Schlumberger

TXU Gas Storage Pty Ltd

IONA-6

WELL SEISMIC PROCESSING REPORT

CHECKSHOT / GEOGRAM

FIELD: Iona

COUNTRY: Australia

COORDINATES: Easting: 677 185.6 m
: Northing: 5 728 761.7 m

PERMIT: PPL2

DATE OF SURVEY: 4-JUN-2004

SURVEY TYPE: Offset Source Checkshot, Onshore, Airgun

REFERENCE NO: DS 1004-05

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1 Introduction

A borehole seismic survey was recorded in one run in the deviated (max 49.5 deg) onshore VIC well Iona-6 on 4 June 2004. This survey consisted of fixed offset checkshot measurements in open and cased hole. The data were acquired using a single Combinable Seismic Acquisition Tool (CSAT-B) downhole and an Air gun source deployed in a pit at 524 m offset. This source offset was chosen to be vertically above the downhole intersection of the well track and the Top Waarre formation at 1513 m MD RT.

Processing of the data consisted of performing Checkshot processing, Sonic calibration and Synthetic seismogram generation. This report describes the processing techniques used, the parameters chosen and presents the results of the data processing.

In deviated wells it is recommended that for sonic calibration purposes vertical incident ray paths be recorded. In this case a fixed offset source was used. To reduce the errors in using only a straight ray geometrical correction to correct these slant measured transit times to true vertical times, ray tracing and travel time inversion were used. This greatly improved the shape of the drift curve and allowed drift correction without introducing artificial contrasts. It should be noted however that this is still an approximation that does not take into account possible lateral velocity variations in the overburden.

2 Data Acquisition

The data were acquired in one logging run in both open and cased hole, using the three component Combinable Seismic Acquisition Tool (CSAT-B) fitted with GAC accelerometers. One 150 cu in G-Gun Airgun was used as the source operating under 2000 psi. The gun was suspended in a pit 2m below GL (102 m above MSL) at an offset of 524 m, azimuth 305 deg from the wellhead. A reference hydrophone was positioned 1 m above the gun. Recording was made on the Schlumberger Maxis 500 Unit using DLIS format. 11 Checkshot levels were acquired from 1619 m MD RT to 109.2 m MD RT at varying intervals. A minimum of 3 good shots were recorded for each level. Figure 13 shows a plan of the well deviation and the source location.

Table 1. Survey Parameters

Elevation of KB/RT	110.5 m above MSL
Elevation of GL (at Source)	102 m above MSL
Well Deviation	Max 49.5 deg
Energy Source	1x 150 cu in G-Gun
Reference Sensor	Hydrophone
Source & Hyd. Offset	524 m
Source & Hyd. Azimuth	305 deg
Source Depth	10.5 m below RT
Hydrophone Depth	9.5 m below RT
Tool	CSAT-B
Sensor Type	3-C GAC – Geophone Accelerometer

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3 Well Seismic Edit

The initial preparation of the data is called Well Seismic Edit and consists of:

- Load Data
- Edit bad records & Sort Data
- Pick Reference Break times
- Median stack & Geophone Transform
- Bandpass Filter : Butterworth Zero Phase, 5-60Hz
- Rotation to Tangent to RaY Component: X,Y to HMX / Z,HMX to TRY
- Pick Break time on TRY
- Survey Geometry / Datum corrections: 2D Ray Tracing / Travel Time Inversion

Each shot of the raw GAC data was evaluated and edited to remove bad traces. The hydrophone data were also evaluated for signature changes and timing shifts. The good shots at each level were stacked, using a median stacking technique, to increase the signal to noise ratio of the data. For better comparison with geophone data, a transform to a 10 Hz/76% damped geophone is applied to the GAC data. This transform from acceleration to velocity is in the field approximated by integrating raw data. After stacking and transform the transit time of each trace was re-computed. The following subsections describe the main aspects of the well seismic edit phase.

3.1 Data Quality

The data quality is good. The source signature is stable indicating a constant gun pressure and gun depth. As the well is highly deviated all three GAC receiver components show energy. There is good continuity and little contamination. Due to the fixed offset and the non-gimballed receivers in the CSAT-B, a rotation towards the maximum downgoing arriving energy is performed. This Tangent to Ray (TRY) component will be used for the final time picking.

3.2 Transit Time Measurement

The measured transit time corresponds to the difference between arrivals recorded by surface and downhole sensors. The reference time (zero time) is the physical recording of the source signal by accelerometers on the gun or sensors positioned near the source. In this case, a hydrophone positioned 1 m above the gun was used as the reference. An inflection point tangent first break picking algorithm was used on both the hydrophone and the geophone data.

3.3 Stacking

After reordering and selecting the raw shots, a median stack was performed on the three component data. In this method of stacking, at each sample time, the amplitudes of the input traces are read and sorted in ascending order. The output is the median amplitude value from this ordering. If an even number of traces is input, the first is dropped and a median calculated. Then the last is dropped and another median found. The final output is the average of these two median values. The surface sensor (hydrophone) breaks are used as the zero time for stacking. The break time of each trace is recomputed after stacking and GAC transform. The X, Y and Z component stacks are presented in Figures 2 ,3 and 4.

3.4 Bandpass Filter

The effective bandwidth of the recorded data is evaluated by examining the amplitude spectrum of the stacked vertical component presented in Figure 1. A zero phase Butterworth Bandpass filter was applied to the data limiting the bandwidth to 5-60 Hz.

3.5 Rotation to Vertical Component

Non-gimballed GAC receivers record the CSAT-B data. To obtain the best component for picking the downgoing first break, the 3 component data need to be rotated to the TRY axis (i.e. Tangent to RaY direction). This can be done by first taking the two horizontal components X and Y and determining via energy hodograms around the picked transit time the orientation of the maximum horizontal component (HMX) as shown in Figure 5. Figure 6 shows the remaining residual energy on the orthogonal component (HMN). The Z and HMX components are then rotated also using energy hodograms and this produces the TRY component for time picking. Figure 7 shows this TRY Component used for further processing.

3.6 Survey Geometry / Datum corrections

Seismic Reference Datum (SRD) is at Mean Sea Level. A near surface reference velocity of 1600 m/s was determined using borehole seismic data, WesternGeco and Client input and applied to the data to correct to SRD. Survey geometry corrections for the lateral offset of the source position with respect to the downhole receiver in this well taking into account well deviation have been applied. This produced a very irregular drift curve, while using good quality sonic data, indicating that straight geometrical corrections to correct the measured times to vertical times are not sufficiently accurate. This may also be further complicated by lateral velocity variations.

To obtain a better vertical time depth relation the measured borehole seismic times were used to construct a 1D model. 2D Ray tracing using the actual source-receiver geometry in a homogeneous background model and travel time inversion were used to obtain a calibrated model matching +/- 1ms to the measured data. This model is shown in figures 8a and 8b. Vertical travel times from MSL to each receiver were subsequently obtained by Ray tracing through this model as shown in figures 9a and 9b.

Figure 9c shows that the vertical times from Ray Tracing/ Travel Time Inversion produce a different and smoother time-depth curve than the geometry corrected vertical times. Drift curve analysis in the next chapter confirms that this is a more realistic result.

3.7 Composite Displays of Results

A snapshot of the 40 cm/s composite display (PLOT-1) of checkshot calibrated log and synthetic data is shown in figure 10.

Composite displays of the generated Synthetic Seismograms are also shown in Figures 11a / 11b. These figures show displays in both normal and reverse polarity. The polarity convention used (Normal: Increase in Acoustic Impedance is a Trough) is explained in Figure 14.

4 Sonic Calibration Processing

4.1 Sonic Calibration

A 'drift' curve is obtained using the sonic log and the vertical check level times. The term 'drift' is defined as the seismic time (from check shots) minus the sonic time (from integration of edited sonic). Commonly the word 'drift' is used to identify the above difference, or to identify the gradient of drift versus increasing depth, or to identify a difference of drift between two levels.

The gradient of drift, that is the slope of the drift curve, can be negative or positive.

For a negative drift (Δdrift/Δdepth < 0) the sonic time is greater than the seismic time over a certain section of the log.

For a positive drift (Δdrift/Δdepth > 0), the sonic time is less than the seismic time over a certain section of the log.

The drift curve, between two levels, is then an indication of the error on the integrated sonic or an indication of the amount of correction required on the sonic to have the TTI of the corrected sonic match the check shot times.

Two methods of correction to the sonic log are used.

1. Uniform or block shift. This method applies a uniform correction to all the sonic values over the interval. This uniform correction is applied in the case of positive drift and is the average correction represented by the drift curve gradient expressed in µsec/m .

2. ΔT Minimum. In the case of negative drift a second method is used, called Δ minimum. This applies a differential correction to the sonic log, where it is assumed that the greatest amount of transit time error is caused by the lower velocity sections of the log. Over a given interval the method will correct only Δt values which are higher than a threshold, the Δt_{min} . Values of Δwhich are lower than the threshold are not corrected. The correction is a reduction of the excess of Δt over Δt_{min}, $\Delta t - \Delta t_{min}$.

$\Delta t - \Delta t_{min}$ is reduced through multiplication by a reduction coefficient which remains constant over the interval. This reduction coefficient, named G, can be defined as:

$$G = 1 + \frac{\text{drift}}{(\Delta t - \Delta t_{min})dZ}$$

Where drift is the drift over the interval to be corrected and the value $(\Delta t - \Delta t_{min})dZ$ is the time difference between the integrals of the two curves Δt and Δt_{min}. only over the intervals where $\Delta t > \Delta t_{min}$.

Hence the corrected sonic: $\Delta t = G(\Delta t - \Delta t_{min}) + \Delta t_{min}$.

4.2 Open Hole Logs

The monopole mode compressional DTCO curve from the DSI data was used for drift computation. The log quality is good.

The density log was also recorded to the top of the sonic log. Other logs included as companion curves are: Gamma Ray, Neutron Porosity, Resistivity (Deep and Shallow) and Caliper.

4.3 Correction to Datum and Velocity Modeling

The sonic calibration processing has been referenced to mean sea level which the seismic reference datum. Geometry corrections are applied to correct for well deviation, source offset, source depth and SRD elevation.

4.4 Sonic Calibration Results

The checkshot near the Top of the Waarre Formation on the sonic log (1513 m MD RT) is chosen as the origin for the calibration drift curve.

The drift curve is the correction imposed upon the sonic log. The adjusted sonic curve is considered to be the best result using the available data. A list of shifts used on the sonic data is given in A2 Listing (supplied in digital form on Final Results CD-ROM). A minimum number of knee points were used due to the increased measurement uncertainty introduced by both the well deviation and possible lateral velocity variations in the overburden.

The Velocity Crossplot is presented in Figure 12 and as a separate plot.

The goals of sonic calibration and time-to-depth conversion in a deviated well may not be compatible due to anisotropy and the different ray paths of sonic and borehole seismic data. The mild, largely positive drift (normal dispersion) however indicates that this calibration method here may be reasonably used.

On request the adjusted sonic Velocity versus Depth curve was resampled at 10 m and is shown on the velocity crossplot and attached as listing in Appendix 4.

5 Synthetic Seismogram Processing

GEOGRAM plots were generated using three different wavelets: 20 Hz, 30 Hz and 40 Hz (Dominant Frequency) zero phase Ricker wavelets.

The presentation includes composite plots on a time scale of 40 cm/sec in both normal and reverse polarity (Plots 1 and 2).

GEOGRAM processing produces synthetic seismic traces based on reflection coefficients generated form sonic and density measurements in the wellbore. The steps in the processing chain are the following:

- Depth to time conversion
- Reflection coefficient generation
- Attenuation coefficient calculation
- Convolution
- Output

5.1 Depth to Time Conversion

Open hole logs are recorded from the bottom to top with a depth index. This data is converted to a two-way time index.

5.2 Primary Reflection Coefficients

Sonic and density data are averaged over chosen time intervals (normally 2 ms). Reflection coefficients are then computed using:

$$R = \frac{r_2.v_2 - r_1.v_1}{r_2.v_2 + r_1.v_1}$$

where:

r_1 = density of the layer above the reflection interface
r_2 = density of the layer below the reflection interface
v_1 = compressional wave velocity of the layer above the reflection interface
v_2 = compressional wave velocity of the layer below the reflection interface

This computation is done for each time interval to generate a set of primary reflection coefficients without transmission losses.

5.3 Primaries with Transmission Losses

Transmission loss on two-way attenuation coefficients is computed using:

$$A_n = (1 - R_1^2).(1 - R_2^2).(1 - R_3^2)...(1 - R_n^2)$$

A set of primary reflection coefficients with transmission loss is generated using:

$$Primary_n = R_n.A_{n-1}$$

5.4 Primaries plus Multiples

Multiples are computed from these input reflection coefficients using the transform technique from the top of the well to obtain the impulse response of the earth. The transform outputs primaries plus multiples.

5.5 Multiples Only

By subtracting previously calculated primaries form the above result we obtain multiples only.

5.6 Wavelet

A theoretical wavelet is chosen to use for convolution with the reflection coefficients previously generated. Choices available include:

Klauder wavelet
Ricker zero phase wavelet
Ricker minimum phase wavelet
Butterworth wavelet
User defined wavelet

Time variant Butterworth filtering can be applied after convolution.

5.7 Polarity Convention

An increase in acoustic impedance gives a positive reflection coefficient, is written to tape as a negative number and is displayed as a white trough under normal polarity. Polarity conventions are displayed in Figure 14.

5.8 Convolution

The standard procedure of convolving the wavelet with reflection coefficients; the output is the synthetic seismogram.

FIGURES

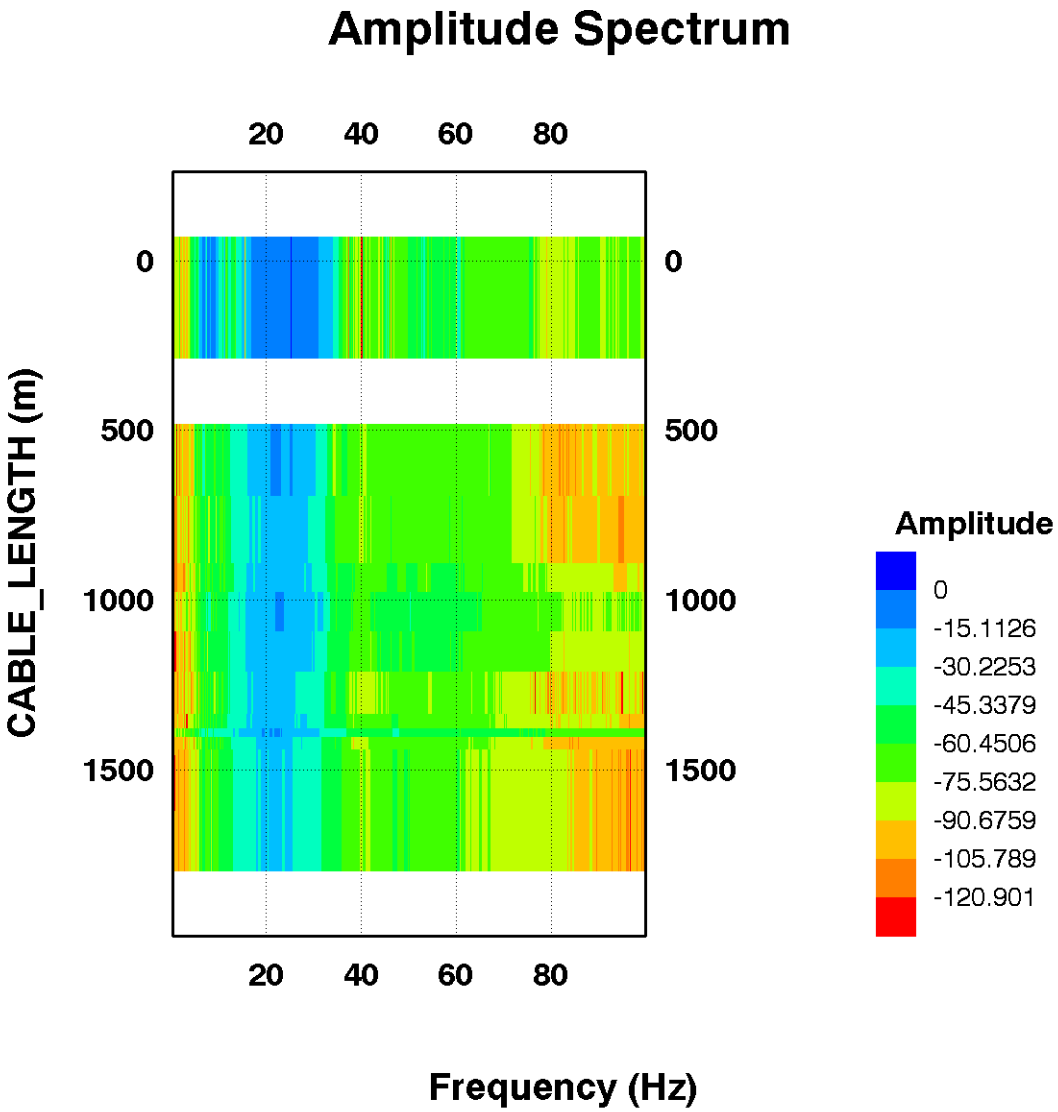

Figure 1. Amplitude Spectrum

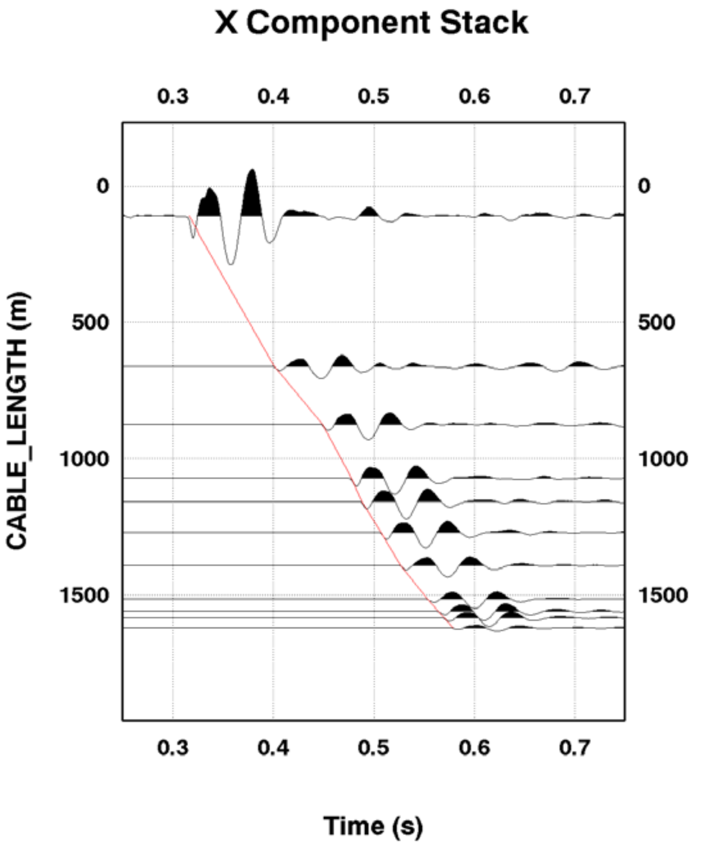

Figure 2. X Component Stack

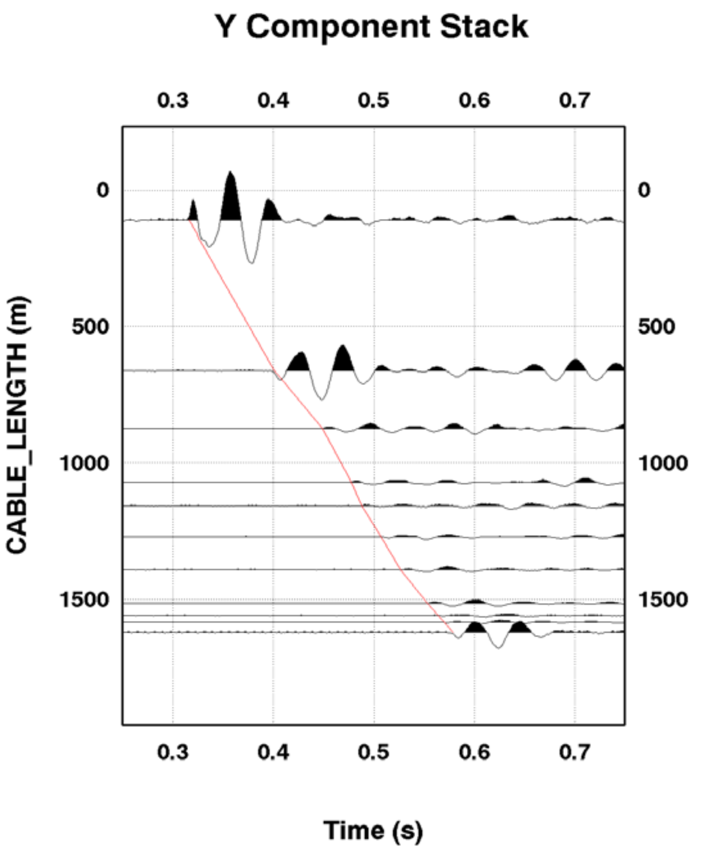

Figure 3. Y Component Stack

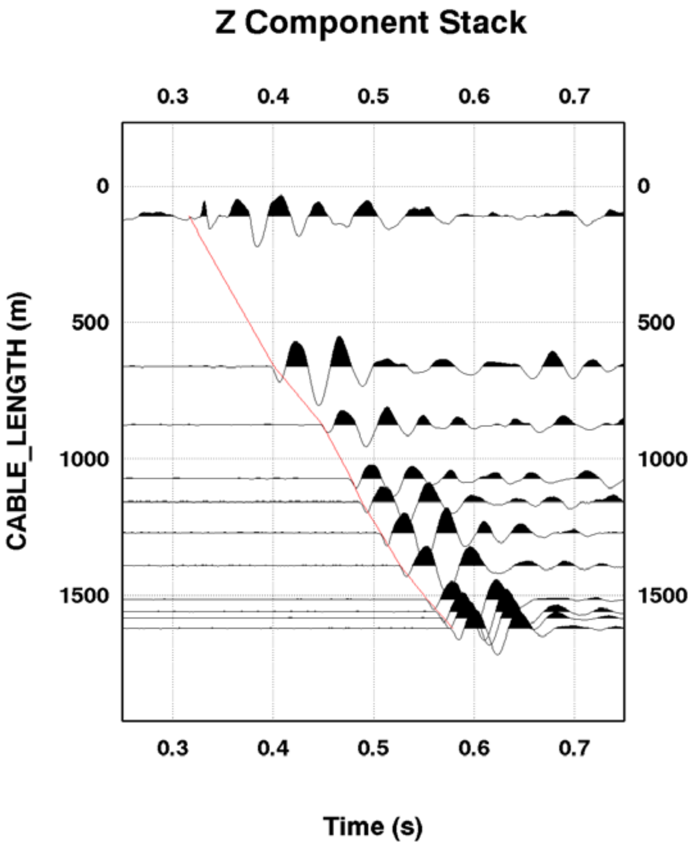

Figure 4. Z Component Stack

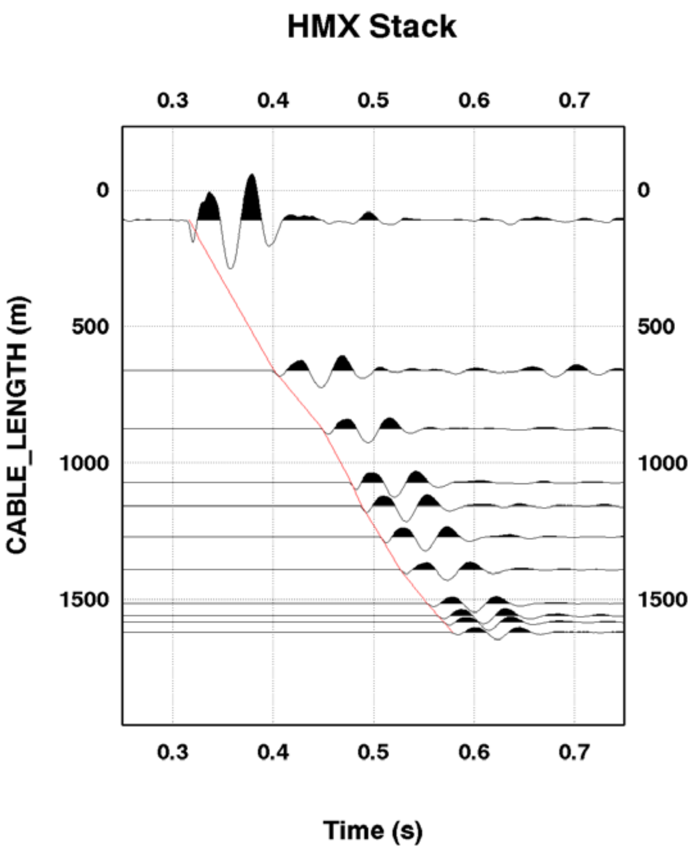

Figure 5. X,Y Components Rotated to HMX Component

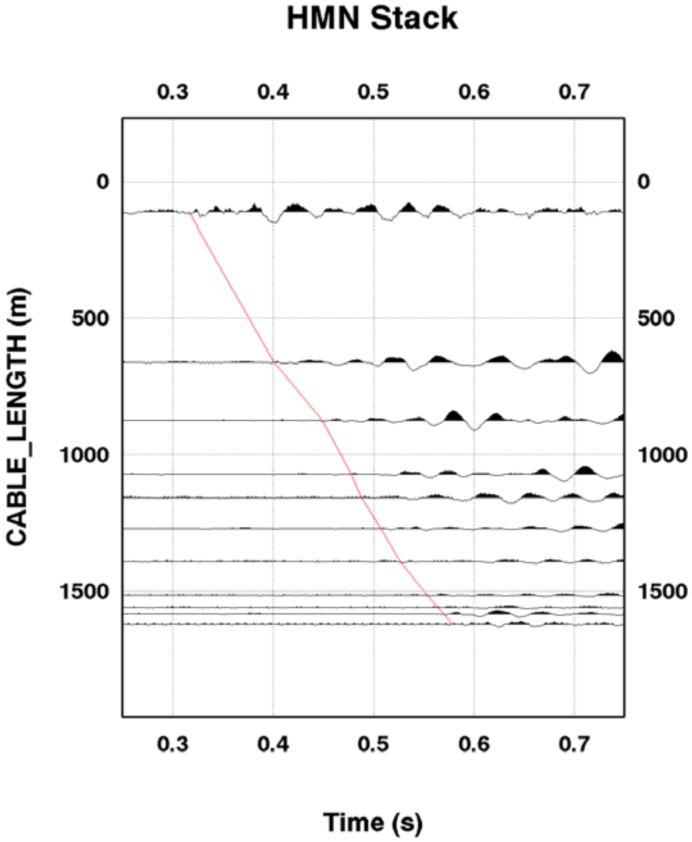

Figure 6. X,Y Components Rotated to HMN Component

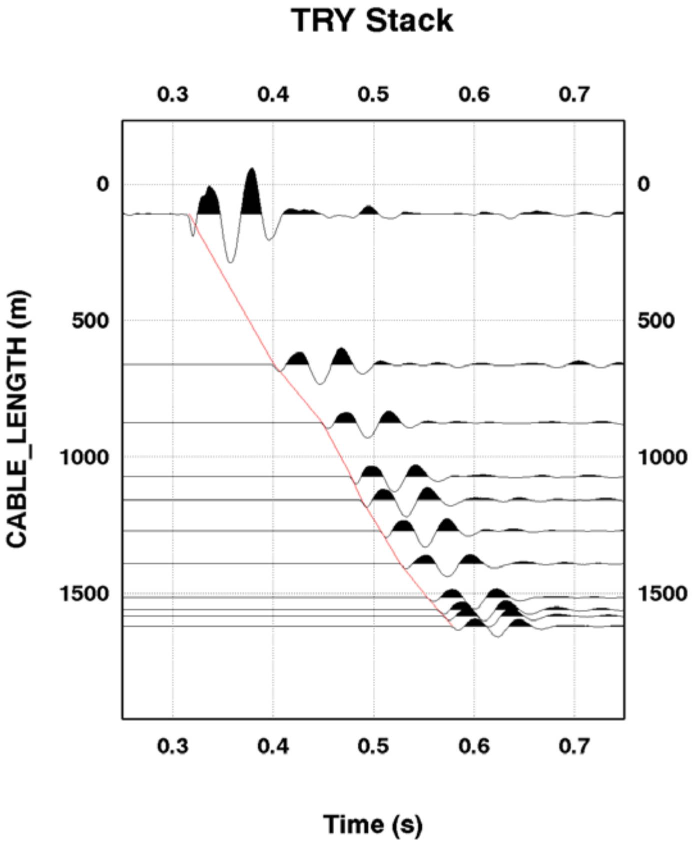

Figure 7. Z,HMX Components Rotated to TRY Component

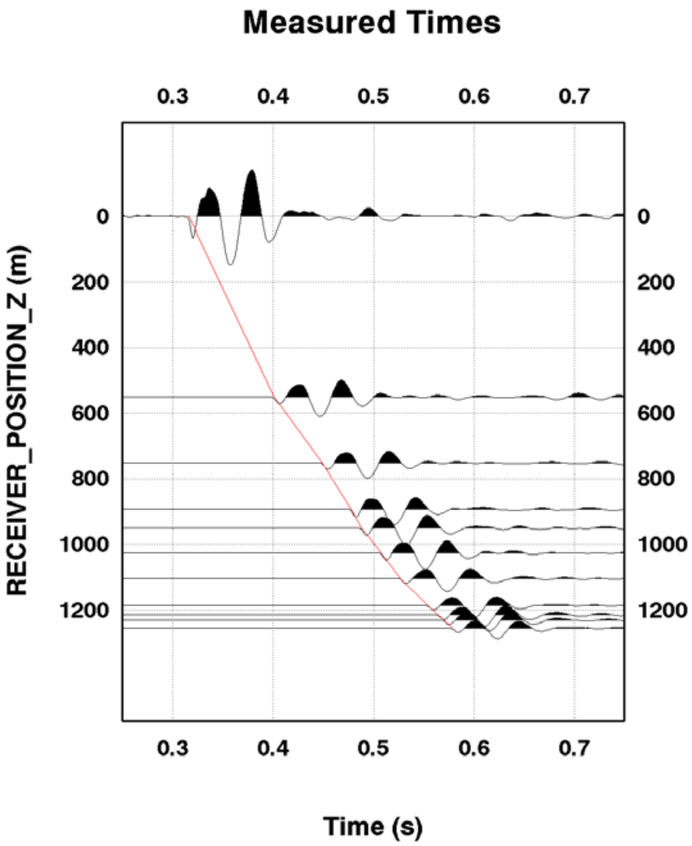

Figure 8a. Iona-6 Final Stack: Measured Times

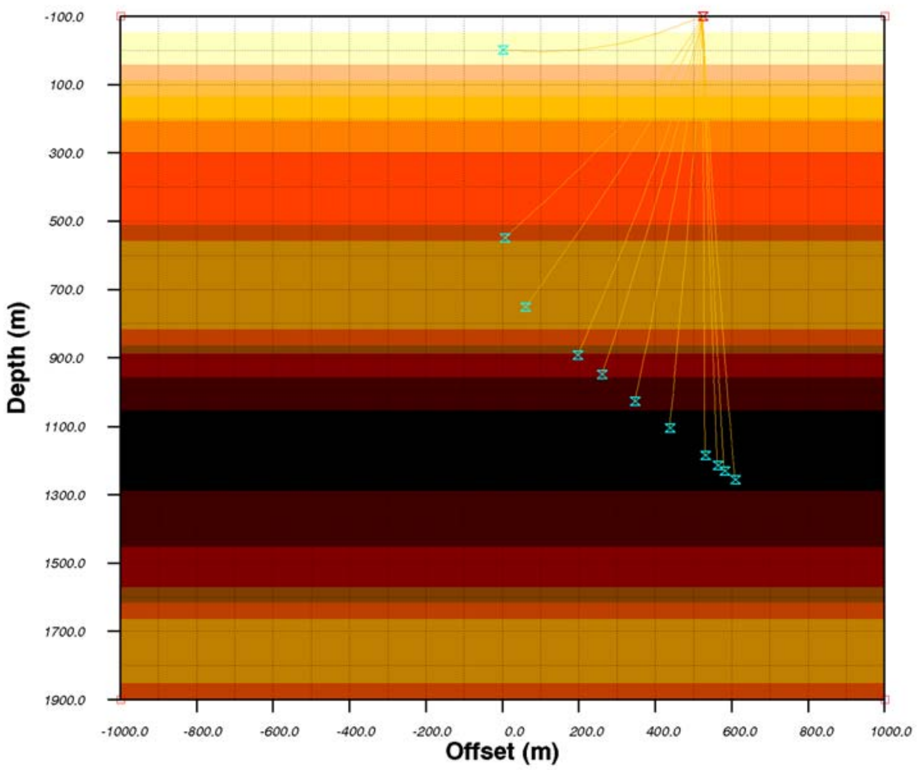

Figure 8b. 2D Travel Time Inversion: Measured Times

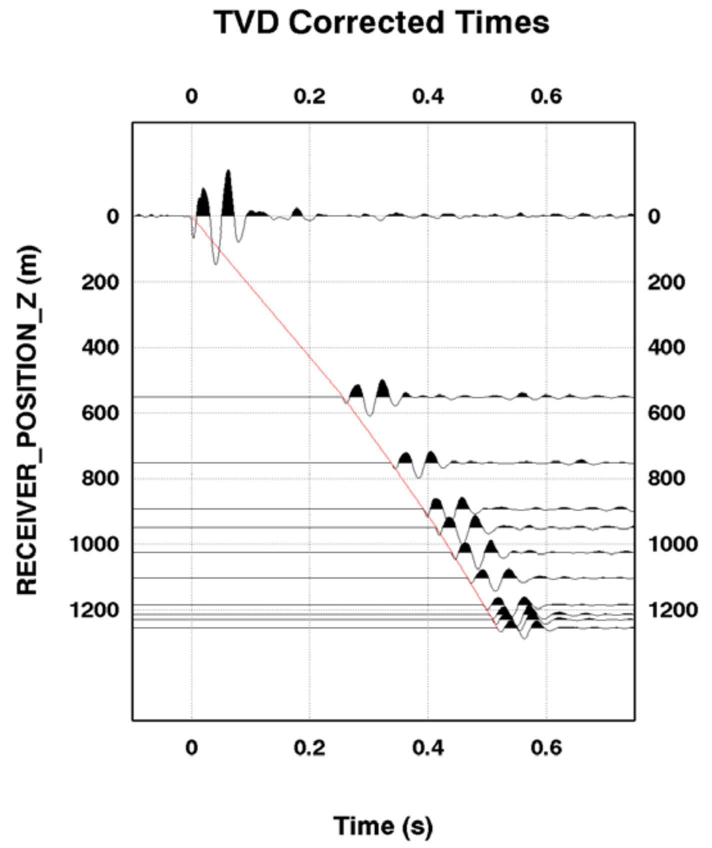

Figure 9a. Iona-6 Final Stack: True Vertical Corrected Times

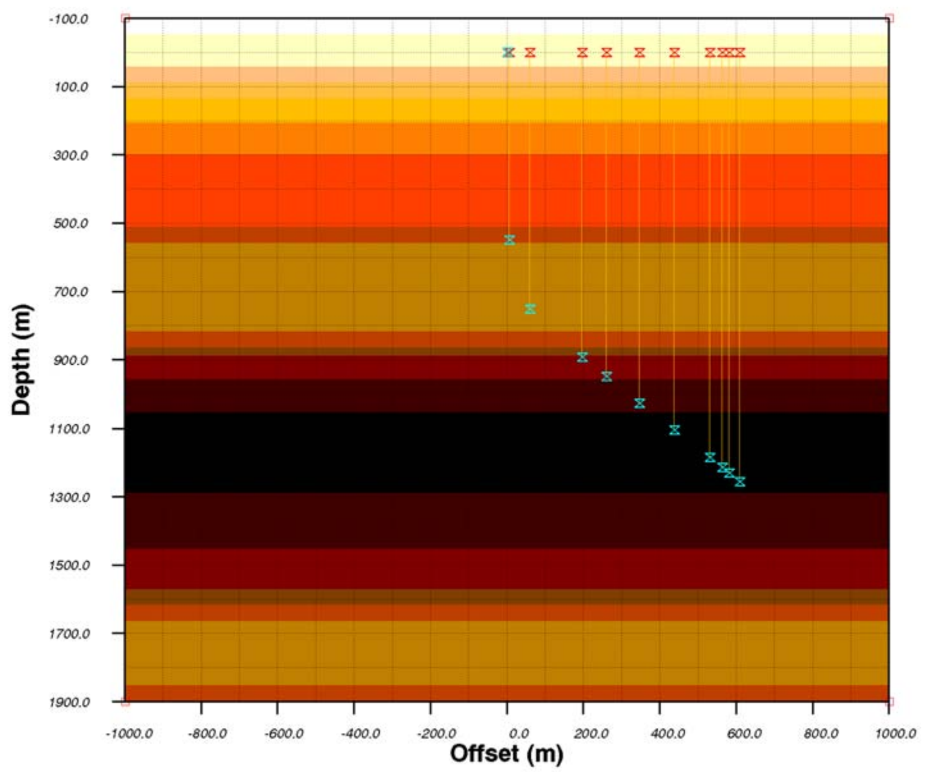

Figure 9b. 2D Travel Time Inversion: True Vertical Corrected Times

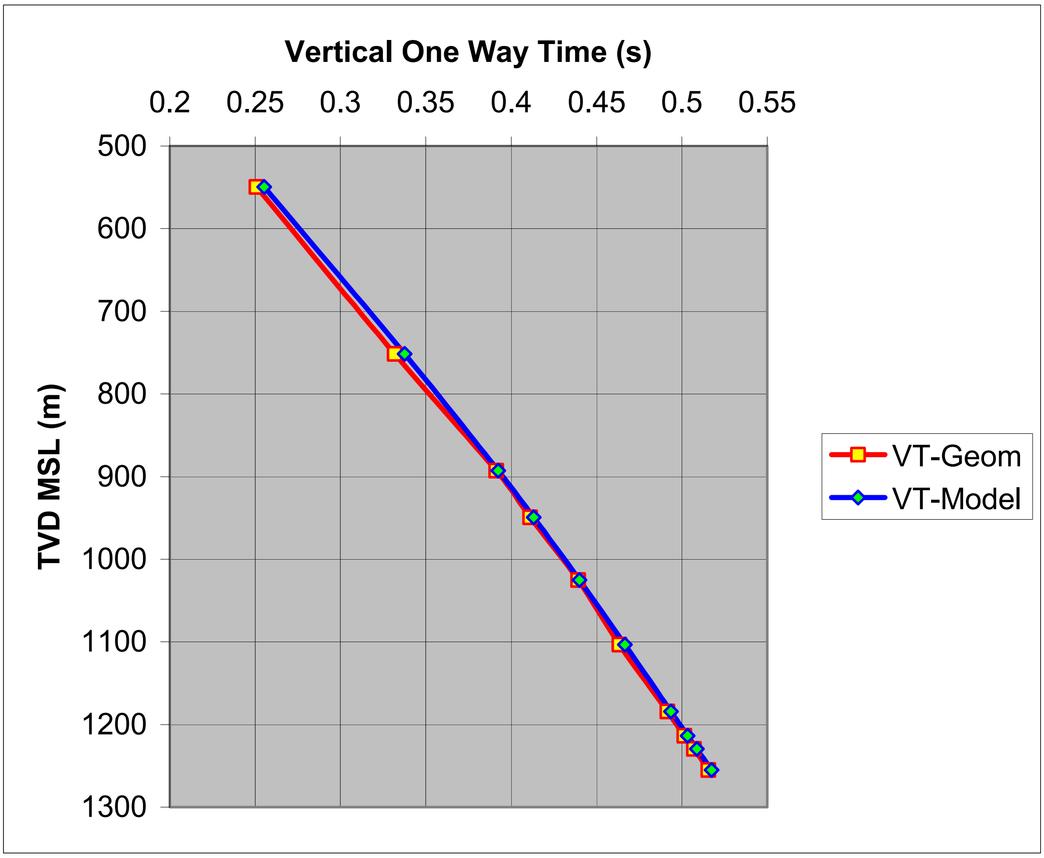

Figure 9c. Comparison Vertical Times corrected using Geometry vs Ray Tracing/Travel time Inversion

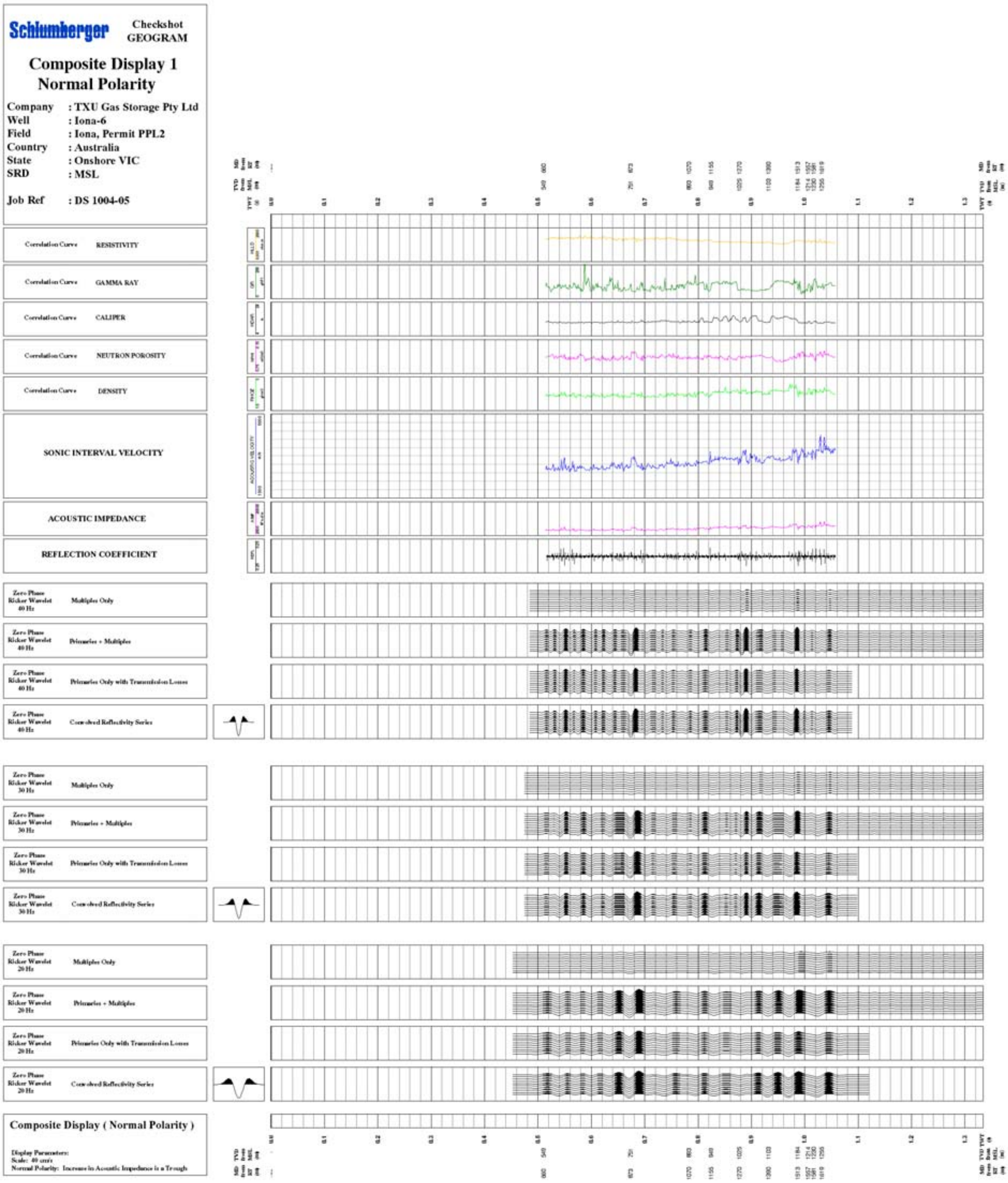

Figure 10. Composite Display (See Plot 1)

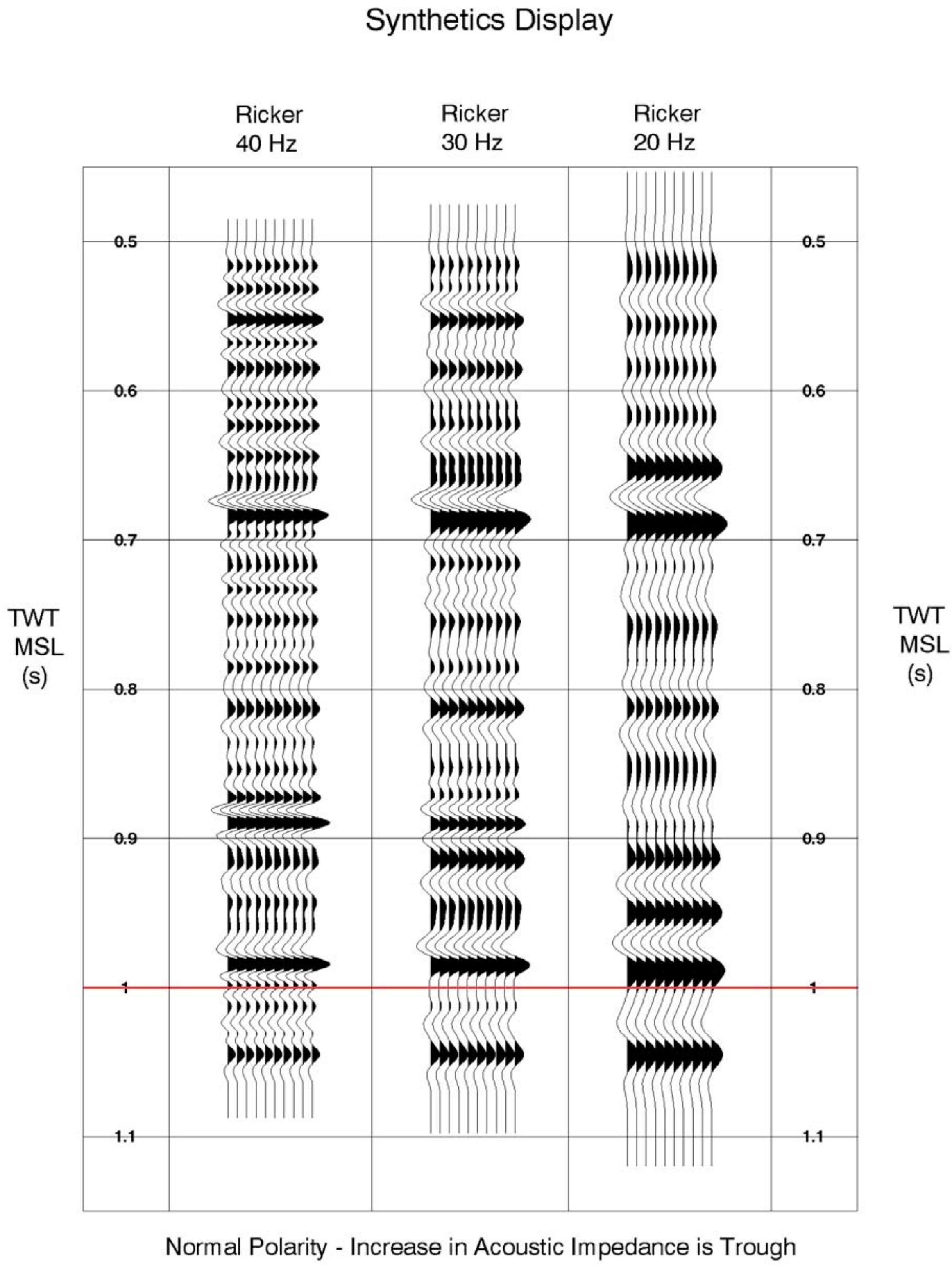

Figure 11a. Display Zero Phase Synthetics (N)

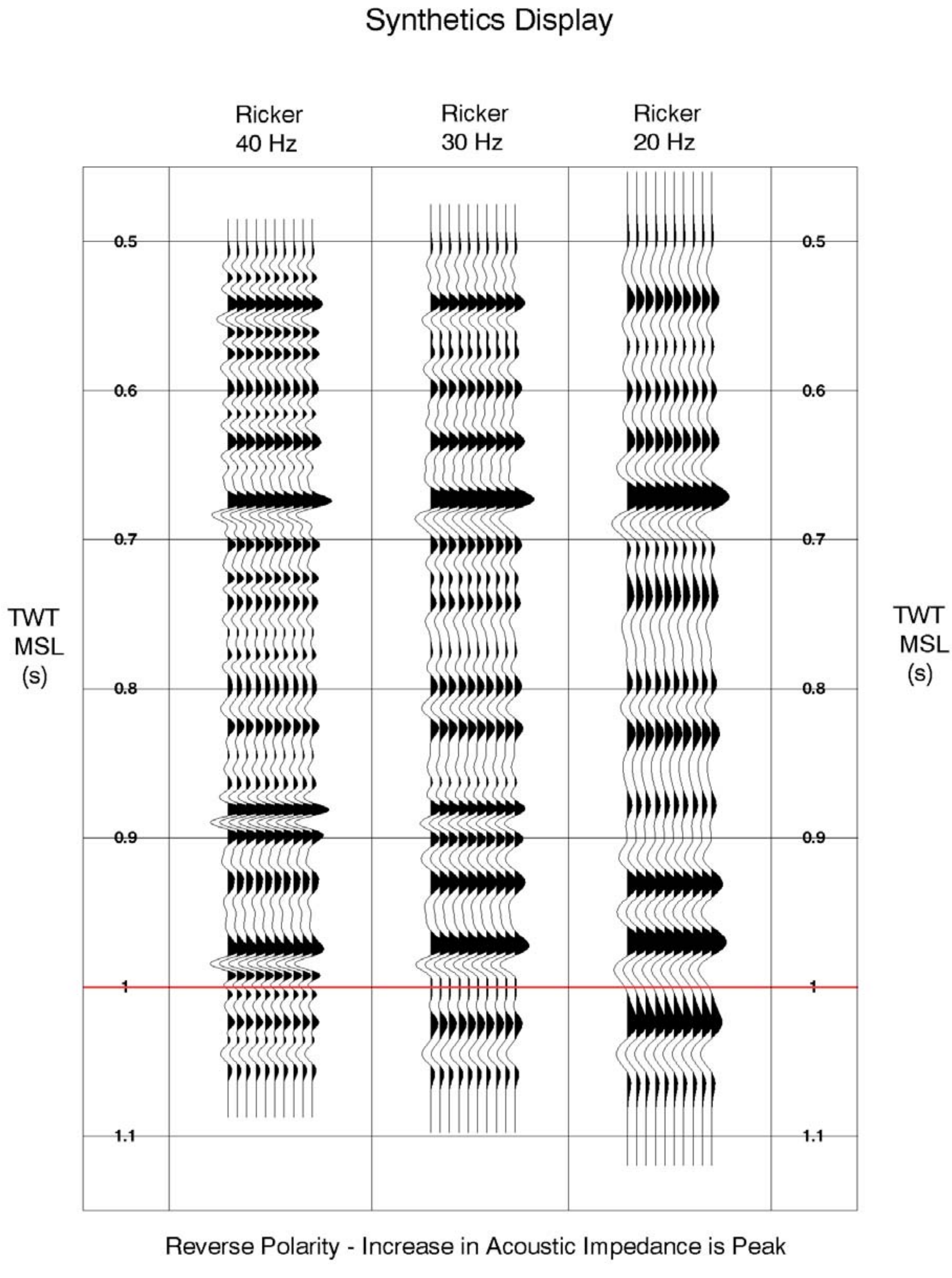

Figure 11b. Display Zero Phase Synthetics (R)

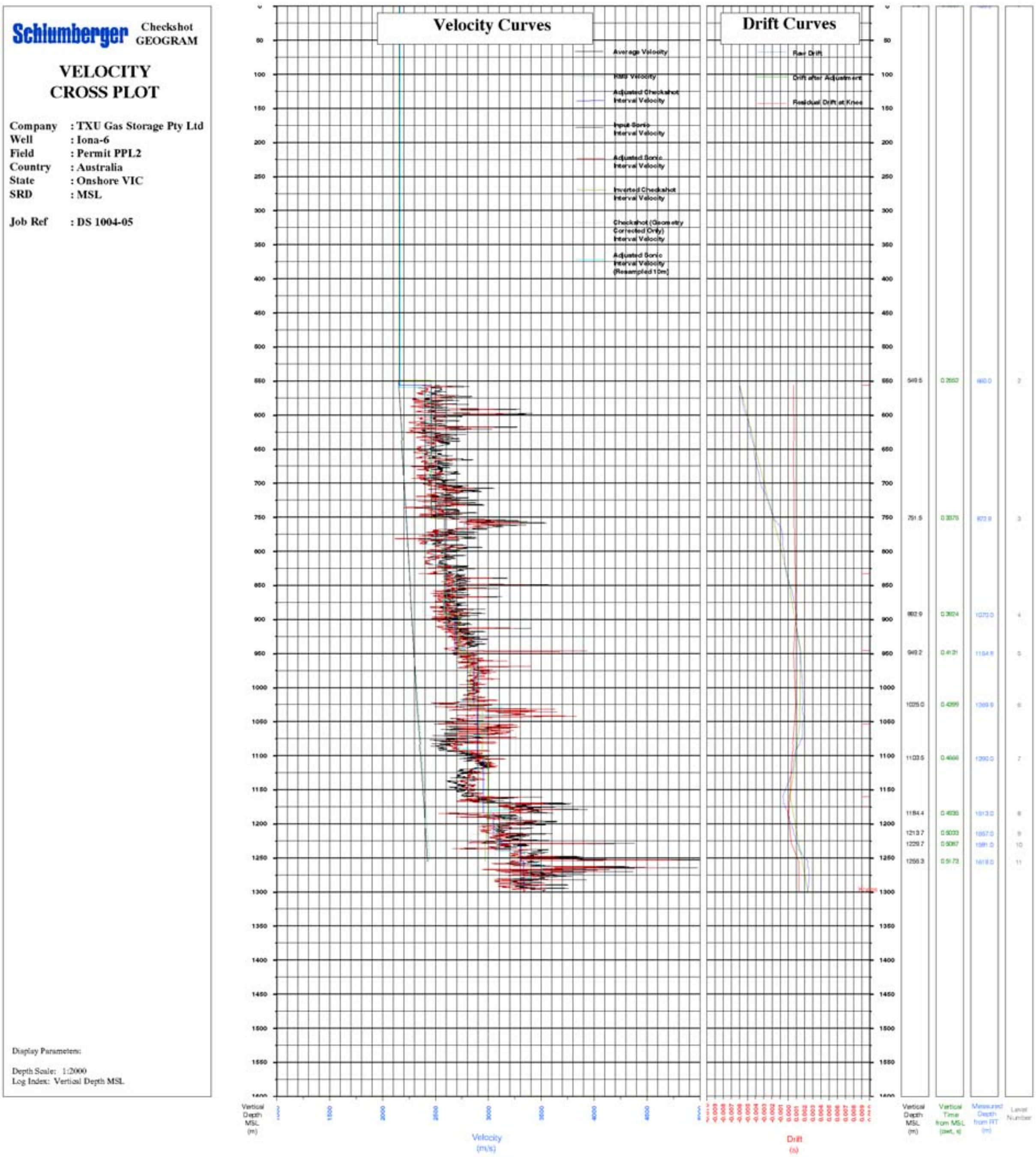

Figure 12. Velocity Crossplot (see Plot Vel 1)

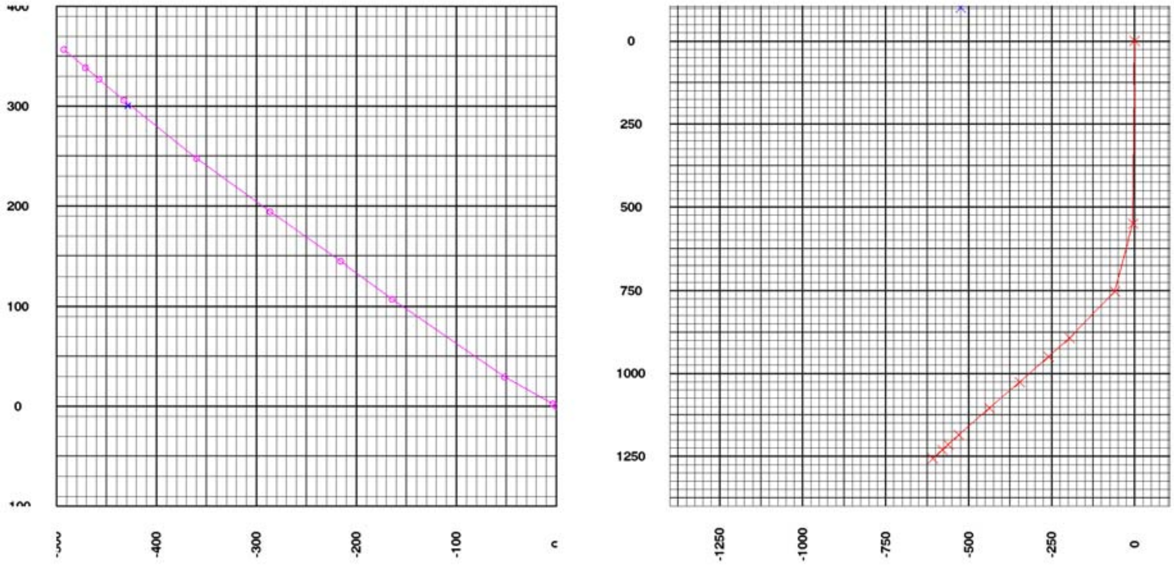

Figure 13. Iona-6 Well Deviation: X-Y and Offset-Z planes

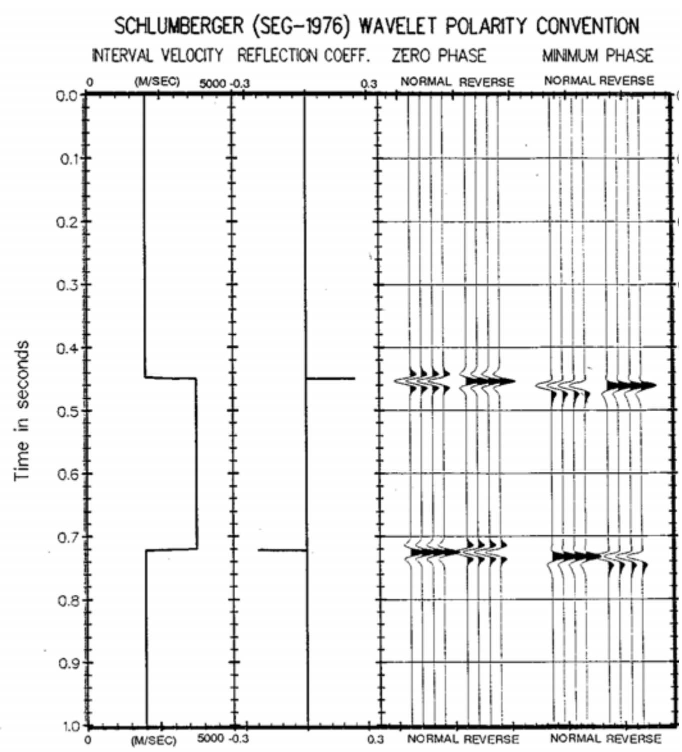

Figure 14. Schlumberger Wavelet Polarity Convention

Attachment 1: Summary of Geophysical Listings

Four geophysical data listings are appended to this report. A1 is included in the report, A2, A3 and A4 are provided in electronic form on the CD-ROM. Following is a brief description of the format.

A1 Check Shot Data

1. Level number: the level number starting from the top level (includes any imposed shots).
2. Vertical depth form SRD: *dsrd*, the depth in meters from seismic reference datum.
3. Measured depth from KB: *dkb*, the depth in meters from KB.
4. Observed travel time HYD to GEO: *tim*0, the transit time picked form the stacked data by subtracting the surface sensor first break time from the downhole sensor first break time.
5. Vertical travel time SRD to GEO: *shtm*, is *timv* – vertical time, corrected for the vertical distance between source and datum.
6. Delta depth between shots: ∆*depth*, the vertical distance between each level.
7. Delta time between shots: ∆*time*, difference in vertical travel time (*shtm*) between each level.
8. Interval velocity between shots: average velocity between each level, ∆*depth/*∆*time*
9. Average velocity SRD to GEO: average velocity from datum to the checkshot level, shtm/dsrd

A2 Drift & Sonic Adjustment

Zone Set Data

1. Knee number: the knee number starting from the highest knee. (The first knees listed will generally be at SRD and the top of sonic. The drift imposed at these knees will normally be zero.)
2. Measured depth from RT: the depth in meters from RT
3. Vertical depth from MSL: the depth in meters from seismic reference datum.
4. Selected Drift at knee: the value of drift imposed at each knee.
5. Shift: the change in drift divided by the change in depth between any two levels.
6. Delta-T: see section 4 of report for an explanation of Δt_{min}.
7. Reduction factor G: see section 4 of report.
8. Selected Drift Gradient: the gradient of the imposed drift curve.

Sonic Adjustment Data

1. Measured depth from RT: the depth in meters from RT
2. Vertical depth from MSL: the depth in meters from seismic reference datum.
3. Vertical shot time MSL to GEO: the calculated vertical travel time from datum to geophone.
4. Adjusted Sonic Time.
5. Computed drift at level: the checkshot time minus the integrated raw sonic time.
6. Residual Shot Time - Adjusted Sonic Time.
7. Adjusted Interval Velocity.
8. Adjusted RMS Velocity.
9. Adjusted Average Velocity.

A3 Velocity Report

The data in this listing has been resampled in time.

1. Two way travel time from MSL: this is the index for the data in this listing. The first value is at MSL (0 ms) and is reported every 10 ms.

2. Measured depth from RT: the depth from RT at each corresponding value of two way time.

3. Vertical depth from MSL: the vertical depth from SRD at each corresponding value of two way time.

4. Average velocity MSL to GEO: the vertical depth from SRD divided by half the two way time.

5. RMS velocity: the root mean square velocity from datum to the corresponding value of two way time.

$$v_{rms} = \sqrt{(\Sigma v_i^2 t_i / \Sigma t_i)}$$

where v_i is the velocity between each 2 ms interval.

6. Interval velocity: the velocity between each sampled depth.

A4 Time to Depth

1. Two Way Sonic Time from MSL

2-11. Depth at Time, ms: times every 1 ms

Attachment 2: A-1 Well Seismic Report

Client and Well Information

Country	**Australia**
State	**Onshore VIC**
Logging Date	**4-Jun-2004**
Company	**TXU Gas Storage Pty Ltd**
Field	**Iona**
Well	**Iona-6**

Check Shot Data (Travel Time Inversion)

LEVEL NUMBER	VERTICAL DEPTH FROM MSL m	MEASURED DEPTH FROM RT m	OBSERVED TRAVEL TIME s	VERTICAL TRAVEL TIME MSL (OWT) s	DELTA DEPTH m	DELTA TIME s	ACOUSTIC INTERVAL VELOCITY m/s	ACOUSTIC AVERAGE VELOCITY m/s	ACOUSTIC RMS VELOCITY m/s
1	-1.3	109.2	0.3161	-0.0007					
					550.8	0.2559	1859		
2	0.0	110.5	0.3163	0.0000					
					550.8	0.2559	2153		
3	549.5	660.0	0.4005	0.2552				2153	2153
					202.0	0.0823	2454		
4	751.5	872.9	0.4486	0.3375				2226	2230
					141.4	0.0548	2578		
5	892.9	1070.0	0.4772	0.3924				2276	2282
					56.4	0.0207	2718		
6	949.2	1154.9	0.4876	0.4131				2298	2306
					75.8	0.0268	2828		
7	1025.0	1269.9	0.5073	0.4399				2330	2341
					78.4	0.0267	2942		
8	1103.5	1390.0	0.5266	0.4666				2365	2379
					80.9	0.0270	3001		
9	1184.4	1513.0	0.5533	0.4935				2400	2418
					29.3	0.0098	2990		
10	1213.7	1557.0	0.5636	0.5033				2411	2430
					16.1	0.0054	2978		
11	1229.7	1581.0	0.5695	0.5087				2417	2436
					25.5	0.0086	2967		
12	1255.3	1619.0	0.5784	0.5173				2426	2446

Attachment 3: Listing of Deliverables (CD-ROM)

Report:

I06_report	Checkshot/Geogram Processing Report	PDF

Graphics Displays:

comp1	Plot 1. Composite Display 1– Normal Polarity	PDF / PDS / CGM/ TIF
comp2	Plot 2. Composite Display 2 – Reverse Polarity	PDF / PDS / CGM/ TIF
vel1	Plot 3. Velocity Crossplot	PDF / PDS / CGM/ TIF

Data files plus Verification (.txt) listings:

I06_rawx.sgy	raw x axis downhole data	(2 files)	SEGY
I06_rawy.sgy	raw y axis downhole data	(2 files)	SEGY
I06_rawz.sgy	raw z axis downhole data	(2 files)	SEGY
I06_rawh.sgy	surface sensor data	(2 files)	SEGY
I06_xstk.sgy	stacked x axis data		SEGY
I06_ystk.sgy	stacked y axis data		SEGY
I06_zstk.sgy	stacked z axis data		SEGY
I06_try.sgy	Tangent to RaY (TRY) rotated data		SEGY
I06_synt_R20.sgy	Zero Phase Synthetic Seismograms – Ricker 20Hz		SEGY
I06_synt_R30.sgy	Zero Phase Synthetic Seismograms – Ricker 30Hz		SEGY
I06_synt_R40.sgy	Zero Phase Synthetic Seismograms – Ricker 40Hz		SEGY
I06_logs_depth.las	Depth indexed Logs		ASCII (LAS)
I06_logs_time.las	Time indexed Logs		ASCII (LAS)
I06_synthetics.las	Time indexed Synthetic Seismograms		ASCII (LAS)

Listings:

A1	Well_Seismic_Report	EXCEL
A2	Drift_and_Sonic_Adjustment_Report	EXCEL
A3	Velocity_Report	EXCEL
A4	Time_to_Depth_Report	EXCEL

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Attachment 4: Velocity Listing – Resampled at 10m

Client and Well Information

Country	**Australia**
State	**Onshore VIC**
Logging Date	**4-Jun-2004**
Company	**TXU Gas Storage Pty Ltd**
Field	**Iona**
Well	**Iona-6**

Adjusted Sonic Data (10m Resampling)

VERTICAL DEPTH FROM MSL m	ONE WAY TRAVEL TIME FROM MSL s	ACOUSTIC INTERVAL VELOCITY m/s	ACOUSTIC AVERAGE VELOCITY m/s	ACOUSTIC RMS VELOCITY m/s
0	0.0000			
		2163		
560	0.2589		2163	2163
		2392		
570	0.2631		2166	2167
		2445		
580	0.2672		2171	2171
		2387		
590	0.2713		2174	2175
		2611		
600	0.2752		2180	2181
		2451		
610	0.2793		2184	2185
		2415		
620	0.2834		2187	2189
		2398		
630	0.2876		2190	2192
		2469		
640	0.2916		2194	2196
		2410		
650	0.2958		2197	2199
		2375		
660	0.3000		2200	2202
		2457		
670	0.3040		2203	2206
		2421		
680	0.3082		2206	2209
		2457		
690	0.3122		2210	2212
		2415		
700	0.3164		2212	2215
		2525		
710	0.3203		2216	2219

VERTICAL DEPTH FROM MSL m	ONE WAY TRAVEL TIME FROM MSL s	ACOUSTIC INTERVAL VELOCITY m/s	ACOUSTIC AVERAGE VELOCITY m/s	ACOUSTIC RMS VELOCITY m/s
		2545		
720	0.3243		2220	2223
		2545		
730	0.3282		2224	2227
		2481		
740	0.3322		2227	2231
		2513		
750	0.3362		2230	2234
		2778		
760	0.3398		2236	2241
		2770		
770	0.3434		2242	2247
		2532		
780	0.3474		2245	2250
		2415		
790	0.3515		2247	2252
		2558		
800	0.3554		2251	2256
		2488		
810	0.3595		2253	2259
		2445		
820	0.3635		2255	2261
		2571		
830	0.3674		2259	2264
		2591		
840	0.3713		2262	2268
		2688		
850	0.3750		2266	2272
		2646		
860	0.3788		2270	2276
		2604		
870	0.3826		2274	2280
		2584		
880	0.3865		2277	2283
		2584		
890	0.3904		2280	2286
		2618		
900	0.3942		2283	2290
		2604		
910	0.3980		2286	2293
		2674		
920	0.4018		2290	2297
		2710		
930	0.4055		2293	2301
		2732		
940	0.4091		2297	2305
		2762		
950	0.4127		2301	2310
		2801		
960	0.4163		2306	2314
		2882		

Schlumberger

VERTICAL DEPTH FROM MSL m	ONE WAY TRAVEL TIME FROM MSL s	ACOUSTIC INTERVAL VELOCITY m/s	ACOUSTIC AVERAGE VELOCITY m/s	ACOUSTIC RMS VELOCITY m/s
970	0.4198		2311	2320
		2915		
980	0.4232		2315	2325
		2907		
990	0.4266		2320	2330
		2874		
1000	0.4301		2325	2335
		2874		
1010	0.4336		2329	2340
		2882		
1020	0.4371		2333	2345
		2747		
1030	0.4407		2337	2348
		3135		
1040	0.4439		2343	2355
		2924		
1050	0.4473		2347	2360
		2915		
1060	0.4508		2351	2365
		2976		
1070	0.4541		2356	2370
		2809		
1080	0.4577		2360	2373
		2725		
1090	0.4613		2362	2376
		2817		
1100	0.4649		2366	2380
		2959		
1110	0.4683		2370	2385
		2994		
1120	0.4716		2375	2390
		2857		
1130	0.4751		2378	2393
		2841		
1140	0.4786		2382	2397
		2825		
1150	0.4822		2385	2400
		2865		
1160	0.4857		2388	2404
		2924		
1170	0.4891		2392	2408
		3247		
1180	0.4922		2397	2414
		3021		
1190	0.4955		2402	2419
		3165		
1200	0.4986		2406	2424
		3077		
1210	0.5019		2411	2429
		3067		
1220	0.5052		2415	2434

VERTICAL DEPTH FROM MSL m	ONE WAY TRAVEL TIME FROM MSL s	ACOUSTIC INTERVAL VELOCITY m/s	ACOUSTIC AVERAGE VELOCITY m/s	ACOUSTIC RMS VELOCITY m/s
		3106		
1230	0.5084		2419	2439
		3086		
1240	0.5116		2424	2443
		3344		
1250	0.5146		2429	2449
		3448		
1260	0.5175		2435	2456
		3509		
1270	0.5203		2441	2463
		3390		
1280	0.5233		2446	2469
		3226		
1290	0.5264		2450	2474