SS02-04-015	015	275	1827	2232	1826	2232	EOL/Complete
SS02-19-016	016	276	1001	1825	1000	1825	SOL
SS02-19-016	016	277	1826	2188	1826	2189	EOL/Complete
SS02-21-017	017	278	2100	1276	2101	1276	SOL
SS02-21-017	017	279	1275	897	1275	897	EOL/Complete

Section 2: Operation Summary

Polar Duke Data Tape Log							
Prospect	Santos-SS02						
Box	002						
Original/Copy	Original						
Shipment No.	PD-2002-110						
Line Name	Seq	Reel	FSP	LSP	FF	LF	Status
SS02-10-018	018	280	1001	1825	1000	1825	SOL
SS02-10-018	018	281	1826	2651	1826	2651	Continue.
SS02-10-018	018	282	2652	3153	2652	3152	EOL/Complete
SS02-12-019	019	283	2882	2058	2884	2058	SOL
SS02-12-019	019	284	2057	1235	2057	1235	Continue.
SS02-12-019	019	285	1234	897	1234	896	EOL/Complete
SS02-23-020	020	286	2240	1416	2241	1416	SOL
SS02-23-020	020	287	1415	897	1415	895	EOL/Complete
SS02-25-021	021	288	1001	1208	1000	1208	SOL/Tape unit error
SS02-25-021	021	289	1209	2022	1209	2022	Incontinue.
SS02-25-022	022	290	1905	2112	1904	2112	SOL
SS02-25-022	022	291	2113	2289	2113	2289	EOL/Complete
SS02-27-023	023	292	1859	/	1860	/	SOL/DNP
SS02-27-024	024	293	1859	1036	1861	1036	SOL
SS02-27-024	024	294	1035	897	1035	895	EOL/Complete
SS02-29-025	025	295	1001	1825	1000	1825	SOL/
SS02-29-025	025	296	1826	1984	1826	1984	EOL/Complete
SS02-31-026	026	297	1904	1080	1905	1080	SOL
SS02-31-026	026	298	1079	897	1079	896	EOL/Complete
SS02-33-027	027	299	1001	1825	1000	1825	SOL
SS02-33-027	027	300	1826	897	1826	896	EOL/Complete
SS02-35-028	028	301	1856	1032	1826	1032	SOL
SS02-35-028	028	302	1031	897	1031	896	EOL/Complete
SS02-37-029	029	303	1001	1825	1000	1825	SOL
SS02-37-029	029	304	1826	1949	1826	1980	EOL/Complete
SS02-39-030	030	305	1850	1026	1851	1026	SOL
SS02-39-030	030	306	1025	897	1025	896	EOL/Complete
SS02-41-031	031	307	1001	1654	1000	1655	SOL/EOL Complete
SS02-16-032	032	308	2123	1299	2124	1299	SOL
SS02-16-032	032	309	1298	897	1298	896	EOL/Complete
SS02-14-033	033	310	1001	1106	1000	1107	DNP
SS02-14-034	034	311	1001	1825	1000	1825	SOL
SS02-14-034	034	312	1826	2004	1826	2005	EOL/Complete

Section 2: Operation Summary

<b>Polar Duke Data Tape Log</b>							
<b>Prospect</b>	<b>Santos SS02</b>						
<b>Box</b>	<b>001</b>						
<b>Original/Copy</b>	<b>COPY</b>						
<b>Shipment No.</b>	<b>PD-2002-111</b>						
<b>Line Name</b>	<b>Seq</b>	<b>Reel</b>	<b>FSP</b>	<b>LSP</b>	<b>FF</b>	<b>LF</b>	<b>Status</b>
SS02-01-001	001	250	1001	1824	999	1824	SOL
SS02-01-001	001	251	1825	2065	1825	2066	EOL/Complete
SS02-03-002	002	252	1999	1175	2000	1175	SOL
SS02-03-002	002	253	1174	897	1174	896	EOL/Complete
SS02-05-003	003	254	1001	1825	1000	1825	SOL
SS02-05-003	003	255	1826	2137	1826	2138	EOL/Complete
SS02-07-004	004	256	1920	1095	1920	1095	SOL
SS02-07-004	004	257	1094	897	1094	896	EOL/Complete
SS02-09-005	005	258	1001	1825	1000	1825	SOL
SS02-09-005	005	259	1826	2106	1826	2107	EOL/Complete
SS02-11-006	006	260	2020	1726	2021	1725	SOL/EOL Incomp.
SS02-11-007	007	261	1831	1154	1832	2510	SOL/EOL Incomp.
SS02-11-008	008	262	1273	1250	1274	1251	SOL/tape error
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SS02-13-009	009	264	1001	1825	1000	1825	SOL
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SS02-17-011	011	268	1001	1825	1000	1825	SOL
SS02-17-011	011	269	1826	2306	1826	2307	EOL/Complete
SS02-08-012	012	270	2447	1623	2448	1623	SOL
SS02-08-012	012	271	1622	897	1622	896	EOL/Complete
SS02-06-013	013	272	1001	1776	1000	1777	SOL/EOL/Complete
SS02-02-014	014	273	1660	897	1661	896	SOL/EOL/Complete
SS02-04-015	015	274	1002	1826	1000	1825	SOL
SS02-04-015	015	275	1827	2232	1826	2232	EOL/Complete
SS02-19-016	016	276	1001	1825	1000	1825	SOL
SS02-19-016	016	277	1826	2188	1826	2189	EOL/Complete
SS02-21-017	017	278	2100	1276	2101	1276	SOL
SS02-21-017	017	279	1275	897	1275	897	EOL/Complete

Section 2: Operation Summary

Polar Duke Data Tape Log							
Prospect	Santos SS02						
Box	002						
Original/Copy	Copy						
Shipment No.	PD-2002-111						
Line Name	Seq	Reel	FSP	LSP	FF	LF	Status
SS02-10-018	018	280	1001	1825	1000	1825	SOL
SS02-10-018	018	281	1826	2651	1826	2651	Continue.
SS02-10-018	018	282	2652	3153	2652	3152	EOL/Complete
SS02-12-019	019	283	2882	2058	2884	2058	SOL
SS02-12-019	019	284	2057	1235	2057	1235	Continue.
SS02-12-019	019	285	1234	897	1234	896	EOL/Complete
SS02-23-020	020	286	2240	1416	2241	1416	SOL
SS02-23-020	020	287	1415	897	1415	895	EOL/Complete
SS02-25-021	021	288	1001	1208	1000	1208	SOL/Tape unit error
SS02-25-021	021	289	1209	2022	1209	2022	Incontinue.
SS02-25-022	022	290	1905	2112	1904	2112	SOL
SS02-25-022	022	291	2113	2289	2113	2289	EOL/Complete
SS02-27-023	023	292	1859	/	1860	/	SOL/DNP
SS02-27-024	024	293	1859	1036	1861	1036	SOL
SS02-27-024	024	294	1035	897	1035	895	EOL/Complete
SS02-29-025	025	295	1001	1825	1000	1825	SOL/
SS02-29-025	025	296	1826	1984	1826	1984	EOL/Complete
SS02-31-026	026	297	1904	1080	1905	1080	SOL
SS02-31-026	026	298	1079	897	1079	896	EOL/Complete
SS02-33-027	027	299	1001	1825	1000	1825	SOL
SS02-33-027	027	300	1826	897	1826	896	EOL/Complete
SS02-35-028	028	301	1856	1032	1826	1032	SOL
SS02-35-028	028	302	1031	897	1031	896	EOL/Complete
SS02-37-029	029	303	1001	1825	1000	1825	SOL
SS02-37-029	029	304	1826	1949	1826	1980	EOL/Complete
SS02-39-030	030	305	1850	1026	1851	1026	SOL
SS02-39-030	030	306	1025	897	1025	896	EOL/Complete
SS02-41-031	031	307	1001	1654	1000	1655	SOL/EOL Complete
SS02-16-032	032	308	2123	1299	2124	1299	SOL
SS02-16-032	032	309	1298	897	1298	896	EOL/Complete
SS02-14-033	033	310	1001	1106	1000	1107	DNP
SS02-14-034	034	311	1001	1825	1000	1825	SOL
SS02-14-034	034	312	1826	2004	1826	2005	EOL/Complete

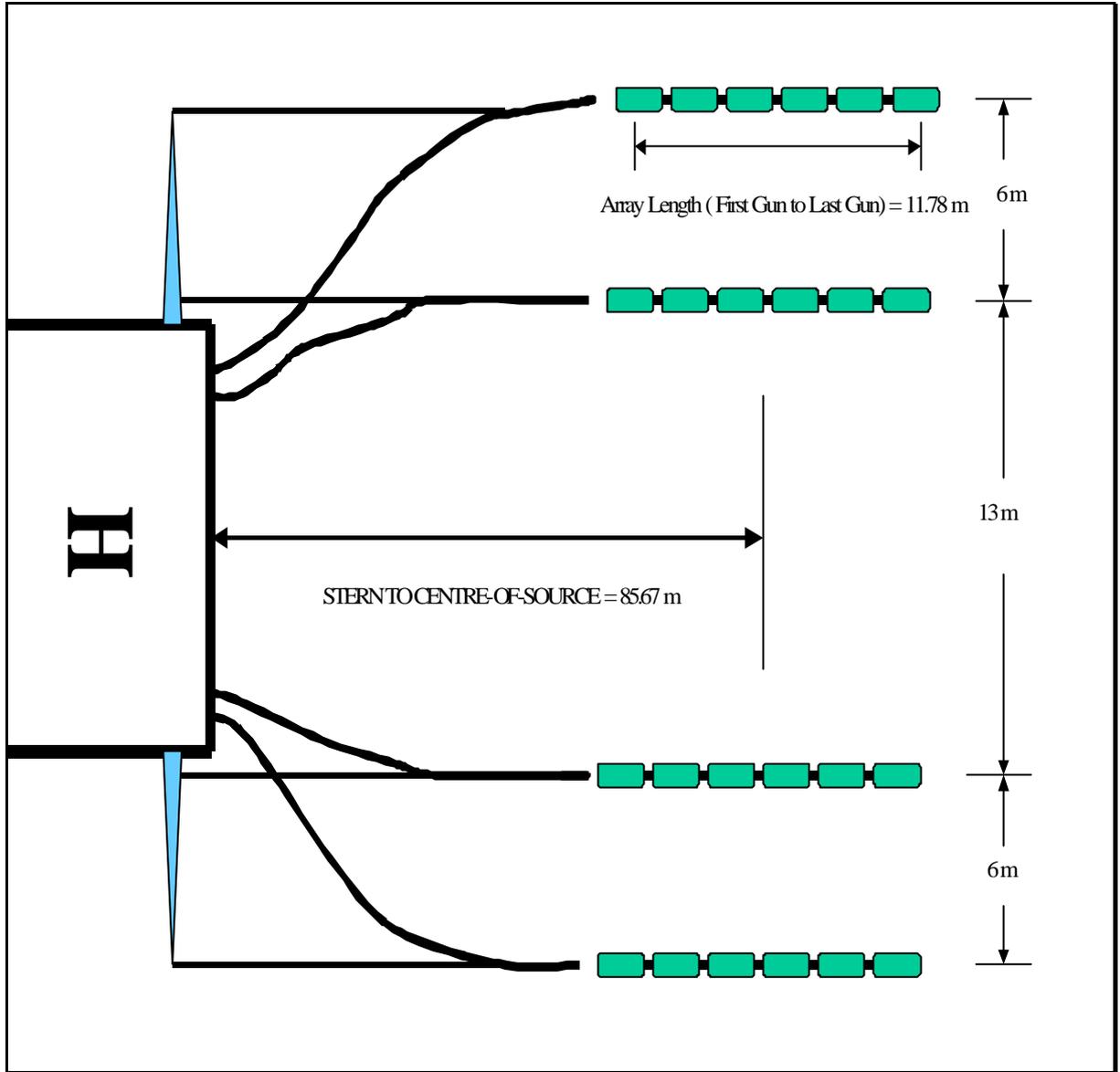
## Section 3: Equipment Configuration

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## Section 3: Equipment Configuration

### 1. Towing Configuration



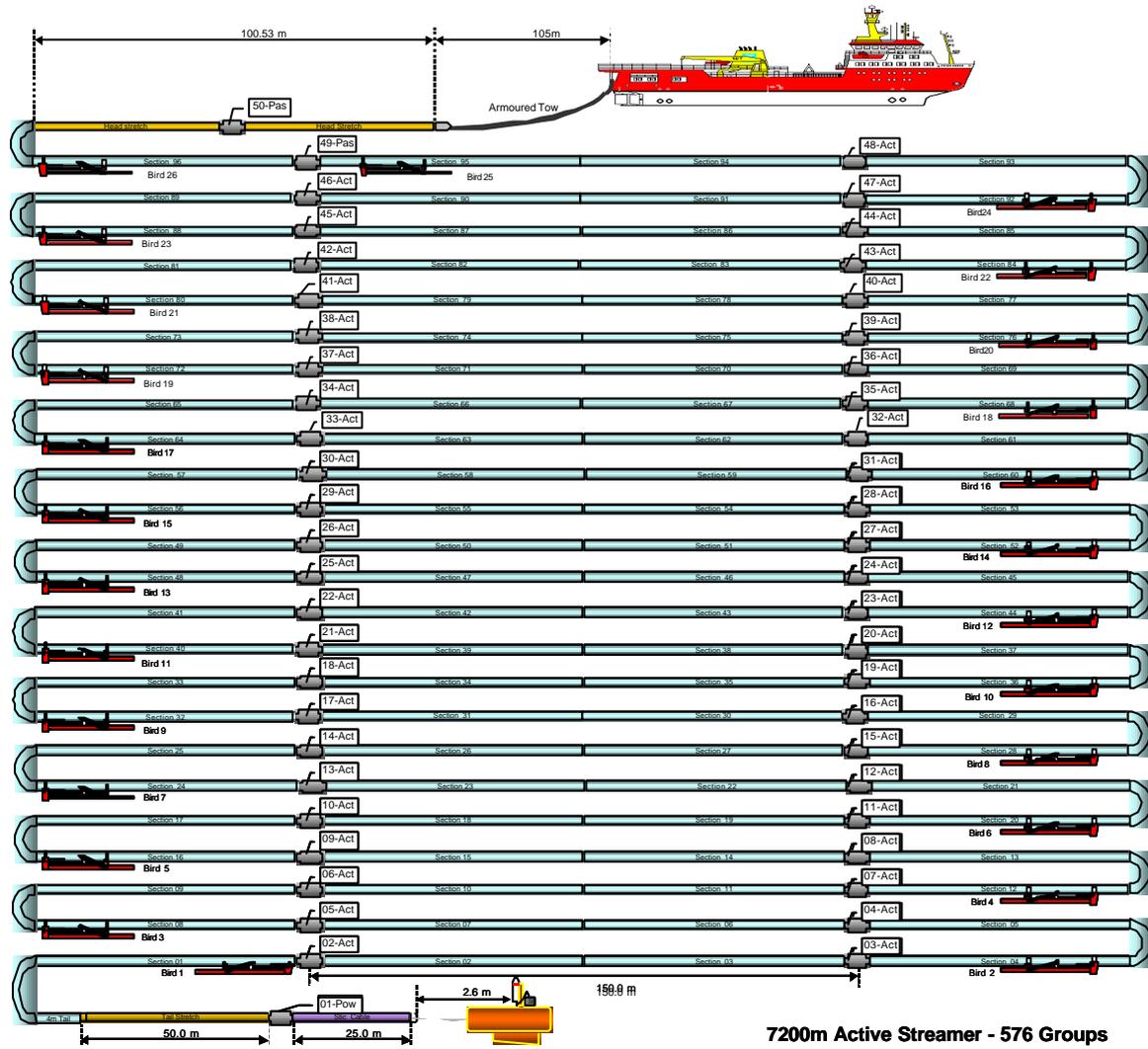
## 2. Streamer Configuration

### 2.1 Streamer System Description

<b>Syntrak 960 Streamer Details</b>	
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	10m
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 each Streamer	2
End of each Streamer	1
No of Compasses per Streamer	26
No of Depth Transducers per Streamer	26

# Section 3: Equipment Configuration

## 2.2 Streamer Layout 7200m



## Section 3: Equipment Configuration

### 2.3 Streamer Configuration 7200m

**POLAR DUKE STREAMER DIAGRAM**

STREAMER 7200m  
 GROUP INT 12.5m **DATE** 24th Nov 2002  
 BIRD COILS Head  
 MODULES 48 Leadin 116m Deployed

<a href="#">\History ListModule_History.xls</a>
<a href="#">\History ListSection_History.xls</a>
<a href="#">\XOFF GOING ON.COMING.xls</a>
<a href="#">\Maint Report.xls</a>

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.	Birc	S/N	Fin	SRD	Comments.
H		0297-10509		1	0	1.kg	289\294					
T	C	0297-10476		2	0	2.kg	283\288					
		3252	24									
H		0397-10594		2	0	2.kg	277\282					
T		0297-10520		2	0	2.kg	271\276	13	11758		SRD	
		3234	23									
H		0498-31559		1.5	0	1.5kg	265\270					
T		0397-10595		1.5	0	1.5kg	259\264					
		2575	22									
H		0397-10541		1.5	0	1.5kg	253\258					
T	H	0294-10511		2	0	2.kg	247\252	12	12198			
		3250	21									
H	C	0297-10525		1	0	1.kg	241\246					
T	C	0197-10403		2	0	2.kg	235\240					
		3141	20									
H		0297-10494		1	0	1.kg	229\234					
T		0397-10592		2	0	2.kg	223\228	11	10560			Chnl 223 noisy
		2738	19									
H	C	0297-10502		1	0	1.kg	217\222					
T		0397-10596		2	0	2.kg	211\216					
		3240	18									
H	C	0397-10535		2.5	0	2.5kg	205\210					
T		0297-10526		2.5	0	2.5kg	199\204	10	15333			
		1922	17									
H		0297-10473		2	0	2.kg	193\198					
T	C	0297-10519		2.5	0	2.5kg	187\192					
		3125	16									
H		0397-10550		1	0	1.kg	181\186					
T		0397-10540		2.5	0	2.5kg	175\180	9	18424		SRD	
		2593	15									
H		0297-10498		1	0	1.kg	169\174					
T		0397-10575		1	0	1.kg	163\168					
		3145	14									
H		0397-10561		2	0	2.kg	157\162					
T		0397-10559		2	0	2.kg	151\156	8	19014			
		3124	13									
H		0397-10586		1	0	1.kg	145\150					
T		0397-10552		3	0	3.kg	139\144					
		1925	12									
H		0397-10607		3	0	3.kg	133\138					
T		0397-10560		3	0	3.kg	127\132	7	8494			CHNL 137 Hyd Lkg
		3233	11									
H		0397-10585		3	0	3.kg	121\126					
T		0397-10576		1	0	1.kg	115\120					
		3242	10									
H		0397-10537		3	0	3.kg	109\114					
T		0397-10584		1	0	1.kg	103\108	6	7584			
		1839	9									
H		0297-10521		1	0	1.kg	97\102					
T		0397-10587		1	0	1.kg	91\96					
		3123	8									
H		0297-10522		1	0	1.kg	85\90					
T		0297-10475		1	0	1.kg	79\84	5	14895			
		2576	7									
H		0397-10534		1	0	1.kg	73\78					
T		0397-10581		3	0	3.kg	67\72					
		1839	6									
H		0397-10558		1	0	1.kg	61\66					
T		0198-10845		2	0	2.kg	55\60	4	18848			
		3246	5									
H		0397-10574		1	0	1.kg	49\54					
T		0297-10516		1	0	1.kg	43\48					
		3127	4									
H	C	0397-10590		4	0	4.kg	37\42					
T	C	0297-10512		3	0	3.kg	31\36	3	15223		SRD	
		1930	3									
H	C	0297-10517		2	0	2.kg	25\30					
T	C	0397-10572		2	0	2.kg	19\24					
		1875	2									
H	C	0397-10591		1	0	1.kg	13\18					
T	H	0397-10556		1	0	1.kg	7\12	2	20006			
		2580	1									
H		0397-10549		1		1.kg	1\6	1	7606			
		4metre Stretch	1097-10024-4T									
		SS1-0297-1388HS										
		12125	PP									
		Stic										
		Tailbuoy										

## Section 3: Equipment Configuration

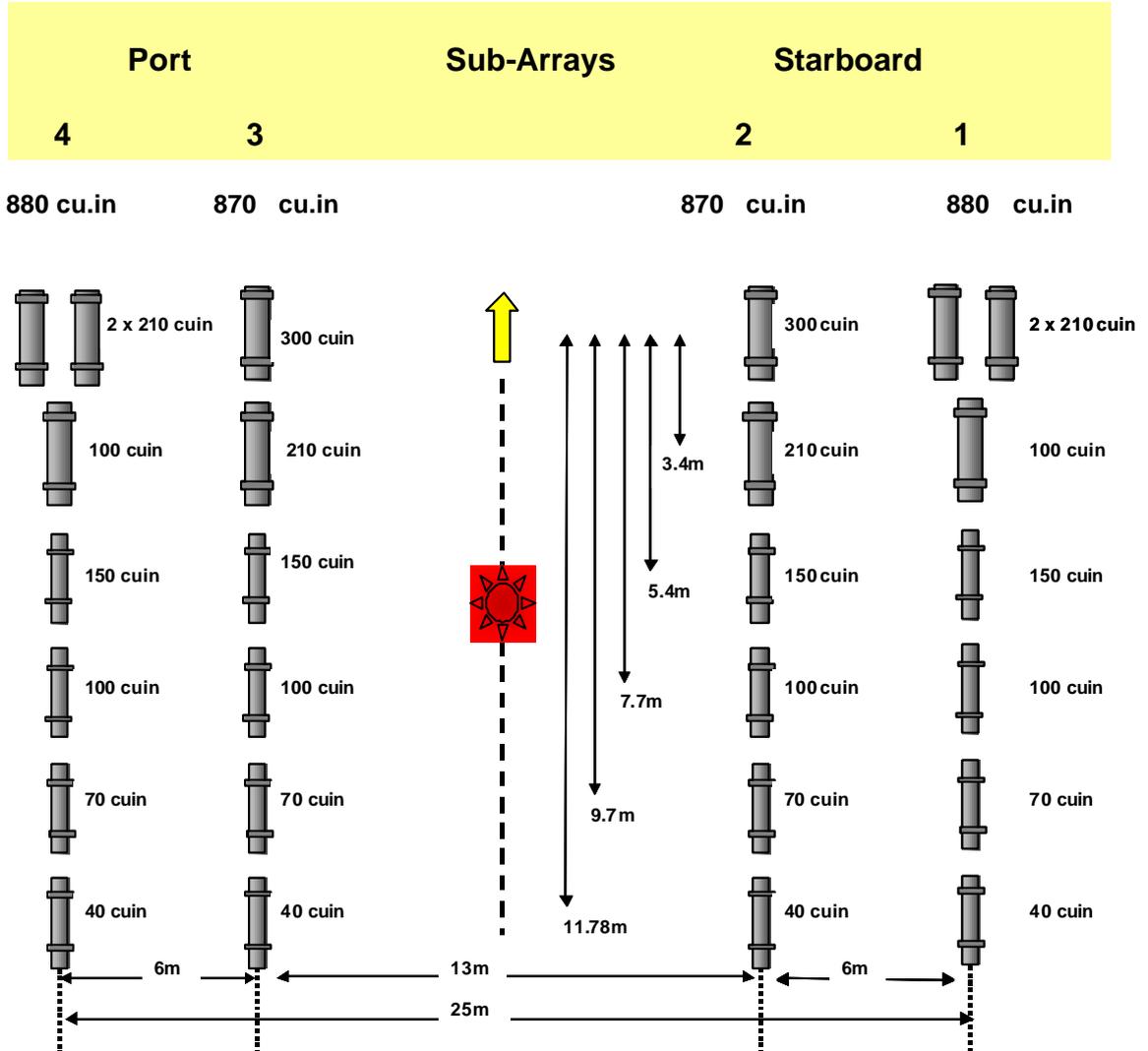
### 3. Source Configuration

#### 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

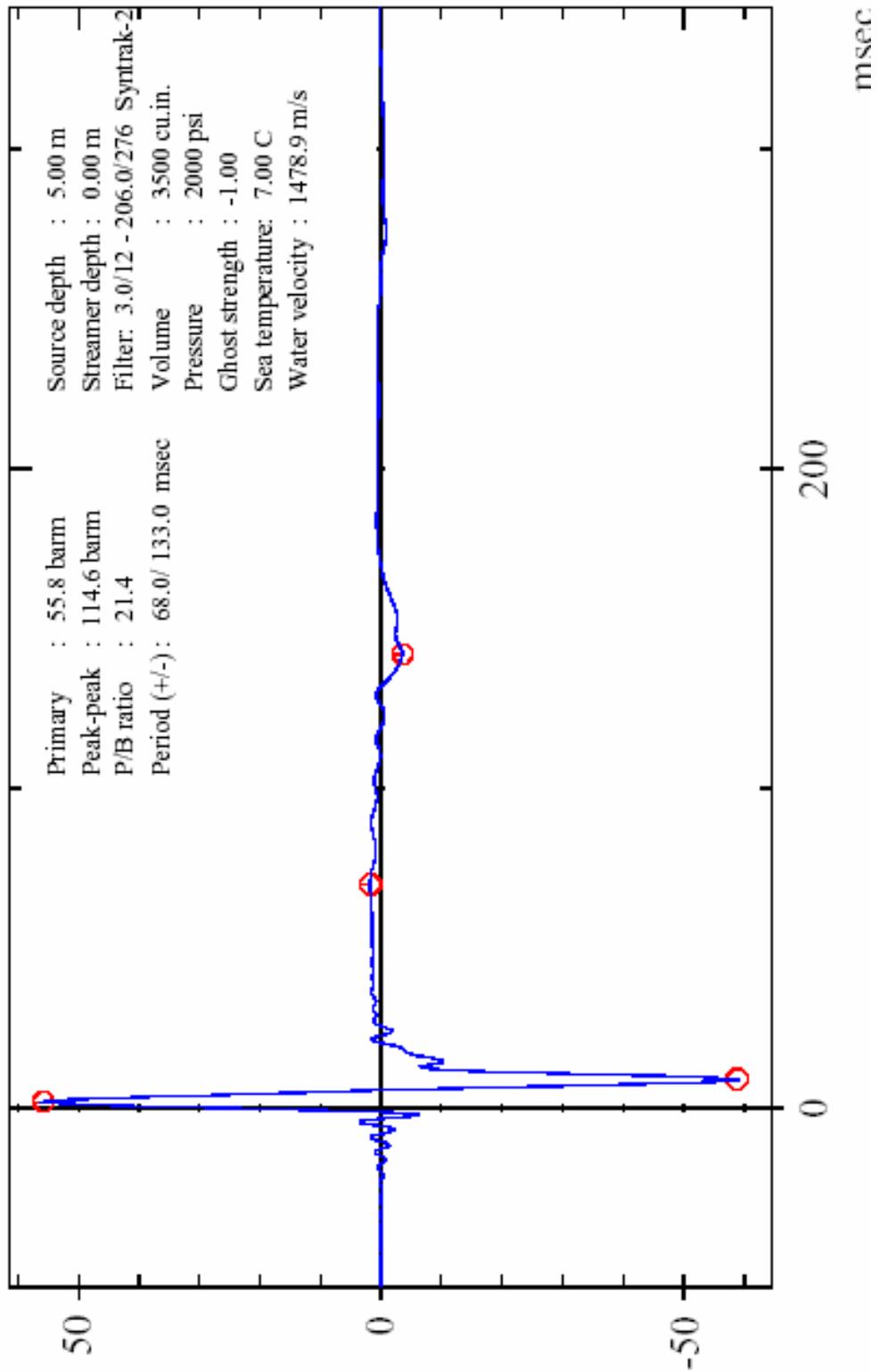
## Section 3: Equipment Configuration

### 3.2 Source Layout

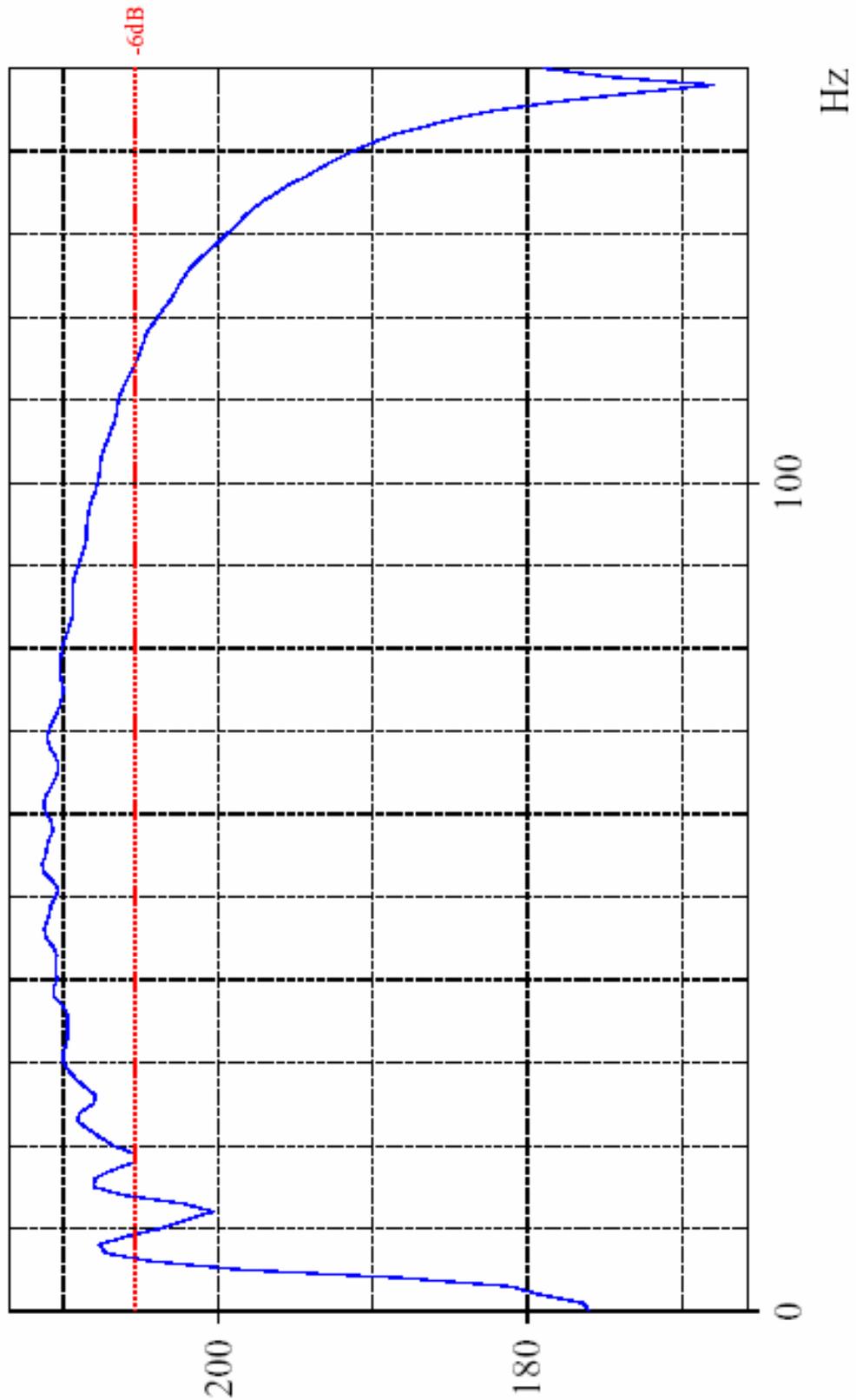


The source array consists of 4 sub-arrays with a total volume of 880 cu.in. for each outer array, and a total volume of 870 cu.in. for each inner array. Each outer sub-array contains 6 gun locations with a total of 7 guns per sub-array. Each inner array consists of only 6 guns.

### 3.3 Far Field Signature



### 3.4 Amplitude Spectrum





## Section 4: Navigation

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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 Furuno FCN-271	
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 tail buoy.

## Section 4: Navigation

### 1.3 Surface Positioning

#### 1.3.1 Vessel Navigation

##### Summary

**System 1:** Trimble 4000SSi Receiver  
RTCM Delivery System: Fugro Starfix via the 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 link.  
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 ApSat

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

## Section 4: Navigation

### 1.3.2 Float Navigation

Source surface navigation was provided by the FUro 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 constant = 14 seconds

Magnetic Declination entered into Spectra for the northern (T32/P) part of the prospect was:  $11.70^\circ$  at Position:  $040^\circ 40' 00.000''\text{S}$   $143^\circ 10' 00.000''\text{E}$

Magnetic Declination entered into Spectra for the southern (T/33P) part of the prospect was:  $12.30^\circ$  at Position:  $041^\circ 15' 00.000''\text{S}$   $144^\circ 00' 00.000''\text{E}$

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  
Secondary Gyro 2: Anschutz Kiel Type:110-310 Serial No: 5185

### 1.4.3 Velocity of Sound in water

The velocity of sound value used on the prospect was 1506.0 m/s This value was obtained from the "Western Monarch" while shooting the Santos OS02 area prior to the SS02 program.

## Section 4: Navigation

### 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 echosounder and consequently no data was recorded with this sensor throughout the survey.

## 2 Navigation Systems Verification and Monitoring

### 2.1 EchoSounder Verification

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

Gyro calibration results for the 05<sup>th</sup> 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***

## Section 4: Navigation

### 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:

<b><u>GPS1</u></b>	<i>Latitude</i>	<i>Longitude</i>
<i>Differential GPS Position</i>	-16.927426	145.780393
<i>RTK Surveyed Position</i>	-16.927410	145.780393
<i>Difference</i>	0.000016 (~1.7m)	0.00m

<b><u>GPS2</u></b>	<i>Latitude</i>	<i>Longitude</i>
<i>Differential GPS Position</i>	-16.927427	145.780392
<i>RTK Surveyed Position</i>	-16.9274135	145.7804085
<i>Difference</i>	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:

<b><u>Pods in use</u></b>	<i>C-O Difference (Range/Bearing)</i>
<i>Pod 689</i>	0.49m / 1.11°
<i>Pod 869</i>	0.98m / 0.49°
<i>Pod 870</i>	0.12m / 0.68°

<b><u>Spare</u></b>	<i>C-O Difference (Range/Bearing)</i>
<i>Pod 1065</i>	1.10m / 1.12°
<i>Pod 864</i>	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 which there was a reduced number of satellites in view.

There was one change of significance submitted to the Spectra Configuration Node effective from sequence 024. We shortened the armoured lead-in d/t problems with the Syntrak systems. It started locking up and the lead-in was shortened in order to eliminate this problem. The nominal offset was changed to 125 meters also causing the CMP to change to 193 meters. The new offset drawings are appended at the end of this section!

#### 4.1.1 DGPS (Primary)

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 1430 to 1830 hours local time due to the occurrence of poor satellite geometry and low number of satellites in view. In these periods both systems were switched to height aiding based on the local geoidal height in the survey area. The geoidal height was based on both observations of the height during Auto 3D positioning and calculations from NIMA EGM96 Calculator. Both methods indicated the same geoidal height. This was also approved by the onboard client representative.

#### 4.1.2 rGPS (Tail Buoy)

The tail buoy was active from sequence 001 – 018, after which we lost the signal from it. The combination of active compasses and low feather let us continue production to completion of the prospect without retrieval of the streamer. The onboard client representative approved further production without the active tail buoy.

## 5 Conclusions

In total there were 34 sequences shot, with all navigation systems working well throughout the survey, except from loss of TB signal. Some sequences were aborted due to loss of air pressure or gun downtime Sequences 018 required the input of the water depth from the seismic record for the navigation processing due to marginal sea conditions causing loss of echo sounder returns.

The Universal Transverse Mercator 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).

## Section 4: Navigation

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 metre 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.

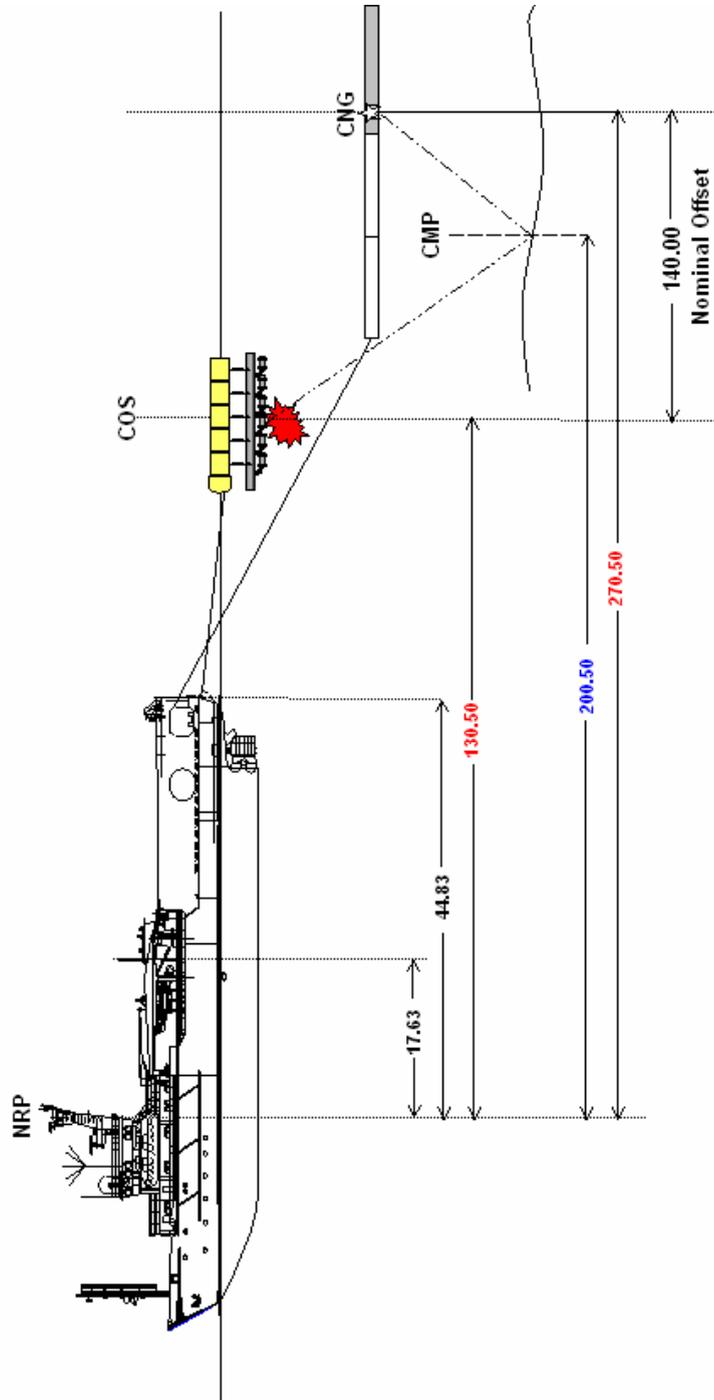
### 6.1.8 Compass Device

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 Diagrams

(seq 001-023)

**Polar Duke In-Sea Towing Dimensions / Offset Diagram**  
 Date: November 2002  
 Client: Santos Pty. Ltd  
 Area: SS02 2D MISS (valid from sequence 024)  
 Streamer Length: 7200m



All Distances in metres

**Key**

CNG	Centre Near Group
NRP	Navigation Reference Point
COS	Centre of Source
CMP	Common Mid Point

**Distances:**

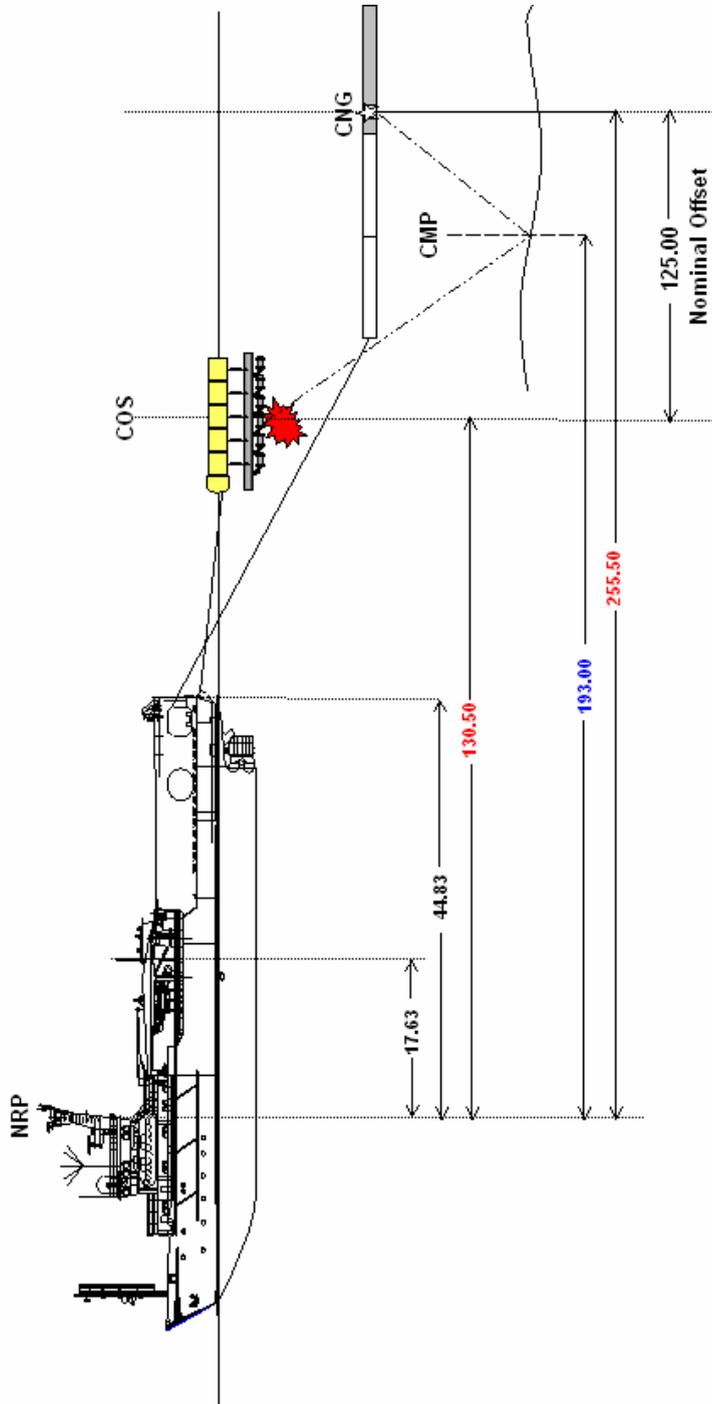
NRP - Stern	44.83	COS - CNG	140.00
Stern - COS	85.67	NRP - CMP	200.50 (Spectra shot layback)
Stern - CNG	225.67	NRP - CNG	270.50

**DIAGRAM NOT TO SCALE**

Section 4: Navigation

(seq 024-034)

**Polar Duke In-Sea Towing Dimensions / Offset Diagram**  
 Date: November 2002  
 Client: Santos Pty. Ltd  
 Area: SS02 2D MSS (valid from sequence 024)  
 Streamer Length: 7200m



All Distances in metres

**Key**

CHG	Centre Near Group
HRP	Navigation Reference Point
COS	Centre of Source
CMP	Common Mid Point

**Distances:**

	Principle Offsets:
NRP - Stern	44.83
COS - CNG	125.00
Stern - COS	85.67
NRP - CMP	193.00 (Spectra shot layback)
Stern - CNG	210.67
NRP - CNG	255.50

**DIAGRAM NOT TO SCALE**

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# 1 Instrumentation and QC System Description

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

## 2 Instrumentation and QC Test 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
16/12	OK	OK	OK	OK	OK	OK	OK	OK	OK	CH # 137/56 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.

Section 5: Instrumentation, Source and QC

**2.2 Daily Tests**

Date	DCR	CGA	HD	CMR	IR	CIO	CIE	HL	RMS	COMMENTS
16/12	OK	OK	OK	OK	OK	OK	OK	OK	OK	CH # 137 Hyd Lkg # 571 Dead
17/12	OK	OK	OK	OK	OK	OK	OK	OK	OK	CH # 56/137 Lkg # 571 Dead
18/12	OK	OK	OK	OK	OK	OK	OK	OK	OK	CH # 56/137 Lkg # 571 Dead
19/12	OK	OK	OK	OK	OK	OK	OK	OK	OK	CH # 137 Lkg # 571 Dead
20/12	OK	OK	OK	OK	OK	OK	OK	OK	OK	CH # 137 Lkg # 571 Dead
21/12	OK	OK	OK	OK	OK	OK	OK	OK	OK	CH # 137 Lkg # 571 Dead
22/12	OK	OK	OK	OK	OK	OK	OK	OK	OK	CH # 137 Lkg # 571 Dead
23/12	OK	OK	OK	OK	OK	OK	OK	OK	OK	CH # 137 Lkg # 571 Dead
24/12	OK	OK	OK	OK	OK	OK	OK	OK	OK	CH # 137 Lkg # 571 Dead
25/12	OK	OK	OK	OK	OK	OK	OK	OK	OK	CH # 137 Lkg # 571 Dead
26/12	OK	OK	OK	OK	OK	OK	OK	OK	OK	CH # 137 Lkg # 571 Dead
27/12	OK	OK	OK	OK	OK	OK	OK	OK	OK	CH # 137 Lkg # 571 Dead
28/12	OK	OK	OK	OK	OK	OK	OK	OK	OK	CH # 137,56 Lkg # 571 Dead
29/12	OK	OK	OK	OK	OK	OK	OK	OK	OK	CH # 137,56 Lkg # 571 Dead
30/12	OK	OK	OK	OK	OK	OK	OK	OK	OK	CH # 137,56 Lkg # 571 Dead

**2.3 End of Job Test**

Date	DCR	CGA	HD	CMR	IR	CIO	CIE	HL	RMS	COMMENTS
30/12	OK	OK	OK	OK	OK	OK	OK	OK	OK	CH # 137, 56 Lkg # 571 Dead

## 2.4 Instrument Summary

The Recording instruments suffered very little 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 1 dead hydrophone group in the streamer, channel 571, with hydrophone leakage on Channel 137 (however not observed as bad on raw and brute stacks).

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.

As was previously mentioned the Recording system suffered from very little Technical Downtime. On the 17<sup>th</sup> of December, while beginning Line SS02-07-004, the Syntrak Recording system tape drives "hung-up", requiring the Observer to re-boot the system. In turn the first 47 shotpoints of the line (SP's 1967-1921) were not recorded to tape, although the line was later accepted to be "Complete".

On the 19<sup>th</sup> of December streamer telemetry errors were observed at the very end of Line SS02-13-009. These errors affected shotpoints 2031-2055 (25 total) which were rejected from processing. The line was accepted as "Complete" by the client.

On the 27<sup>th</sup> of December Line SS02-27-023 was aborted due to telemetry errors on the streamer. In order to troubleshoot the problem (which was of an intermittent nature) the offset was reduced from 140 metres (centre source to centre of rear group) to 125 metres. This would place the strain point of the armoured lead-in at a new position, hopefully eliminating the problem. All lines from Sequence No. 24 onwards were shot with the slightly shorter offset.

### 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:

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

### 3.4 Processing Sequence for Brute Stack:

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

### 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 bandpass 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. Band-pass 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

## Section 6: Onboard Processing

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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**. The survey comprised two blocks: T/32P and T/33P in Sorell Basin offshore of Tasmania, Australia. Acquisition was implemented using a source array of 3500 cu in. volume and a single streamer with 576 primary and 12 auxiliary channels.

The survey commenced recording on the 16<sup>th</sup> December and was completed on the 30<sup>th</sup> December 2002. A total of 34 sequences and approximately 1143 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 76 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. 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. A variable degree of swell noise was visible on most of the raw stack sections.

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 +/- 1m
Near trace offset from source:		140 m (seq. 1 – 23) 125 m (seq. 24 – 34)

### 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

16<sup>th</sup> December to 30<sup>th</sup> December 2002: Adam Gebarski

#### Onboard Processing Hardware

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

#### 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 SEG-D 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.

## Section 6: Onboard Processing

### 4 Raw Stack Processing Sequences:

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

## Section 6: Onboard Processing

### 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 OC 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 500-10000ms 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  $\mu$ bar 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 SEG-D 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  $\mu$ bar.

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 SEG-D 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 SEG-Y 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.

## Section 6: Onboard Processing

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. 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

$$\text{Station} = \text{first SP} + ((\text{CDP}-288)/3).$$

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 SEG Y format, and shipped to the client office at the end of the survey. The SEG Y 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 SEG Y 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 was not considered to be a major problem. Factors affecting data quality included the following:

- ✓ Ship noise
- ✓ Spikes / noisy channels
- ✓ Geological noise
- ✓ Swell 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.

## Section 6: Onboard Processing

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 as well as the stack sections.

Diffractions were often visible and were probably caused by the prodigious faulting and not uniform water bottom 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 10-20 $\mu$ bars on the most sequences.

## 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 76 km per day. Data processing also averaged approximately 76 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 LOGS**

## Section 6: Onboard Processing

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	SS02-01-001	56	16/12	1001	2065	1001-2065	1-3480	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	GOOD. Start of line RMS noise 1-5ubar peaking up to 11.5ubar on the far end of the streamer. SP numbers in headers on tape all equal to 0. However, all follow the FFID numbers. SP's renumbered to match the FFID numbers during the processing towards the brute stack. Mid to high frequency anomaly d/t effect of geology present on the shot RMS display above the raw stack between SP 1510 and 1620. Swell noise up to 6.0s visible on the raw stack.
002	SS02-03-002	238	17/12	1999	897	1999-897	1-3594	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	GOOD. SOL RMS noise 1-7ubar peaking up to 15ubar on the far end of the streamer. Similar to the line SS02-01-001, mid to high frequency anomaly d/t effect of geology present on the shot RMS display above the raw stack between SP 1488 and 1530. Swell noise up to 6.0s visible on the raw stack.
003	SS02-05-003	58	17/12	1001	2137	1001-2137	1-3696	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	GOOD. RMS noise at the beginning of line 1-6ubar with peaks up to over 9ubar on the far channels. Noise on the front end of the streamer gradually increasing from SP 2117, Ch 576 to SP 2137, Ch 551 visible on the Shot vs. Channel RMS display. Similar to the previous two lines, mid to high frequency anomaly d/t effect of geology present on the shot RMS display above the raw stack between SP 1465 and 1510. Swell noise breaking through the events at around 6.0s on the raw stack.











## **Appendix B**

### **DATA SHIPMENTS**

## Section 6I: Onboard Processing

### Appendix B - List of Deliverable Products

*The following data shipment was sent off in Eden January 2003.*

1. Paper Displays for Sorell Basin SS02 Survey (Sequences 001-034):  
Start of line RMS noise, Near Trace displays, Raw Stacks and Brute Stacks.
2. 1 x 8mm tape containing SEGY format Raw Stacks for Sorell Basin SS02 Survey.  
Seq. 001-034 (SEGY files 1-32)
3. 1 x 8mm tape containing SEGY format Brute Stacks for Sorell Basin SS02 Survey.  
Seq. 001-034 (SEGY files 1-32)
4. 1 x 8mm tape for seq. 001-034 of Sorell Basin SS02 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. 001-034 of Sorell Basin SS02 Survey containing:  
Master flows, Stacks, Near Traces, Shot vs. Chan RMS  
(ProMAX archive format).
6. 1 x 8mm tape for seq. 001-034 of Sorell Basin SS02 Survey containing:  
Stacks  
(ProMAX archive format).
7. 1 x floppy disk for seq. 001-034 of Sorell Basin OS02 Survey containing:  
Velocity files (ASCII format).

**APPENDIX C**

**START OF LINE NOISE RECORD RMS ANALYSIS**

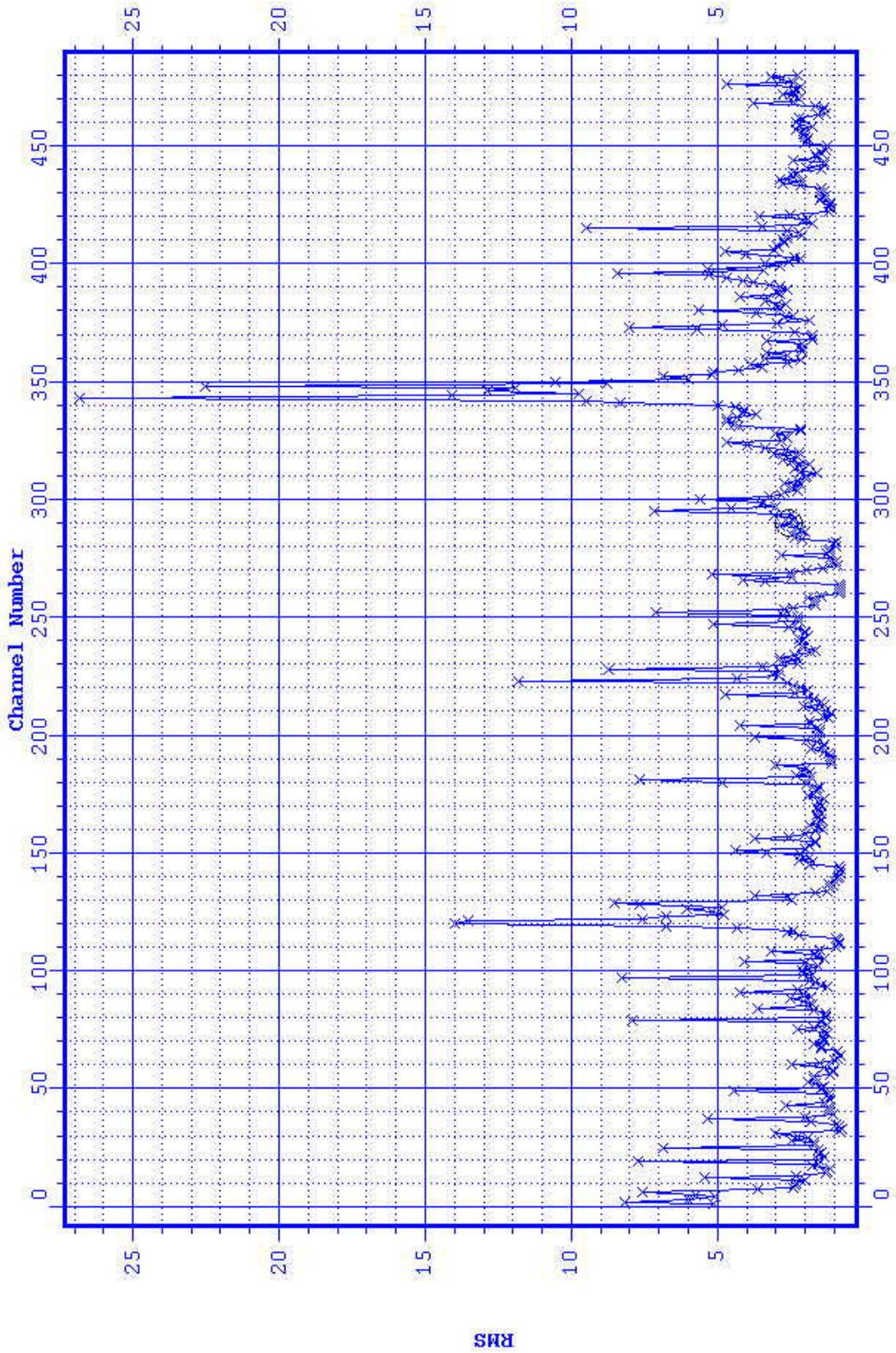
Section 6I: Onboard Processing

Help

Exit Database 3D ASCII Math New Zoom Screen Options

CHN GEOMETRY RMS

Line: SS02-13-009



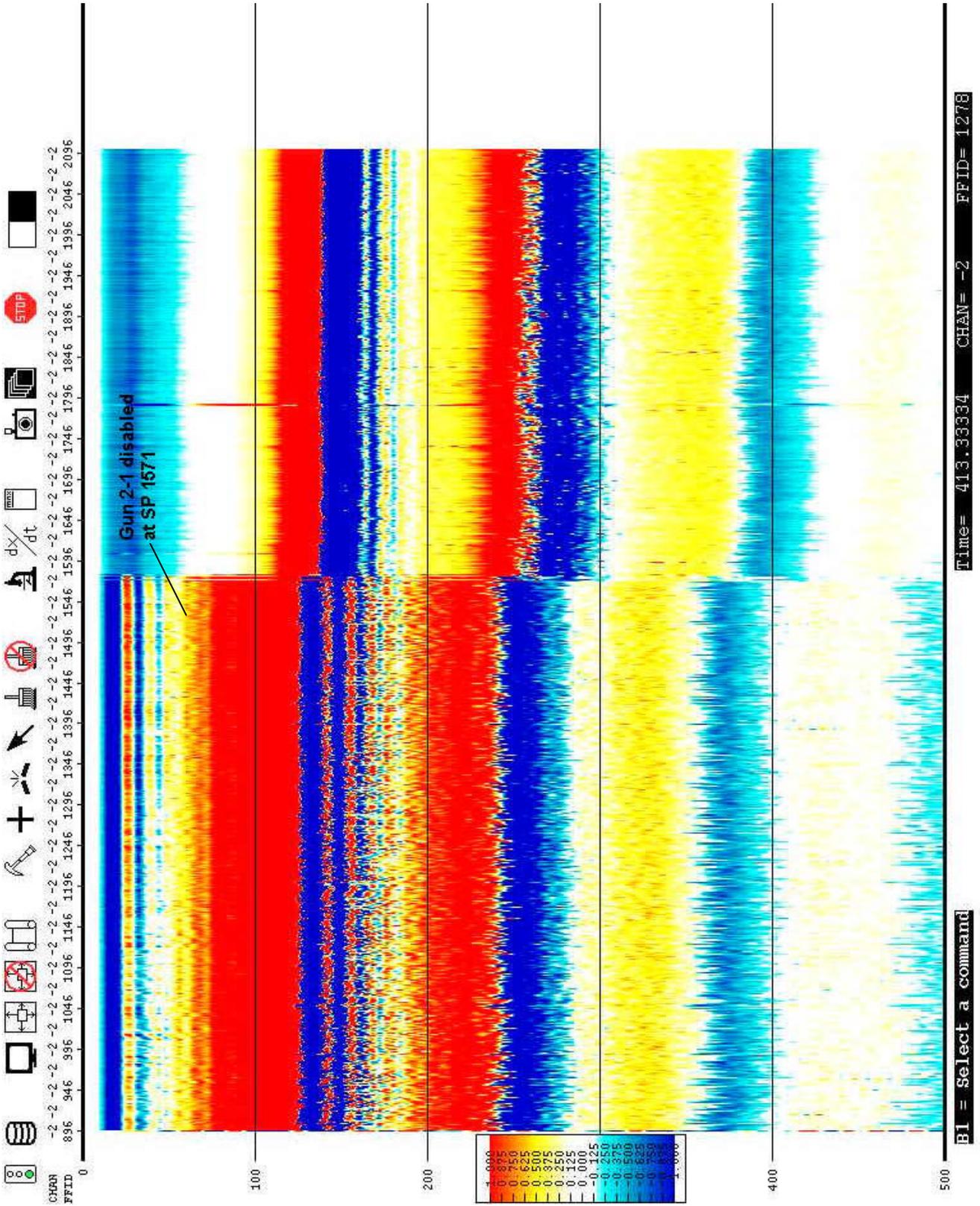
Nearest sample: (CHN, RMS) = (290, 3) Cursor: (CHN, RMS) = (289.7, 2)  
MB1 = Edit MB2 = Interpolate

**APPENDIX D**

**AUXILIARY CHANNELS DISPLAY**

# Section 6I: Onboard Processing

Display of auxiliary channel mounted on Gun 2-1. Line: SS02-21-017.

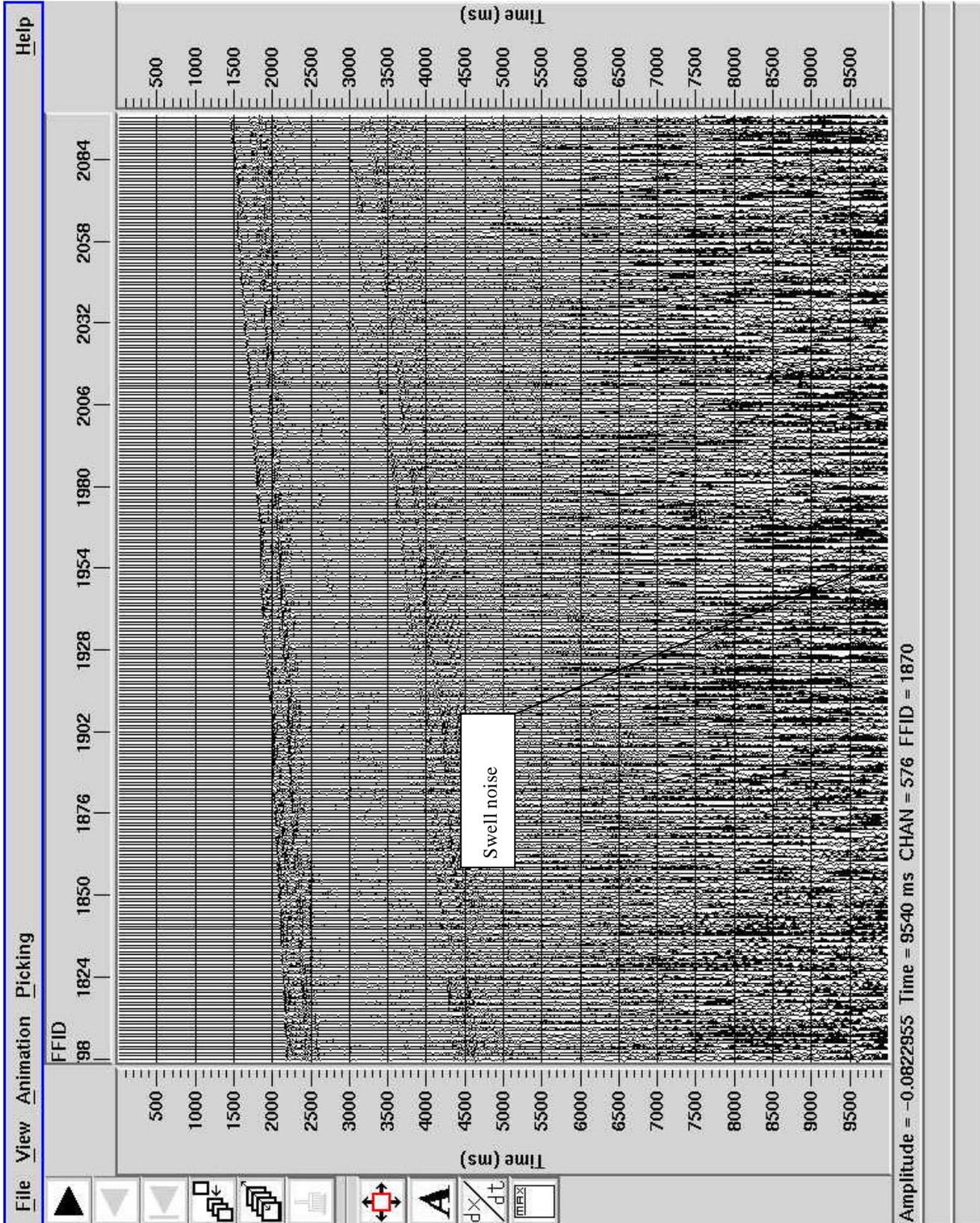


**APPENDIX E**

**NEAR TRACE DISPLAY**

# Section 6I: Onboard Processing

Near trace gather; Line: SS02-15-010

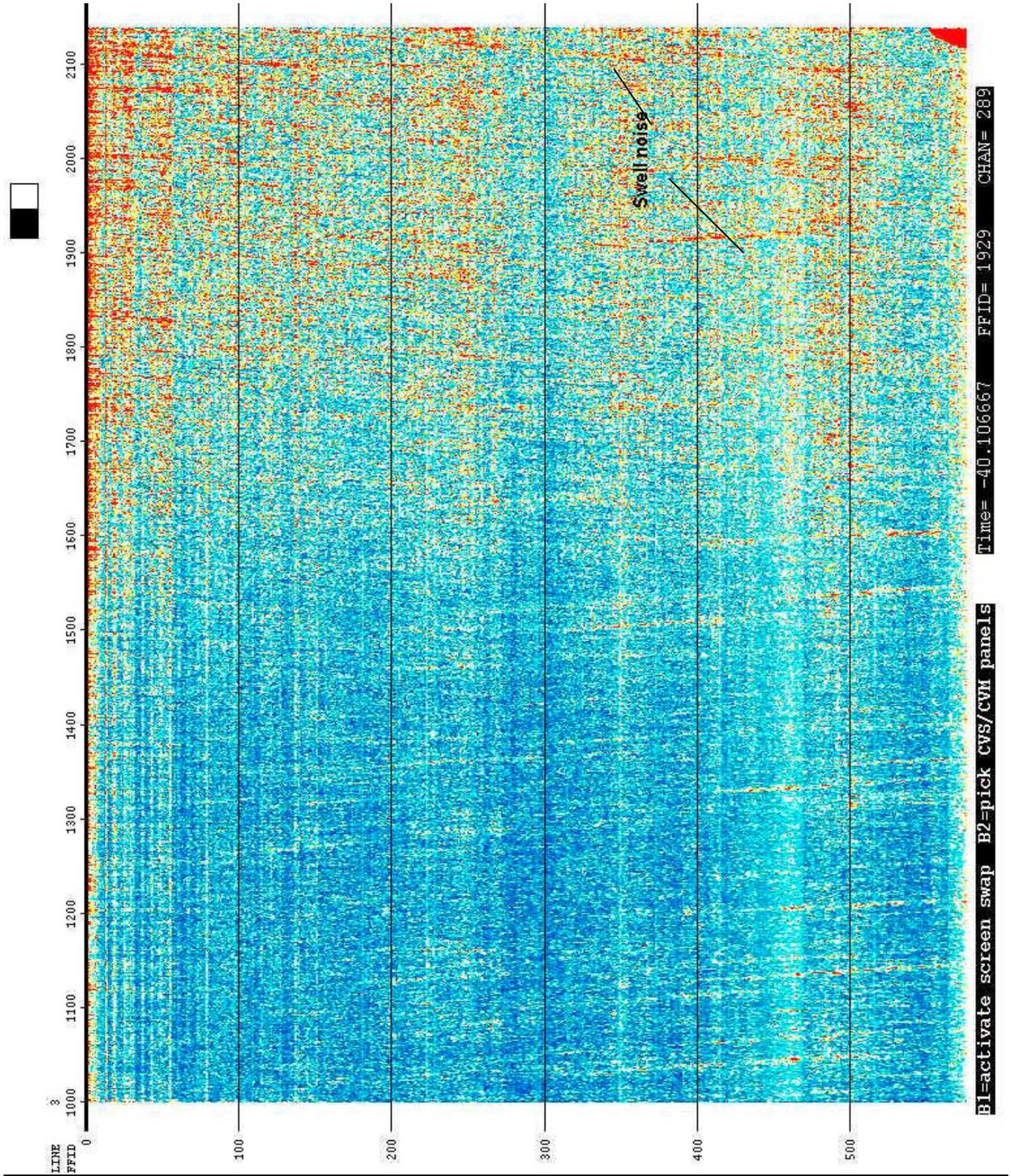


**APPENDIX F**

**SHOT vs. CHANNEL COLOUR RMS**

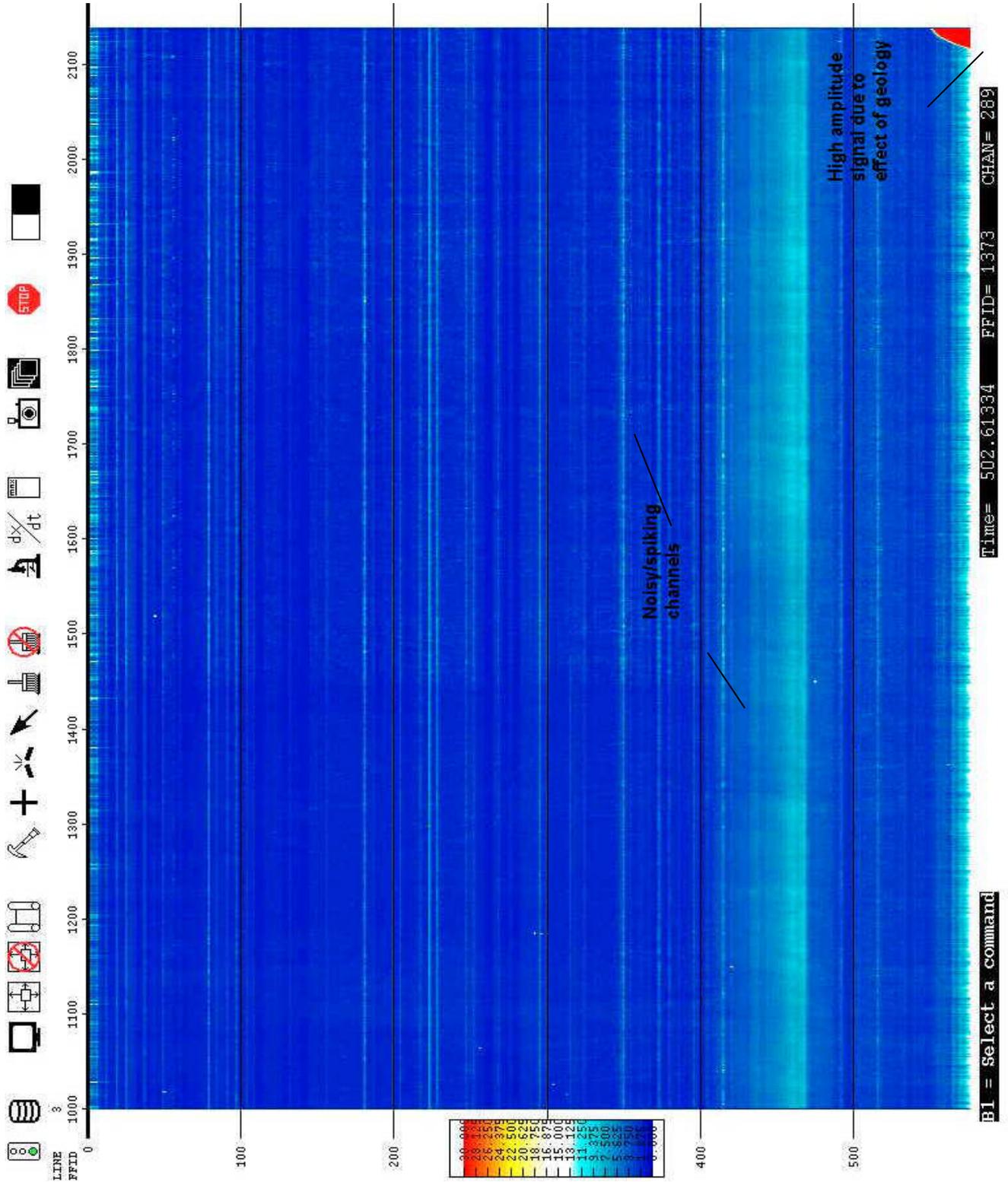
# Section 6I: Onboard Processing

Shot vs. Channel RMS, No filter applied; Line: SS02-05-003.



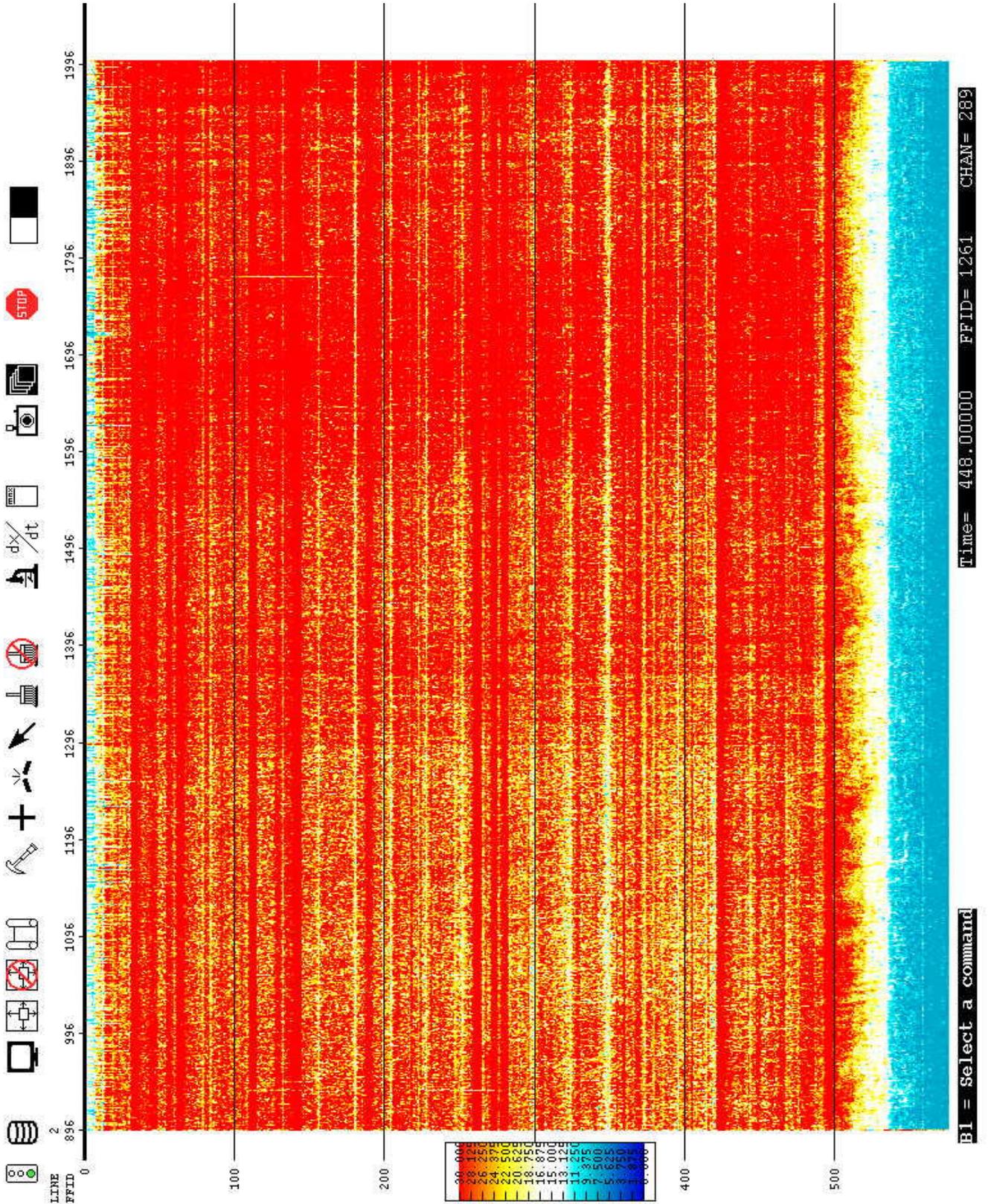
# Section 6I: Onboard Processing

Shot vs. Channel RMS, Ormsby bandpass filter 4-8-90-120 Hz applied; Line: SS02-05-003.



# Section 6I: Onboard Processing

Shot vs. Channel RMS, Dominant frequency; Line: SS02-05-003.

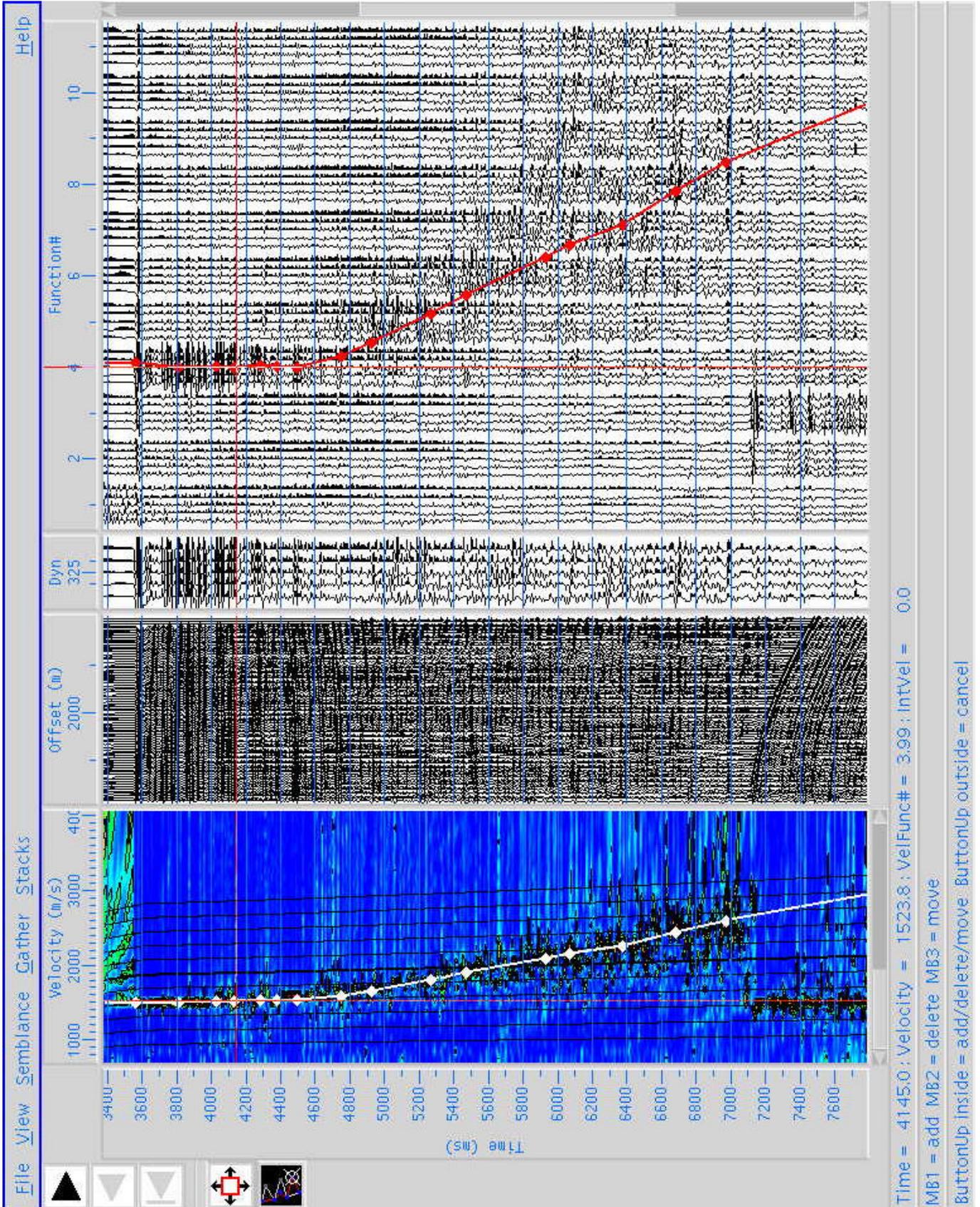


**APPENDIX G**

**VELOCITY ANALYSIS**

Section 6I: Onboard Processing

Line SS02-11-007

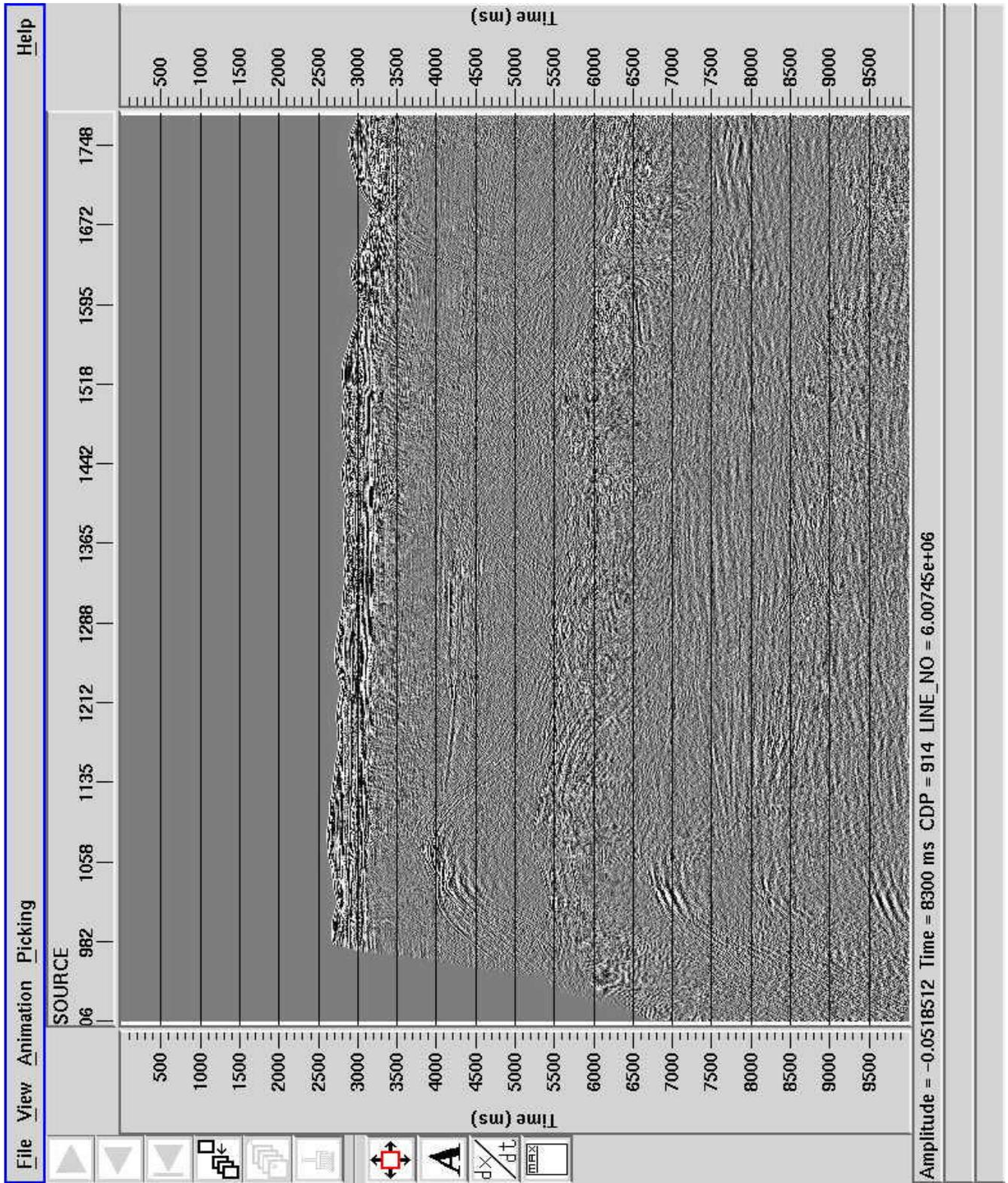


## **APPENDIX H**

### **STACKS**

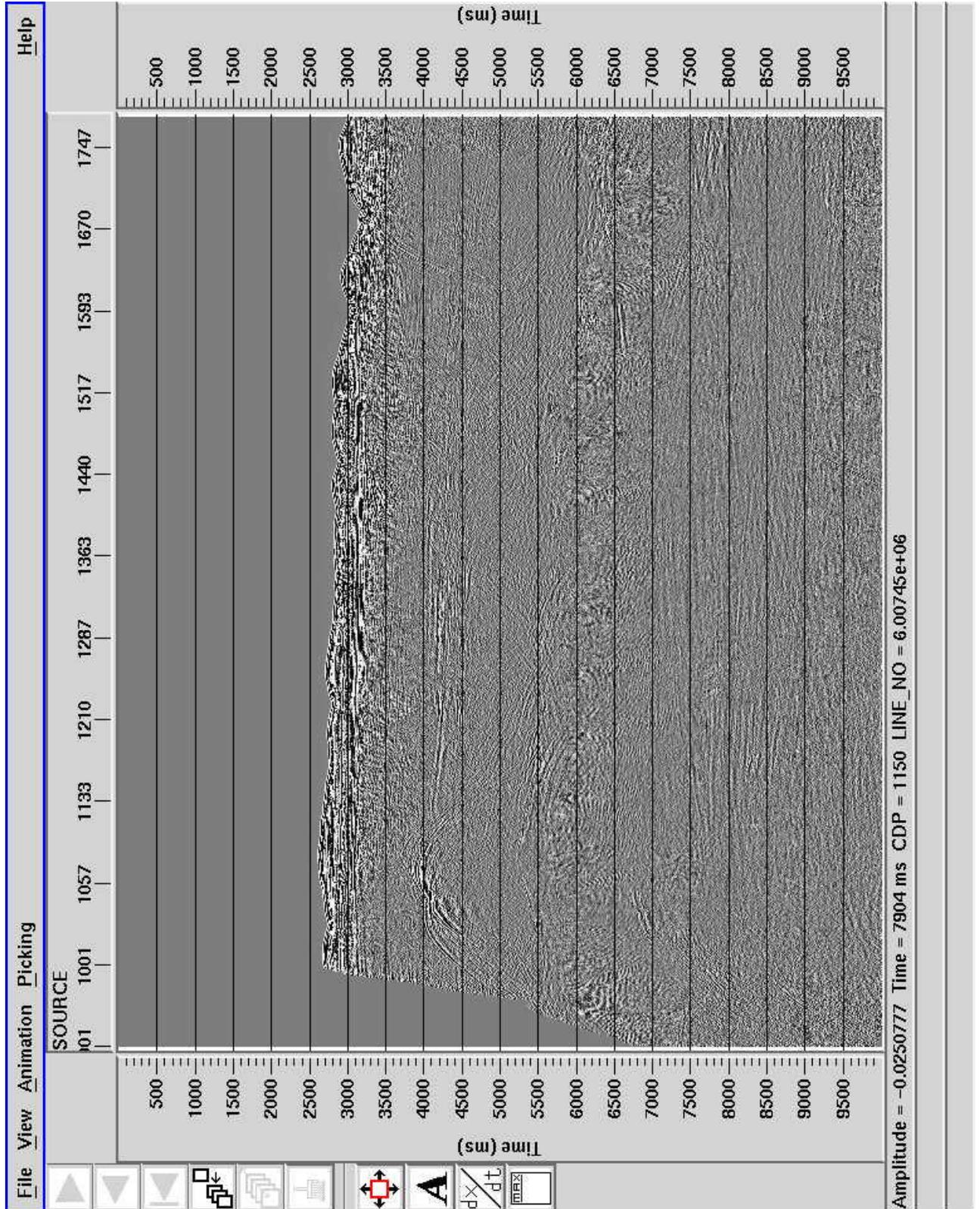
# Section 6I: Onboard Processing

Raw stack: Ormsby band-pass 4-8-90-120 Hz filter applied; Line: SS02-06-013.



# Section 6I: Onboard Processing

Brute stack: Ormsby band-pass filter, inside trace mute and predictive deconvolution applied; Line: SS02-06-013.



**APPENDIX I**

**SPECTRAL ANALYSIS**

# Section 6I: Onboard Processing

Line SS02-01-001

