



SEISMIC DATA PROCESSING REPORT

for

ORIGIN ENERGY

Project:	T/18P
Survey:	Shearwater 2D and 3D
Location:	Bass Basin
Date:	February 2006

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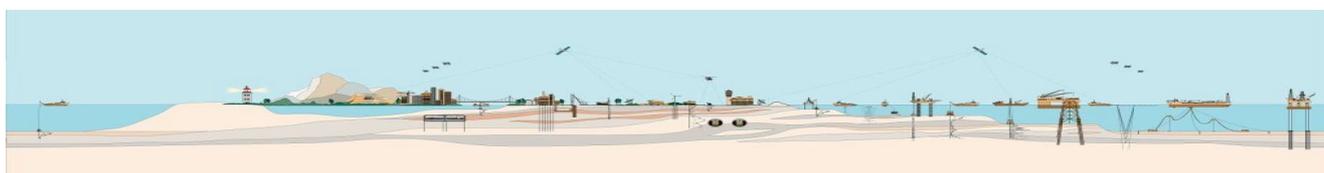


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1 Introduction

The Shearwater 3D survey consisted of a 250 sq. km (or 208 sq km full fold) and 202 sail km 2D lines. The data was acquired by P.G.S. using M/V Orient Explorer towing 4 X 4350 m streamers, 100 m separation and dual gun arrays, of 50 m separation. The data was acquired between 14th November to 9th December 2005.

Processing commenced in January to July 2006. All processing were undertaken at the Fugro Seismic Imaging office in Perth, Western Australia. All testing results were presented in Powerpoint format and delivered with SEG Y file when required. All velocity QC's were created on DVDs and sent to Origin's office in Brisbane where a MGIVA system provided by FSI earlier.

1.1 Personnel

Fugro Seismic Imaging Pty Ltd

Robert Fletcher	Marine 3D Manager
C.K. Ong	Senior Geophysicist

Origin Energy

Mike Lonergan	Staff Geophysicist
Randall Taylor	Chief Geophysicist

1.2 Location Map

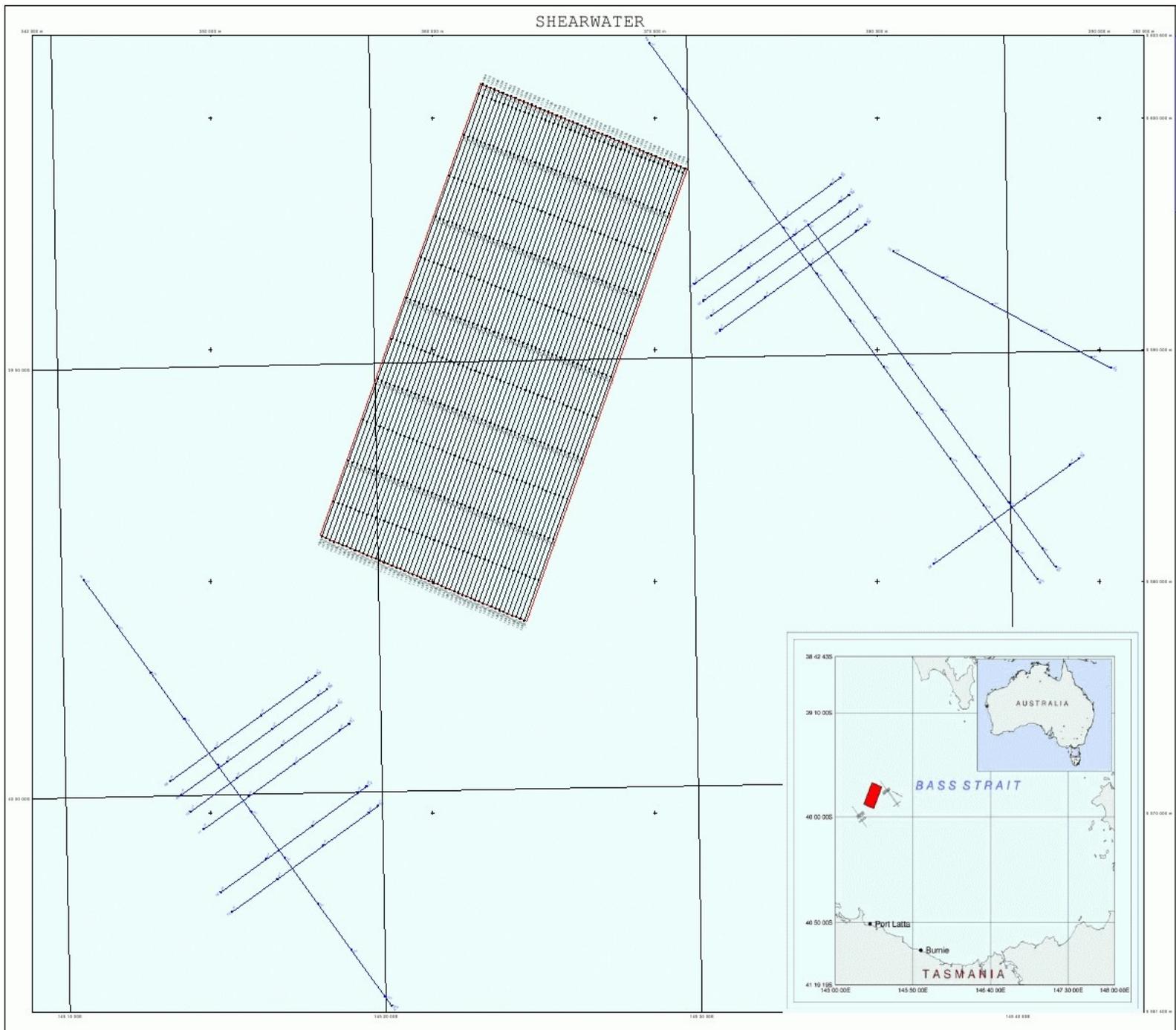


Figure 1: Shearwater 2D and 3D line location map.

1.3 Tape/Line Listing

Tape No.	Line/Seq.No.	Seq	FFID	FSP	FGSP	LFID	LSP	LGSP
39732	OS2D2007P1001	1	1	840	840	951	9	13
39734	OS051180P1003	3	100	2119	2119	1030	1199	1199
39735	OS051180P1003	3	1031	1198	1198	1352	888	892
39736	OS051396P1004	4	100	1001	1001	1030	1920	1920
39737	OS051396P1004	4	1031	1921	1921	1354	2232	2228
39738	OS051172P1005	5	100	2119	2119	1030	1199	1199
39739	OS051172P1005	5	1031	1198	1198	1350	889	893
39740	OS051388P1006	6	100	1002	1002	1030	1907	1907
39741	OS051388P1006	6	1031	1908	1908	1365	2232	2228
39742	MONTHLY TEST	0	1	0	0	12	0	0
39743	OS051164P1007	7	100	2119	2119	649	1590	1681
39744	OS051164P2008	8	100	1690	1690	923	889	893
39745	OS051380P1009	9	100	1002	1002	1030	1922	1922
39746	OS051380P1009	9	1031	1923	1923	1350	2232	2228
39747	OS051156P1010	10	100	2120	2120	1030	1201	1201
39748	OS051156P1010	10	1031	1200	1200	1352	889	893
39749	OS051380J1011	11	100	1002	1002	1030	1921	1921
39750	OS051380J1011	11	1031	1922	1922	1351	2232	2228
39751	OS051148P1012	12	100	2120	2120	1030	1202	1202
39752	OS051148P1012	12	1031	1201	1201	1352	889	893
39753	OS051372P1013	13	100	1002	1002	1030	1922	1922
39754	OS051372P1013	13	1031	1923	1923	1165	2057	2057
39755	OS051372P1013	13	1167	2059	2059	1351	2233	2229
39756	OS051140P1014	14	100	2120	2120	1030	1200	1200
39757	OS051140P1014	14	1031	1199	1199	1351	890	894
39758	OS051364P1015	15	100	1002	1002	237	1129	1129
39759	OS051364P1015	15	238	1130	1130	1168	2060	2060
39760	OS051364P1015	15	1169	2061	2061	1352	2233	2229
39761	OS051132P1016	16	100	2121	2121	1030	1202	1202
39762	OS051132P1016	16	1031	1201	1201	1352	890	894
39763	OS051356P1017	17	100	1003	1003	1030	1921	1921
39764	OS051356P1017	17	1031	1922	1922	1352	2233	2229
39765	OS051132J1018	18	101	2121	2121	1030	1202	1202
39766	OS051132J1018	18	1031	1201	1201	1164	1068	1068
39767	OS051132J1018	18	1166	1066	1066	1352	890	894
39768	OS051356J1019	19	100	1003	1003	1030	1923	1923
39769	OS051356J1019	19	1031	1924	1924	1350	2233	2229
39770	OS051124P1020	20	NTBP					
39771	OS051124P1020	20	100	2121	2121	2919	1213	1213
39772	OS051124P1020	20	2920	1212	1212	3252	890	894
39773	OS051348P1021	21	2000	1003	1003	1022	1914	1914
39774	OS051348P1021	21	1023	1915	1915	1349	2233	2229
39775	OS051116P1022	22	100	2121	2121	1030	1203	1203
39776	OS051116P1022	22	1031	1202	1202	1352	891	895
39777	OS051340P1023	23	100	1003	1003	1030	1923	1923
39778	OS051340P1023	23	1031	1924	1924	1352	2234	2230
39779	OS051116J1024	24	100	2121	2121	1030	1201	1201
39780	OS051116J1024	24	1031	1200	1200	1352	891	895
39781	OS051332P1025	25	100	1003	1003	236	1129	1129
39782	OS051332P1025	25	238	1131	1131	1168	2061	2061
39783	OS051332P1025	25	1169	2062	2062	1354	2234	2230
39784	OS051108P1026	26	NTBP					

Tape No.	Line/Seq.No.	Seq	FFID	FSP	FGSP	LFID	LSP	LGSP
39785	OS051108P2027	27	100	2121	2121	1012	1218	1218
39786	OS051108P2027	27	1013	1217	1217	1351	891	895
39787	OS051332J1028	28	100	1003	1003	1030	1938	1938
39788	OS051332J1028	28	1031	1939	1939	1336	2234	2230
39789	OS051100P1029	29	100	2122	2122	534	1711	1743
39790	OS051332R1030	30	100	1688	1688	265	1831	1826
39791	OS051100P2031	31	100	1752	1752	981	891	895
39792	OS051324P1032	32	100	0	0	116	0	0
39793	OS051324P1032	32	117	1004	1004	247	1124	1124
39794	OS051324P1032	32	249	1126	1126	1149	2015	2011
39795	OS051092P1033	33	100	2122	2122	1030	1201	1201
39796	OS051092P1033	33	1031	1200	1200	1159	1072	1072
39797	OS051092P1033	33	1161	1070	1070	1350	891	895
39798	OS051092J1034	34	100	2122	2122	2919	1213	1213
39799	OS051092J1034	34	2920	1212	1212	3251	891	895
39800	OS051316P1035	35	100	1004	1004	232	1127	1127
39801	OS051316P1035	35	234	1129	1129	1025	1920	1920
39802	OS051316P1035	35	1027	1922	1922	1348	2234	2230
39803	OS051084P1036	36	100	2122	2122	1030	1203	1203
39804	OS051084P1036	36	1031	1202	1202	1352	892	896
39805	OS051308P1037	37	100	1004	1004	1030	1923	1923
39806	OS051308P1037	37	1031	1924	1924	1352	2235	2231
39807	OS051076P1038	38	NTBP					
39808	OS051076P1038	38	NTBP					
39809	OS051300P1039	39	100	1004	1004	1030	1922	1922
39810	OS051300P1039	39	1031	1923	1923	1353	2235	2231
39811	OS051076P2040	40	100	2122	2122	337	1895	1895
39812	OS051076P2040	40	338	1894	1894	1268	964	964
39813	OS051076P2040	40	1269	963	963	1351	892	896
39814	OS051300J1041	41	100	1004	1004	1030	1924	1924
39815	OS051300J1041	41	1031	1925	1925	1351	2235	2231
39816	OS051068P1042	42	100	2123	2123	1030	1203	1203
39817	OS051068P1042	42	1031	1202	1202	1352	892	896
39818	OS051292P1043	43	100	1005	1005	859	1754	1754
39819	OS051292P1043	43	861	1756	1756	1351	2235	2231
39820	OS051060P1044	44	100	2123	2123	1030	1204	1204
39821	OS051060P1044	44	1031	1203	1203	1352	892	896
39822	OS051284P1045	45	100	1005	1005	1030	1925	1925
39823	OS051284P1045	45	1031	1926	1926	1350	2235	2231
39824	OS051060J1046	46	100	2123	2123	1030	1203	1203
39825	OS051060J1046	46	1031	1202	1202	1351	892	896
39826	OS051284J1047	47	100	1005	1005	1030	1922	1922
39827	OS051284J1047	47	1031	1923	1923	1354	2235	2231
39828	OS051052P1048	48	100	2123	2123	1030	1203	1203
39829	OS051052P1048	48	1031	1202	1202	1350	893	897
39830	OS051276P1049	49	100	1005	1005	1030	1925	1925
39831	OS051276P1049	49	1031	1926	1926	1352	2236	2232
39832	OS051052J1050	50	100	2123	2123	1030	1203	1203
39833	OS051052J1050	50	1031	1202	1202	1300	933	933
39834	OS051052J1050	50	1302	931	931	1355	893	897
39835	OS051268P1051	51	100	1006	1006	1030	1926	1926
39836	OS051268P1051	51	1031	1927	1927	1351	2236	2232
39837	OS051188P1052	52	NTBP					
39838	OS051188P1052	52	NTBP					

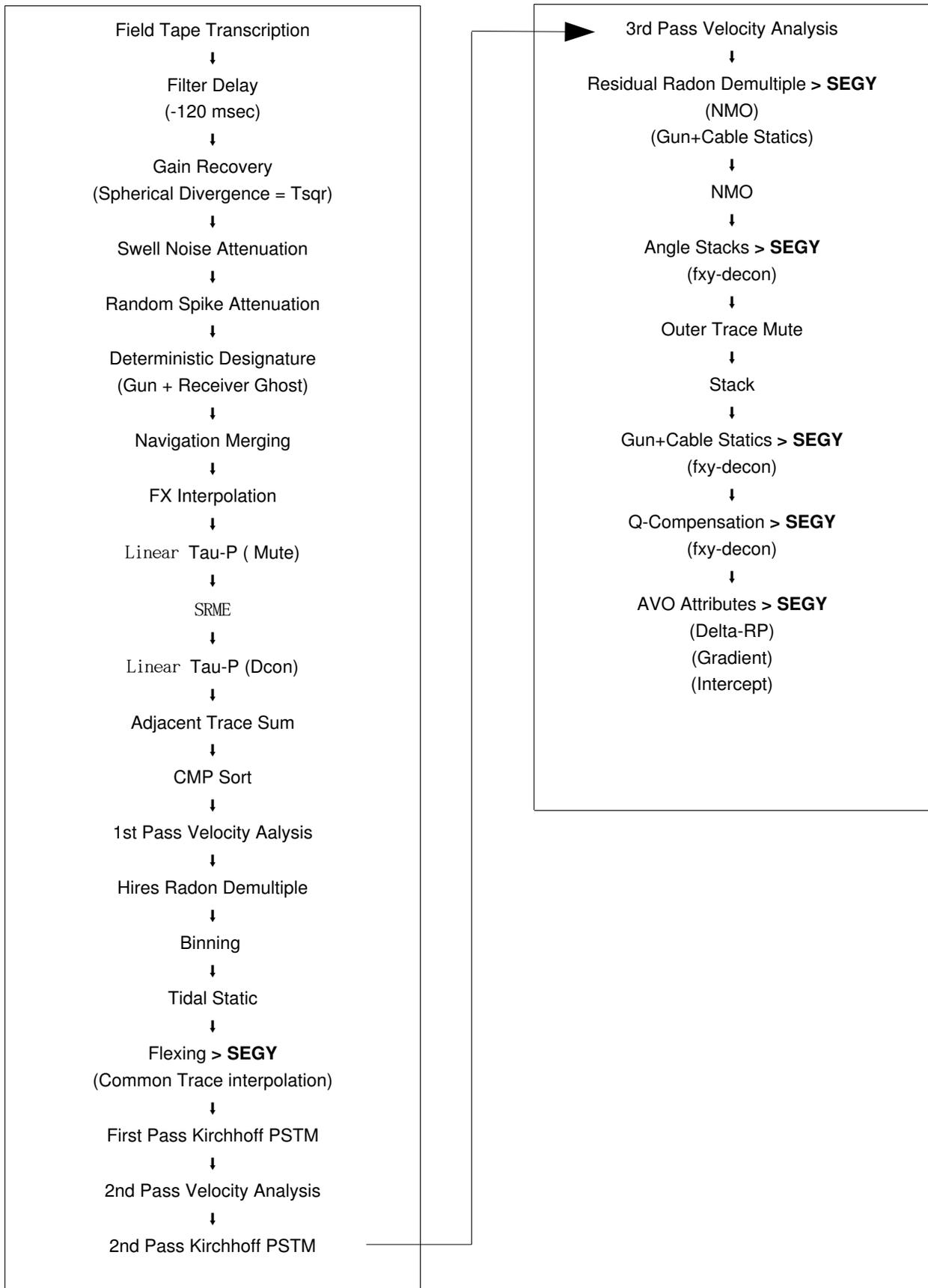
Tape No.	Line/Seq.No.	Seq	FFID	FSP	FGSP	LFID	LSP	LGSP
39839	OS051052J2053	53	100	2123	2123	1030	1203	1203
39840	OS051052J2053	53	1031	1202	1202	1350	893	897
39841	OS051260P1054	54	100	1006	1006	1030	1926	1926
39842	OS051260P1054	54	1031	1927	1927	1351	2236	2232
39843	OS051044P1055	55	100	2123	2123	1030	1203	1203
39844	OS051044P1055	55	1031	1202	1202	1350	893	897
39845	OS051260J1056	56	3000	0	0	3009	0	0
39846	OS051260J1056	56	3010	1006	1006	3940	1936	1936
39847	OS051260J1056	56	3941	1937	1937	4250	2236	2232
39848	OS051036P1057	57	100	2124	2124	1030	1204	1204
39849	OS051036P1057	57	1031	1203	1203	1352	893	897
39850	OS051252P1058	58	100	1006	1006	235	1131	1131
39851	OS051252P1058	58	237	1133	1133	1167	2063	2063
39852	OS051252P1058	58	1168	2064	2064	1350	2237	2233
39853	OS051028P1059	59	100	2124	2124	1030	1204	1204
39854	OS051028P1059	59	1031	1203	1203	1350	897	897
39855	OS051244P1060	60	100	1006	1006	1030	1926	1926
39856	OS051244P1060	60	1031	1927	1927	1351	2237	2233
39857	OS051028J1061	61	100	2124	2124	237	1998	1998
39858	OS051028J1061	61	239	1996	1996	1169	1066	1066
39859	OS051028J1061	61	1170	1065	1065	1352	893	897
39860	OS051236P1062	62	100	1007	1007	1030	1927	1927
39861	OS051236P1062	62	1031	1928	1928	1349	2237	2233
39862	OS051020P1063	63	100	2124	2124	1030	1204	1204
39863	OS051020P1063	63	1031	1203	1203	1350	894	898
39864	OS051228P1064	64	100	1007	1007	369	1265	1265
39865	OS051228P1064	64	371	1267	1267	1301	2197	2197
39866	OS051228P1064	64	1302	2198	2198	1349	2237	2233
39867	OS051188P2065	65	100	2119	2119	1030	1202	1202
39868	OS051188P2065	65	1031	1201	1201	1353	888	892
39869	OS051228J1066	66	100	1008	1008	1030	1927	1927
39870	OS051228J1066	66	1031	1928	1928	1356	2237	2233
39871	OS2D3014P1067	67	2011	1020	1020	2085	946	946
39872	OS2D3014P1067	67	2086	945	945	2998	33	33
39873	OS2D3014P1067	67	2999	32	32	3018	13	13
39874	OS2D3010P1068	68	6000	420	420	529	9	13
39875	OS2D3013P1069	69	100	100	100	531	511	507
39876	OS2D3009P1070	70	100	420	420	530	9	13
39877	OS2D3011P1071	71	100	100	100	531	511	507
39878	OS051220P1072	72	100	1007	1007	1030	1926	1926
39879	OS051220P1072	72	1031	1927	1927	1351	2238	2238
39880	OS051212P1073	73	100	1007	1007	633	1530	1530
39881	OS051212P1073	73	635	1532	1532	1351	2238	2234
39882	OS051012P1074	74	100	2125	2125	1030	1205	1205
39883	OS051012P1074	74	1031	1204	1204	1350	894	898
39884	OS051212J1075	75	100	1007	1007	1030	1927	1927
39885	OS051212J1075	75	1031	1928	1928	1351	2238	2234
39886	OS051004P1076	76	100	2125	2125	1030	1204	1204
39887	OS051004P1076	76	1031	1203	1203	1348	894	898
39888	OS051204P1077	77	100	1008	1008	1030	1927	1927
39889	OS051204P1077	77	1031	1928	1928	1350	2238	2234
39890	OS051004J1078	78	100	2125	2125	1030	1205	1205
39891	OS051004J1078	78	1031	1204	1204	1349	894	898

Tape No.	Line/Seq.No.	Seq	FFID	FSP	FGSP	LFID	LSP	LGSP
39892	OS051196P1079	79	100	1008	1008	1030	1927	1927
39893	OS051196P1079	79	1031	1928	1928	1352	2238	2234
39894	OS051188J1080	80	100	2119	2119	1030	1199	1199
39895	OS051188J1080	80	1031	1198	1198	1350	888	892
39896	OS051196J1081	81	101	1040	1040	565	1481	1476
39897	OS051324P2082	82	100	2002	2002	352	2234	2230
39898	OS2D2006P1083	83	100	101	101	1012	1000	1000
39899	OS2D2006P1083	83	1013	1001	1001	1373	1351	1347
39900	OS2D2005P1084	84	100	100	100	532	511	507
39901	OS2D3012P1085	85	101	100	100	532	511	507
39902	OS2D2003P1086	86	100	100	100	531	511	507
39903	OS2D2001P1087	87	100	420	420	230	300	300
39904	OS2D2001P1087	87	232	298	298	530	9	13
39905	OS2D2004P1088	88	100	100	100	356	346	346
39906	OS2D2004P1088	88	358	348	348	531	511	507
39907	OS2D2002P1089	89	100	420	420	531	9	13
39908	OS2D3008P1090	90	100	420	420	531	9	13
39909	MONTHLY TEST	0	1	0	0	12	0	0

2 Acquisition Parameters

DESCRIPTION	DETAILS
Data recorded by :	P.G.S.
Date recorded :	14 th Nov-9 th Dec 2005
Vessel :	Orient Explorer
General :	
Field CMP interval	8 X 6.25 m
Nominal fold	58
Recording format :	SEG-D 8036
Seismic source :	
Type	Bolt 1500LL / 600B guns
Volume	2 X 2500 cu.in
Pressure :	1800 psi
Depth :	6.0 m
Shot interval 3D :	37.5 m flip-flop
Shot interval 2D :	25.0 m
Recording system :	
Instrument :	Syntrak / gAS
Record length / Sample interval	5120 / 2.0 msec
Recording Filter	3/12-206/276 Hz/(dB/Oct)
Filter Delay	-120 msec
Gain Setting	12 dB
Receivers:	
Streamer Type :	Syntron / Teledyne LDA
Data Channels :	4 X 348
Streamer depth :	8.0 m
Nominal near group offset :	96.0 m
Polarity Convention	
	SEG, +ve pressure gives -ve no.

3 Processing Sequence



4 Processing Description

A brief description of each of the processes used in the processing sequence follows:

4.1 Transcription

Field data in SEG-D format was converted to Fugro Seismic Imaging internal format for processing. Fugro Seismic Imaging internal format is trace sequential, with samples in 32 bit IEEE floating point. When reading the shot records, strategic header values related to acquisition were reserved (where available).

4.2 Filter Delay

A static correction of -120 msec. was applied to compensate for system digital filter delay.

4.3 Gain Recovery

A gain function was applied to the data set to compensate for amplitude decay. The functions applied used a T squared compensation for inelastic attenuation and spherical divergence losses. (T is the two way travel time in milliseconds).

4.4 Swell Noise Attenuation

Swell noise attenuation is achieved by shaping the amplitude spectra of selected "swell noise affected" traces.

Analysis and attenuation are performed in the FX domain, processing one source position at a time. For analysis, the amplitude spectra are normalized, considering only the higher frequency range which is less influenced by swell noise. After normalization the swell noise traces are recognized by their relatively high amplitude, low frequency component. The shallow portion of each shot record is muted before analysis, removing the high amplitude shallow reflections and direct arrivals.

The user nominates a frequency range for analysis, and for spectral scaling. Typically this frequency range is from 0 to 32 Hz. Scalars are calculated to shape the spectra of individual swell noise affected traces to the mean of the non swell noise affected traces. The scalars are fully applied from 0 to one half the defined frequency range, after which the scalars are tapered to zero application at the maximum defined frequency. No modification is made to other traces.

The mechanism of swell noise recognition is not influenced by change in source energy, or by systematic variation in trace amplitude levels. Shots not affected by swell noise will not present any traces for swell noise attenuation.

The swell noise attenuation is monitored by recording the number of channels flagged as being affected by swell noise.

4.5 Random Spike Attenuation

Despike was applied to remove any anomalous high energy amplitudes which could be the source of noise in the pre-stack migration. Amplitudes were measured in a matrix of 45 time windows of 100 ms length. The matrix was composed of seven consecutive time windows across 11 adjacent traces in a shot gather. The amplitude of the centre window is compared to the rest of the matrix and the centre window is defined as containing a spike if the peak to median ratio is greater than 15, or if the centre window median value exhibits more than 8.0 units of standard deviation from the average median. Spike affected windows are scaled to the mean of the matrix.

4.6 Instrument Dephase and Source Designature

A filter was designed to convert the supplied far field signature to its zero phase equivalent. The effect of applying this filter to the data is to remove the phase rotations caused by the recording instruments, and to collapse the effective source signature. The data was output zero-phase.

The modeled source far field signature, full system response with source and receiver ghost is shown below and the listing is include in section 7 of this report.

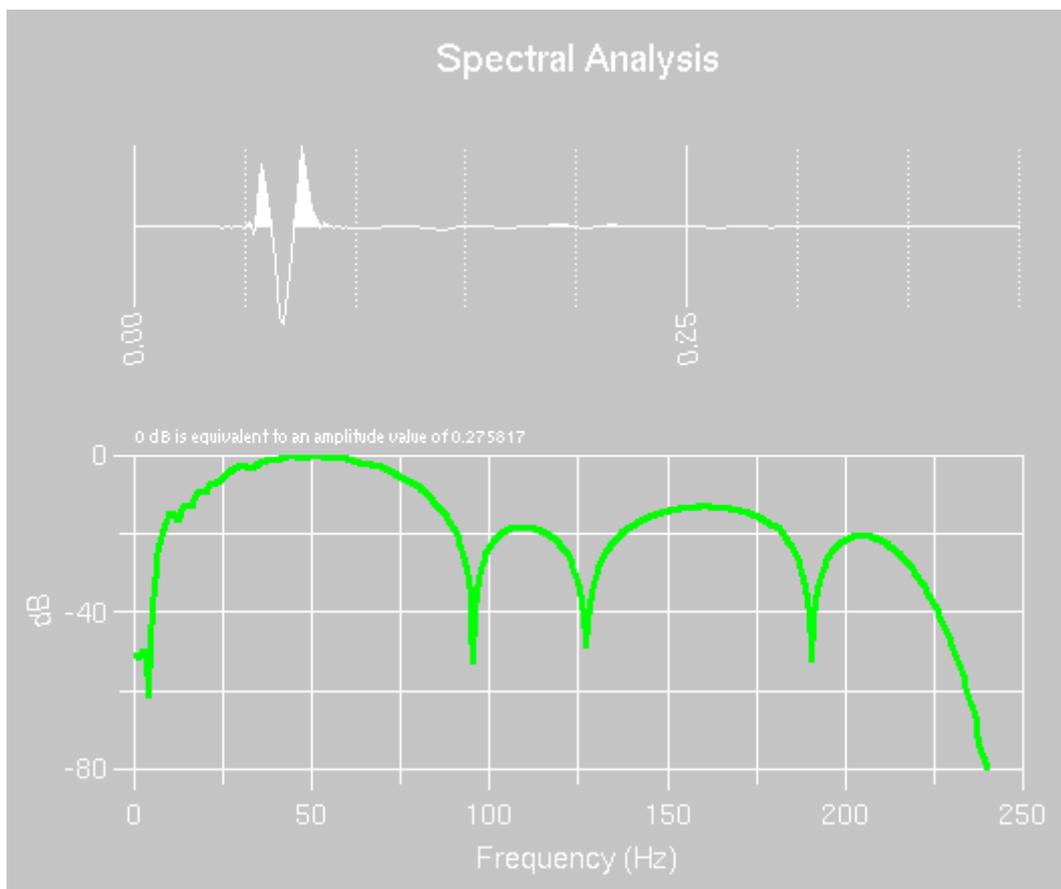


Figure 2: Modeled Source Signature. Full system response with source and receiver ghost.

4.7 Seismic/Navigation Merge

The seismic trace headers were updated with easting and northing values from the supplied navigation files. The acquisition time in the navigation files and seismic headers were compared to ensure a correct match (with a tolerance of 4 seconds). The water depth (depth at sounder) was updated and the sea floor two way time calculated using a water velocity of 1500m/s. Trace offsets were calculated using the source and receiver coordinates.

CLOCK TIME	GMT
GEODETTIC DATUM AS SURVEY	GDA94 GRS1980 6378137.000 298.2572221
GEODETTIC DATUM FOR POST	GDA94 GRS1980 6378137.000 298.2572221
PROJECTION	002 UTM SOUTH
ZONE	55S
CENTRAL MERIDIAN	147 0 0.000E

4.8 FX-Interpolation

To reduce the potential for aliasing, 2:1 F-X interpolation was performed, output trace spacing of 6.25 m, prior to Tau-p linear transform. The spatial interpolation is based on the forward-backward linear prediction [FBLP] theory (cf., Tufts and Kumaresan, 1982; Spitz, 1991).

4.9 Tau-P Linear Transformation (Mute)

The shot record seismic data was transformed into the Tau-p domain performed in linear mode. The transform Delta-T ranged from -2000 msec to +4000 msec at offset 4520 meters with increment at 8 msec and output 751 P-traces.

A spatial Time vs P-variant mute with a cosine square taper was applied to eliminate linear noise generated within the water column.

Time (msec)	P-trace mute on	P-trace mute off
-100	150 - 200	600 - 700
250	150 - 200	410 - 490
500	150 - 200	400 - 470
1000	150 - 200	390 - 450
2000	150 - 200	380 - 440
5000	150 - 200	375 - 440

4.10 Surface Related Multiple Elimination (S.R.M.E.)

SRME or **S**urface **R**elated **M**ultiple **E**limination uses the geometry of shot recording to estimate all possible multiples that can be generated by the surface. It was developed by the Delphi Consortium at Tu Delft in the Netherlands. One order of surface related multiples is predicted using auto-convolutions of input data. The predicted multiple energy is then removed from the input gathers by a process of cascaded adaptive subtraction.

Prior to forming the multiple estimate, it is necessary to interpolate new shots such that the shotpoint interval is equal to the group interval. The recorded data is then extrapolated to zero offset and regularized before constructing the multiple estimate by a series of convolutions and summation.

4.11 Tau-P Linear Transformation (DBS)

The shot record seismic data was transformed into the Tau-p domain performed in linear mode. The transform Delta-T ranged from -2000 msec to +4000 msec at offset 4520 meters with increment at 8 msec and output 751 P-traces.

Predictive deconvolution was utilized to attenuate short period reverberations. A single operator was used. The short period reverberation is more periodic in tau-p domain than in t-x domain

Operator Length (msec)	300
Gap (msec)	32
Design Gate (msec)	0 - 3500

4.12 Adjacent Trace Sum

A 2:1 adjacent trace sum was applied to form a 37.5 m/25.0 m shot/group interval geometry. This was applied after NMO correcting the shots with the first pass velocity functions. A trace mix was also applied during the summation process:

4.13 CMP Gather

Data from each source/cable combination was sorted into the common midpoint domain gathers. With a nominal fold of 58.

4.14 First Pass Velocity Analysis

First pass velocities at 1000 X 1000 m grid were determined using Fugro Seismic Imaging Pty Ltd "MGIVA" interactive velocity analysis program on crude gathers (FK filter and DBS applied). Each velocity analysis comprised a semblance display, a CDP stacked panel repeated 14 times with a suite of velocity functions, and a central CDP gather. The suite of functions were generated using 0%, +/-5 %, +/-10%, +/-15%, +/-20 %, +/-25%, +/-30%, and +40% increments from a central velocity function. The central functions were final velocity functions varying according to WBT derived from the previously processed data.

A mild F-K multiple attenuation was applied to enhance the primary energy of the data before the analysis using the following percentages of the brute velocity function: - -10% at 1000 ms and -15% at 2500 ms. This was applied for the purpose of the analysis only.

The velocity analysis incorporated a map of all velocity locations, and the semblance display included functions from proximate lines. This enabled the velocities to be picked with knowledge of areal velocity trends. Velocity QC can be performed more effectively when discordant velocities can be recognised on the map.

4.15 Radon Multiple Attenuation (HI-Res)

Radon demultiple was generally applied from WBT plus 400 ms to record lengths. This process was performed in the high resolution parabolic Tau-P domain using NMO corrected gathers with 1st pass velocity functions.

The Tau-P transform range was -1000 to 2000 ms and was sampled over 301 p traces. The multiples were modelled from :

Multiple attenuation was accomplished by subtracting modelled multiples from input gathers.

To reduce the potential for aliasing, 2:1 F-X interpolation was performed along common offset domain prior to demultiple. After demultiple, interpolated traces were dropped from the processing stream.

A 300 ms AGC was applied before the Radon demultiple, and the scalars preserved for later removal.

4.16 Binning

The data was binned, output onto a 12.50 m inline and 25.00 m crossline grid. No flexing was performed. Missing traces from each offset plane were interpolated using a 3D dip model derived from the full offset stack.

Grid Definition :

	Easting	Northing	Crossline	Inline	Increment
Grid Origin	351556.18	5578658.54	787	921	1 X 1

Azimuth	20.29 degrees
Line Interval	25.00 m
CMP Interval	12.50 m
Datum	GDA94
Central Meridian	147 0 0.000E
Projection Type	002 UTM SOUTHERN HEMISPHERE
Projection Zone	55S

4.17 Tidal Static

Tidal Static were computed using measured sea level from Burnie Sea Level Observation in Tasmania. The tidal static were computed with reference to MSL in 6.0 minute interval and applied to the binned gathers.

4.18 First Pass Kirchhoff PSTM

Full pre-stack Kirchhoff time migration was used to migrate data for velocity analysis. FSI's SHIMOGEN migration algorithm was used in straight ray mode, with a 4 km half aperture. The velocity field was constructed by smoothing the first pass velocities. Apertures were muted with a 50% stretch mute to avoid operator aliasing. Migration was performed on all the offset planes. The migration generates fully corrected CDP gathers on each line. The migration velocity field is then used to 'remove' the NMO corrections before velocity analysis.

4.19 Second Pass Velocity Analysis

The second pass of velocities were picked at 500 X 500 m grid on first pass PSTM gathers using Fugro Seismic Imaging Pty Ltd "MGIVA" interactive velocity analysis program. Each velocity analysis comprised a semblance display, a CDP stacked panel repeated 14 times with a suite of velocity functions, and a central CDP gather. The suite of functions were generated using 0%, +/-4%, +/-8%, +/-12%, +/-16%, +/-20% , +/-24% and +30% increments from a central velocity function. The first pass of velocities were used as the central function for this suite of velocity variant functions.

4.20 Second Pass Kirchhoff PSTM

Kirchhoff pre-stack time migration was applied using a maximum half aperture of 4 km. Anti-aliasing protection was applied by pre-filtering the data within the migration scan depending upon the local migration operator dip. Smoothed 100% second pass velocities at 1 km were used in the migration except at the end of the data where velocities were reduced to lessen the migration artefacts. Migration was performed on all offset planes.

4.21 Third Pass Velocity Analysis

The third pass of velocities were picked on a 250 X 250 m grid on second pass PSTM gathers using Fugro Seismic Imaging Pty Ltd "MGIVA" interactive velocity analysis program. Each velocity analysis comprised a semblance display, a CDP stacked panel repeated 14 times with a suite of velocity functions, and a central CDP gather. The suite of functions were generated using 0%, +/-4%, +/-8%, +/-12%, +/-16%, +/-20% , +/-24% and +30% increments from a central velocity function. The second pass of velocities were used as the central function for this suite of velocity variant functions.

4.22 Residual Radon Demultiple (Hi-Res)

The initial demultiple processing was performed in the knowledge that some multiple energy remained in the data. A conservative approach was necessary until the velocities could be more accurately interpreted on the finer sampled grid, and with the benefit of pre-stack time migration. This remnant multiple energy could then be addressed with a 'residual' demultiple.

Normal moveout corrections were performed using the final velocities, and the pre-stack time migrated gathers transformed into the parabolic Tau-P domain. Weighting terms were added to the least squares solution to reduce residual error in the transform – a method known as "high resolution radon". The segment of the Tau-P domain corresponding to primary reflections was then muted, leaving the multiple energy to be transformed back into the T-X domain and subtracted from the original CDP gather.

The Tau-P transform range was –500 to 3000 ms and was sampled over 351 p traces. Multiple attenuation was accomplished by subtracting modelled multiples from input gathers.

To reduce the potential for aliasing, 2:1 F-X interpolation was performed in CDP domain prior to demultiple. After demultiple, interpolated traces were dropped from the processing stream.

A 300 ms AGC was applied before the Radon demultiple, and the scalars preserved for later removal.

4.23 NMO Correction

Fourth order NMO corrections were applied using the final picked PSTM velocity functions.

4.24 Angle Stacks

The Near, Mid and Far angle stacks were created with incident angle mutes listed below. A +9.0 msec static compensation for gun and cable depths was applied. FXY deconvolution was applied prior SEG Y output.

Near Angle	0 – 15 degree
Mid Angle	15 – 30 degree
Far Angle	30 -45 degree

4.25 Outer Trace Mute

A post NMO outer trace mute was applied to remove any coherent noise on the outer traces and to reduce contamination from the effect of NMO stretch on the far offsets.

General outer trace mutes :

Offset (m)	130	210	810	4410
Time (Msec)	0	0	500	2800

4.26 Common Depth Point Stack

The traces within each common depth point gather were summed using 1/root(N) stack compensation. The raw angle stacks were summed using 1/N stack compensation.

4.27 Gun and Cable Statics

A +9.0 msec static compensation for gun and cable depths was applied.

4.28 FXY Deconvolution

FXY Deconvolution was applied to reduce random noise. The method is based on the forward-backward linear prediction [FBLP] theory (cf., Tufts and Kumaresan, 1982).

4.29 Q-Compensation

Two fundamental properties associated with wave propagation through subsurface materials are: energy dissipation of plane waves with high frequency, and velocity dispersion by which plane waves of high frequency

travel faster than ones with low frequency. These effects may be represented mathematically as the earth Q-filter, defined in terms of a specified earth Q model.

In seismic data processing where the earth Q model is often assumed to be frequency independent, inverse Q-filtering attempts to compensate recorded seismic signals for these wave propagation effects. A general stabilization scheme (both phase and amplitude) was used. A value of Q = 180 and a Gain Limit of 12 dB were used. FXY deconvolution was applied prior to SEG Y output.

5 AVO Processing

Three Separate AVO products were produced: Intercept(I), Gradient(G), and Delta-Rp.

The data was processed in an amplitude consistent manor. The good S/N ratio of the data set suggests that AVO analysis should be relatively reliable. The cable length of 4400m gave sufficient angle sampling ie. 40 degrees at a target of 3 seconds.

5.1 Ostrander Mix

The PSTM gathers were NMO corrected as per section 5.20 and an Ostrander mix was performed to improve the S/N ratio of the pre-stack data. An "Ostrander Mix" involves a dual combination of a three trace mix in the common-offset domain and in the CDP domain.

Ostrander Mix	
Trace mix weights:	1,1,1
Apply:	Both common offset and common CDP.

5.2 Band Pass Filter

Bandpass Filter Parameters	
Time (msec)	Frequency trapezoid (Hz)
0	3/6 – 90/105
4000	1/4 – 40/50

5.3 Linear Gain

Inelastic absorption of energy was corrected for by an exponential gain application of 4dB per second.

5.4 Phase Rotation

The data was phase shifted 180 degrees to convert it from SEG negative to SEG positive; the convention required for AVO analysis.

5.5 AVO Analysis

Three 3D cubes were produced.

i) Intercept (I)

I represents intercept, which is the zero offset reflection coefficient.

ii) Gradient (G)

G represents Gradient which is essentially the change in amplitude with offset at any particular time sample within a CDP gather.

iv) Delta Rp

This method is based on the concept of cross plotting AVO measurements. Data input to the cross plot are Rp (or Intercept) and the Gradient measurement from the seismic gathers. The algorithm calculates a lithological trend from the Rp and Gradient data. This trend represents the average response of brine filled rocks in the analysis window. Unusual rocks like gas-filled sands are displaced from this wet trend. The Delta Rp calculation is the reflectivity separation between a data point with the anomalous reflectivity and the trend. The top of a class III hydrocarbon saturated sand unit is a negative amplitude anomaly, whereas the base is a positively amplitude anomaly.

5.6 Gun and Cable Statics

A +9.0 msec static compensation for gun and cable depths was applied to the three AVO cubes.

6 Archive

The following data sets were archived :

Tape No.	Dataset	Inline Range	Remark
028MV001DVD	MGIVA VA1		Bad
028MV002DVD	MGIVA VA1		
028MV003DVD	MGIVA VA2		
028MV004DVD	POST-STACK MIG. (KIRCHHOFF)	1000-1200	
028MV005DVD	POST-STACK MIG. (KIRCHHOFF)	1201-1400	Bad Destroyed
028MV006DVD	POST-STACK MIG. (KIRCHHOFF)	1201-1400	Replace 028MV005DVD
028MV007DVD	VA3 MGIVA FILES VOLUME 1/4		
028MV008DVD	VA3 MGIVA FILES VOLUME 2/4		
028MV009DVD	VA3 MGIVA FILES VOLUME 3/4		
028MV010DVD	VA3 MGIVA FILES VOLUME 4/4		
028MV011DVD	PSTM (NO SCAMP)	1000-1200	

Tape No.	Dataset	Inline Range	Remark
028MV012DVD	PSTM (NO SCAMP)	1201-1400	
028MV013DVD	PSTM (SCAMP)	1000-1200	
028MV014DVD	PSTM (SCAMP)	1201-1400	
028MV015DVD	PSTM STACKS (Q-COMP)	1000-1200	
028MV016DVD	PSTM STACKS (Q-COMP)	1201-1400	
028MV017DVD	PSTM STACKS	1000-1200	
028MV018DVD	PSTM STACKS	1201-1400	
028MV019DVD	PSTM STACKS (Q-COMP/FXY-DECON)	1000-1200	
028MV020DVD	PSTM STACKS (Q-COMP/FXY-DECON)	1201-1400	
028MV021DVD	PSTM STACKS (FXY-DECON)	1000-1200	
028MV022DVD	PSTM STACKS (FXY-DECON)	1201-1400	
028MV023DVD	NEAR ANGLE STACKS (0-15 Degree)	1000-1200	
028MV024DVD	NEAR ANGLE STACKS (0-15 Degree)	1201-1400	
028MV025DVD	MID ANGLE STACKS (15-30 Degree)	1000-1200	Error Destroyed
028MV026DVD	MID ANGLE STACKS (15-30 Degree)	1201-1400	Error Destroyed
028MV027DVD	FAR ANGLE STACKS (30-45 Degree)	1000-1200	Error Destroyed
028MV028DVD	FAR ANGLE STACKS (30-45 Degree)	1201-1400	Error Destroyed
028MV029DVD	NEAR ANGLE STACKS (FXY-DECON)	1000-1200	
028MV030DVD	NEAR ANGLE STACKS (FXY-DECON)	1201-1400	
028MV031DVD	MID ANGLE STACKS (FXY-DECON)	1000-1200	
028MV032DVD	MID ANGLE STACKS (FXY-DECON)	1201-1400	
028MV033DVD	FAR ANGLE STACK (FXY-DECON)	1000-1200	
028MV034DVD	FAR ANGLE STACK (FXY-DECON)	1201-1400	
028MV035DVD	AVO ATTRIBUTE DELTA-RP	1101-1200/1201-1300	
028MV036DVD	AVO ATTRIBUTE DELTA-RP	1000-1100/1301-1400	
028MV037DVD	AVO ATTRIBUTE GRADIENT	1000-1200	
028MV038DVD	AVO ATTRIBUTE GRADIENT	1201-1400	
028MV039DVD	AVO ATTRIBUTE INTERCEPT	1000-1200	
028MV040DVD	AVO ATTRIBUTE INTERCEPT	1201-1400	
028MV041USB	BINNED GATHERS VOL.1/2	1000-1289	
028MV042USB	BINNED GATHERS VOL.2/2	1290-1400	
028MV043USB	PSTM GATHERS (NMO) VOL.1/2	1000-1259	
028MV044USB	PSTM GATHERS (NMO) VOL.2/2	1260-1400	

7 FAR-FIELD SIGNATURE LISTING

Full system response with source and receiver ghost

Array name : 2500LB_60_1800_100
Total volume : 2500 cu.in.
Source depth : 6.00 m
Streamer depth : 8.00 m
Group length : 0.00 m
Average pressure : 1800 psi
Ghost strength : -1.00
Seawater temperature : 20.00 C
Seawater velocity : 1521.6 m/s
Filter :
Low-cut frequency : 8.80 Hz
Low-cut slope : 18.00 dB/oct
High-cut frequency : 206.00 Hz
High-cut slope : 276.00 dB/oct
Instrument : S-24 g-6.25
Time of 1st sample: -56.00 msec i.e. index of time zero = 29.0
Sample interval : 2.00 msec resampled from 0.5 ms.
Far-field position :
Distance : 9000.00 m
Azimuth : 0.00 deg
Angle of vertical : 0.00 deg

Amplitudes are in bar m

Time is increasing horizontally

0.000	0.000	0.000	0.002	0.004	-0.026	-0.006	0.019	-0.023	0.051
-0.014	-0.018	0.069	-0.030	0.130	-0.039	0.119	-0.085	-0.218	0.135
-0.644	0.624	-0.542	0.440	0.468	-1.104	2.469	-4.496	14.337	36.628
15.120	-0.925	-20.905	-53.746	-57.064	-26.735	-3.662	17.700	46.480	31.486
9.306	5.344	-1.223	2.344	1.810	-0.727	0.466	-0.825	-0.266	-0.467
-0.818	-0.504	-0.822	-0.784	-0.575	-0.504	-0.342	-0.188	-0.175	-0.098
-0.098	-0.158	-0.095	-0.168	-0.317	-0.411	-0.687	-1.053	-1.471	-1.885
-1.856	-1.429	-0.833	-0.159	0.190	0.174	0.041	-0.146	-0.047	0.291
0.360	0.130	-0.415	-1.059	-1.214	-0.965	-0.475	0.138	0.370	0.275
0.103	-0.105	-0.016	0.366	0.807	1.297	1.534	1.405	1.086	0.469
-0.163	-0.517	-0.714	-0.528	-0.062	0.329	0.746	0.985	0.928	0.826
0.565	0.255	0.111	-0.054	-0.117	-0.060	-0.116	-0.119	-0.144	-0.246
-0.183	-0.152	-0.159	-0.021	-0.006	-0.043	-0.028	-0.183	-0.285	-0.324
-0.473	-0.476	-0.437	-0.437	-0.307	-0.208	-0.092	0.079	0.091	0.082
0.039	-0.139	-0.227	-0.319	-0.425	-0.329	-0.269	-0.224	-0.035	0.045
0.120	0.234	0.222	0.331	0.467	0.488	0.615	0.636	0.536	0.490
0.299	0.136	0.087	-0.067	-0.125	-0.129	-0.235	-0.238	-0.265	-0.346
-0.277	-0.262	-0.262	-0.161	-0.176	-0.173	-0.132	-0.184	-0.107	-0.015
0.009	0.141	0.177	0.122	0.121	0.025	-0.020	0.060	0.072	0.158
0.264	0.237	0.231	0.167	0.057	0.053	0.018	-0.010	0.030	0.000
-0.031									

8 SEG Y Header Information

Type	Offset	Description	Type	Offset	Description
I32	0	Trace number within line.	I32	196	Northing of CDP.
I32	4	Trace number within reel.	I16	200	Scaler to be applied to SPNO.
I32	8	Sequential record number.	I16	98	Source static correction.
I32	8	Original field record number.	I16	100	Receiver static correction.
I32	12	Trace number.	I16	102	Total static applied.
I32	16	Shot point number.	I16	108	Delay recording time (ms).
I32	20	CDP number.	I16	110	Mute time start.
I32	24	Trace no. within the CDP.	I16	112	Mute time end.
I16	28	Trace identification code.	I16	114	No. of samples.
I16	30	No. of summed traces.	I16	116	Samp interval in microseconds.
I16	32	Total number of traces in CDP.	I16	156	Year of recording
I16	34	Data use 1=production, 2=test.	I16	158	Julian day number (1-366)
I32	36	Trace offset (integer).	I16	160	Hour of day (24 hour clock)
I32	40	Elevation at receiver.	I16	162	Minute of hour
I32	44	Elevation at source.	I16	164	Second of minute
I32	60	Water depth at source.	I16	166	Time base code 1.local,2.gmt,3.?
I32	64	Water depth at receiver.	I16	180	Seqn record no. (pre-stack only)
I16	68	Scaler to be applied to elevations	I32	180	3D Line number.
I16	70	Scaler to be applied to coordinates	I32	184	CDP no. within 3D line.
I32	72	Source easting.	I32	188	2D shotpoint number (Maersk)
I32	76	Source northing.	I32	192	Easting of CDP.
I32	80	Receiver easting.	I32	196	Northing of CDP.
I32	84	Receiver northing.	I16	200	Scaler to be applied to SPNO.
I16	88	Coordinate units (m/arc)			
I32	192	Easting of CDP.			