Schlumberger Oilfield Australia Pty Limited
A.C.N. 003 264 597
Level 5, 256 St. George's Tce.
Perth WA 6000
Ph: (09) 9420 4800 Fax: (09) 9420 4715

ESSO Australia

WELL SEISMIC PROCESSING REPORT

VSP

East Pilchard-1

FIELD: Exploration

COUNTRY: Australia

COORDINATES: Latitude: 38 11′ 54.184″ S
: Longitude: 148 33′ 42.825″ E

DATE OF VSP SURVEY: 3-AUG-2001

REFERENCE NO: DS 801-007

INTERVAL: 146.5-3137 mRT

Prepared by:
Yuri Solovyov (Schlumberger DCS)

CONTENTS

List of Figures

List of tables

VSP PLOTS

1. Introduction

A single run borehole seismic survey was recorded in the vertical well East Pilchard-1 on 3 August, 2001. This survey included both rig source VSP and additional checkshot measurements. The data were acquired using a Dual Combinable Seismic Acquisition Tool (CSAT-B) downhole and a cluster of 3 G-Guns suspended from the rig.

This report describes the techniques used, the parameter choices and presents the results of the checkshot and VSP data processing.

2. Data Acquisition

The data were acquired in one logging run in both open and cased hole, using the three component Dual Combinable Seismic Acquisition Tool (CSAT-B), fitted with GAC accelerometer. A cluster of 3 G-guns with 150 cu in capacity each used as the source, was fired at 1900 psi air pressure. The gun cluster was positioned 5 m below the SRD sea level. Hydrophone was positioned 5 m below the gun. Recording was made on the Schlumberger Maxis 500 Unit using DLIS format .
The VSP levels were acquired from 1546.6 mKB to 3137 mKB with additional checkshot levels from 146.5 mKB to 1475.9 mKB. VSP levels were recorded with 15 m interval.

Table 1. Survey Parameters

Elevation of KB	25 m
Elevation of DF	25 m
Elevation of GL	-91 m
Well Deviation	0 (vertical)
Energy Source	3x150 cu in. G-guns
Source Offset	45 M
Source Depth	5 M below Sea Level
Reference Sensor	Hydrophone
Hydrophone Offset	45 M
Hydrophone Depth	10 M below Sea Level
Source & Hyd. Azimuth	140 Deg.
Tool Type	CSAT-B
Tool Combination	Dual CSAT-B+GR
De-coupled Sensors	Yes
Shaker Fitted	Yes
Number of Axis	3
Sensor Type	GAC – Geophone Accelerometer
Frequency Response (GAC)	3-200 Hz
Sampling Rate	1 ms.
Recording Time	6.0 sec.
Acquisition Unit	MAXIS
Recording Format	DLIS

3. Well Seismic Edit

The data for both VSP and the checkshot intervals were prepared using the same methods.

Each shot of the raw GAC integrated 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. The transit time of each trace was re-computed after stacking.

The following subsections describe the main aspects of the well seismic edit phase:

- Data Quality
- Transit Time Measurement
- Stacking

3.1 Data Quality

The data quality is good.

3.2 Transit Time Measurement

The transit time measured, corresponds to a 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 5 m below 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 , see Attachment 1.

3.3 Stacking

After reordering and selecting the raw shots, a median stack was performed on the vertical 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 are 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. Z component median stack presented in Figure 2.

4. VSP Processing Chain

The vertical component of the VSP data was processed using the conventional zero offset processing chain. The following subsections describe the main aspects of the processing chain:

Well Seismic Edit:

- load data
- edit bad records
- pick break time
- Z component median stack

Pre processing:

- transit time correction to datum
- spherical divergence correction
- bandpass filter
- trace normalization

VSP Procesing:

- wavefield separation
- waveshaping deconvolution
- corridor stack

4.1 Pre Processing

4.1.1 Transit Time Correction to Datum

Seismic Reference Datum (SRD) is at Mean Sea Level.
The source was positioned 5 meters below sea surface. The reference hydrophone was located 5 meters below the G-Guns cluster, 10 m below sea level. Correction to SRD was calculated using a water layer velocity of 1524 m/s .

4.1.2 Spherical Divergence Correction

To correct the recorded amplitudes for the loss of energy due to spherical divergence, a time varying gain function of the exponential form:

$$Gain(T) = \left(\frac{T}{T_0}\right)^{\alpha}$$

where T is the recorded time, T_0 is the first break time and a = 1.2 was applied.

4.1.3 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. Zero phase Butterworth Bandpass filter was applied to the data limiting the bandwidth to 5-120 Hz.

4.1.4 Trace Normalization

Trace equalization was applied by normalizing the RMS amplitude of the first break to correct for transmission losses of the direct wave. A normalization window of 100 milliseconds used.

4.2 VSP Processing

4.2.1 Wavefield Separation

A velocity filter (coherency) technique was used to separate upgoing and downgoing wavefields.

The downgoing coherent compressional energy is estimated using nine levels mean velocity filter parallel to the direct arrival curve. The filter array is moved down one level after each computation and the process is repeated level by level over the entire dataset.
The downgoing wavefield is displayed in one way time (Figure 3).

The residual wavefield is obtained by subtracting the estimated downgoing coherent energy from the total wavefield. The residual wavefield is dominated by reflected compressional events (Figure 4).

4.2.2 Waveshaping Deconvolution

The waveshaping process shortens the seismic pulse within races and for zero phase centers their amplitude peak on the reflector. This improves the resolution of the seismic data and helps to clarify the correlation of the seismic events. It is also applied to collapse the recorded multiples.

The waveshaping deconvolution operator is a double-sided Wiener-Levinson waveshaping filter. The operator is computed for each level of the downgoing wavefield using a design window length of 2 s starting 20 ms before the picked break times in order to include the wavelet precisely. The designed outputs were chosen to be zero phse with a bandwidth of 5-80 Hz. Once the design is made upon the downgoing wavefield, it is applied to the both downgoing and upgoing wavefields at the same level. The upgoing compresional wavefield is then enhanced using 7 level median coherency velocity filter as shown in Figure 5.

The downgoing wavefield is displayed in one way time (Figure 5).

4.2.3 Corridor Stack

A corridor stack was computed on the data after zero phase waveshaping deconvolution by designing a constant 100 ms timing window along the to-way time depth curve and stacking the data onto a single trace. The deepest 7 traces are stacked entirely. The resulting trace under normal circumstances satisfies the assumption of one dimentiality and provides the best seismic representation of borehole. This corridor stack is displayed in Figure 7 along with the enhanced upgoing wavefield in two way time.

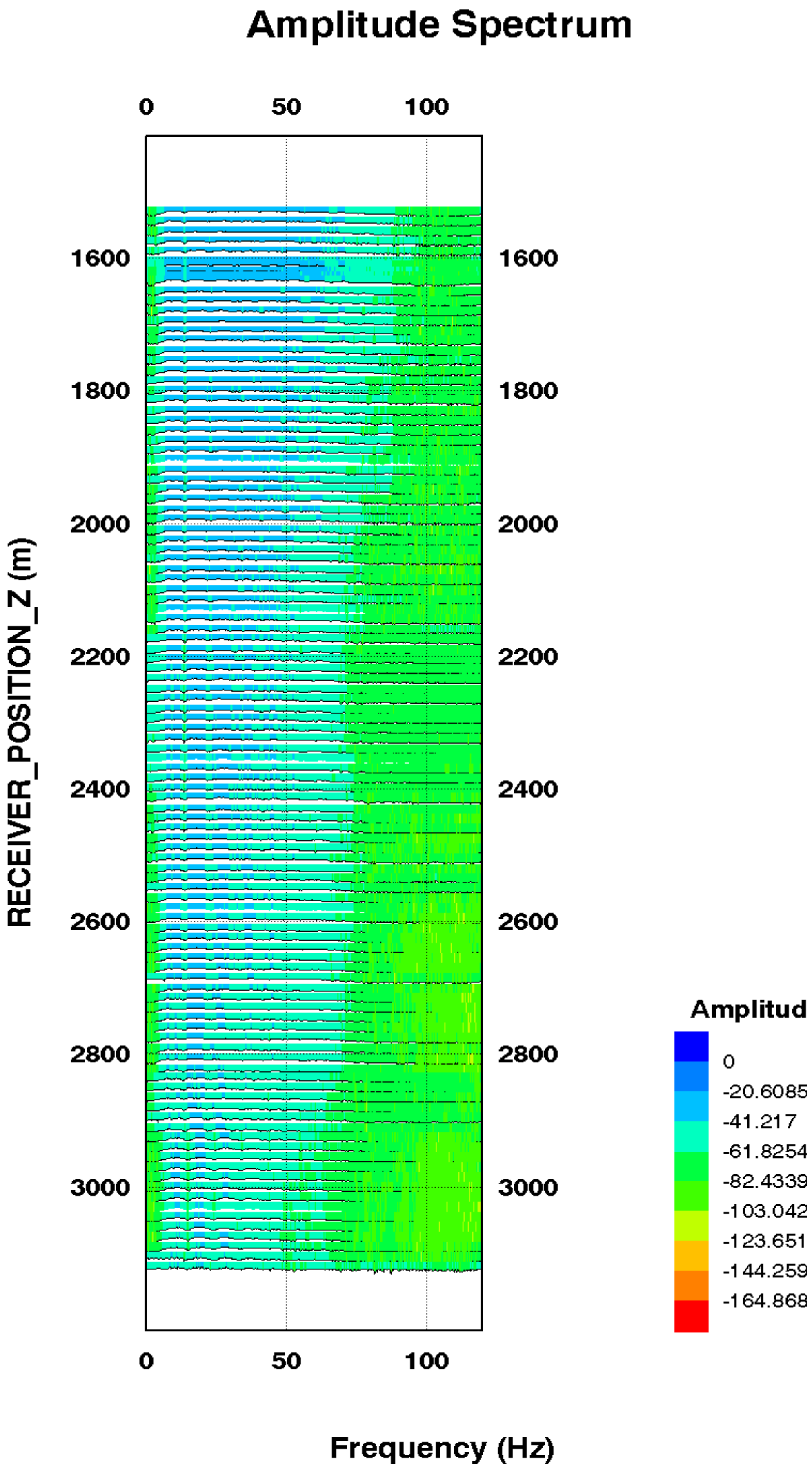


Figure 1. Amplitude Spectrum

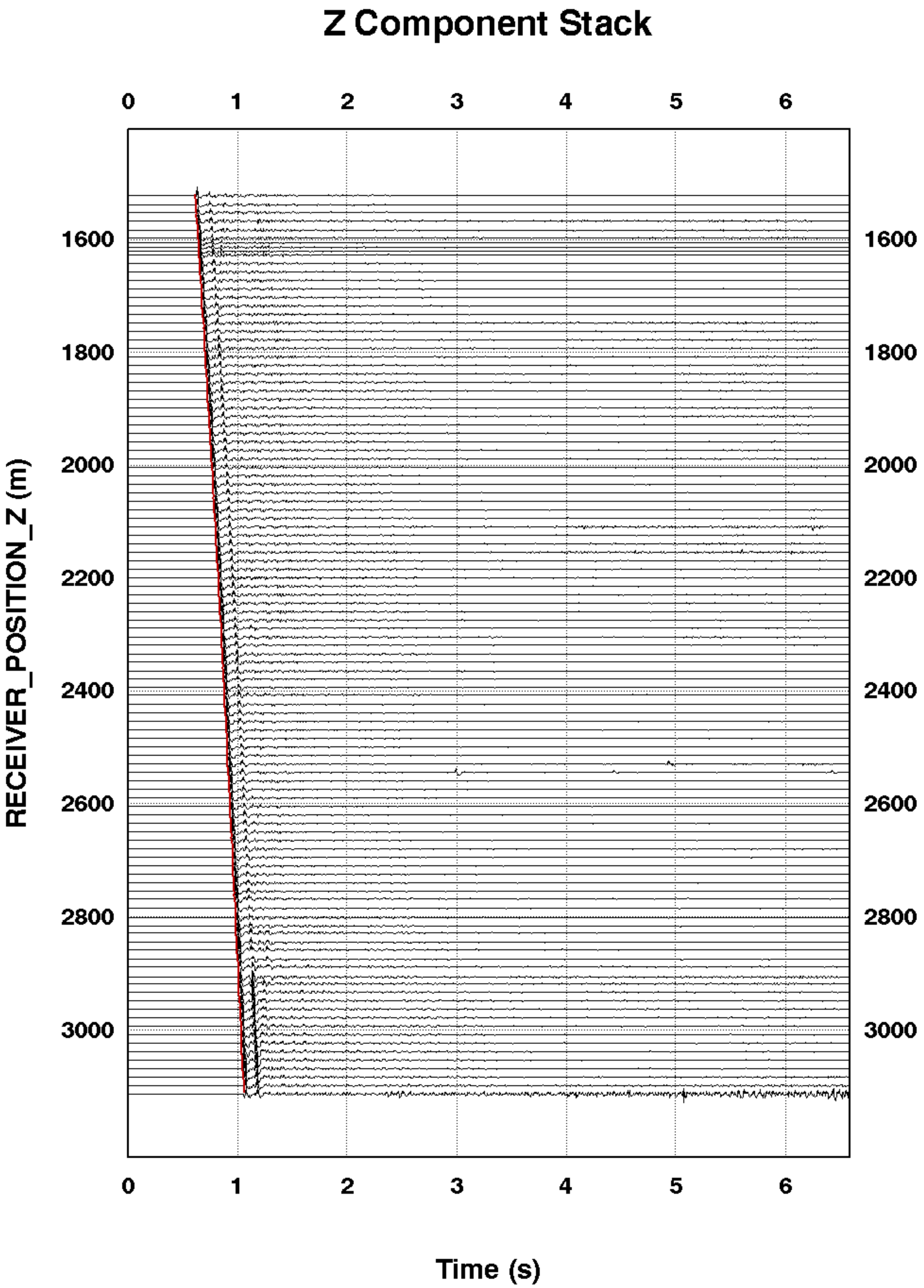


Figure 2. Z Median Stack

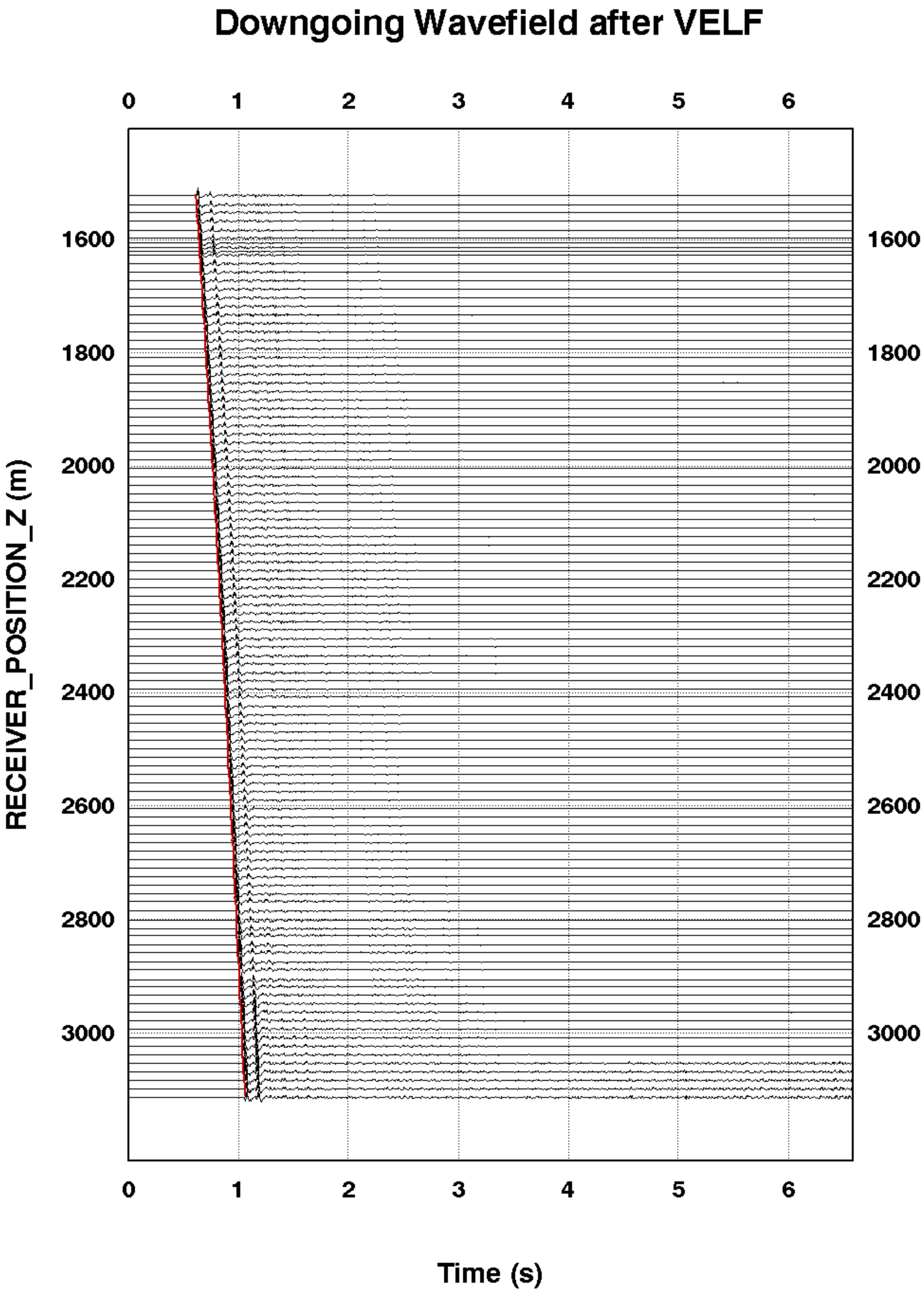


Figure 3. Downgoing Wavefield after VELF

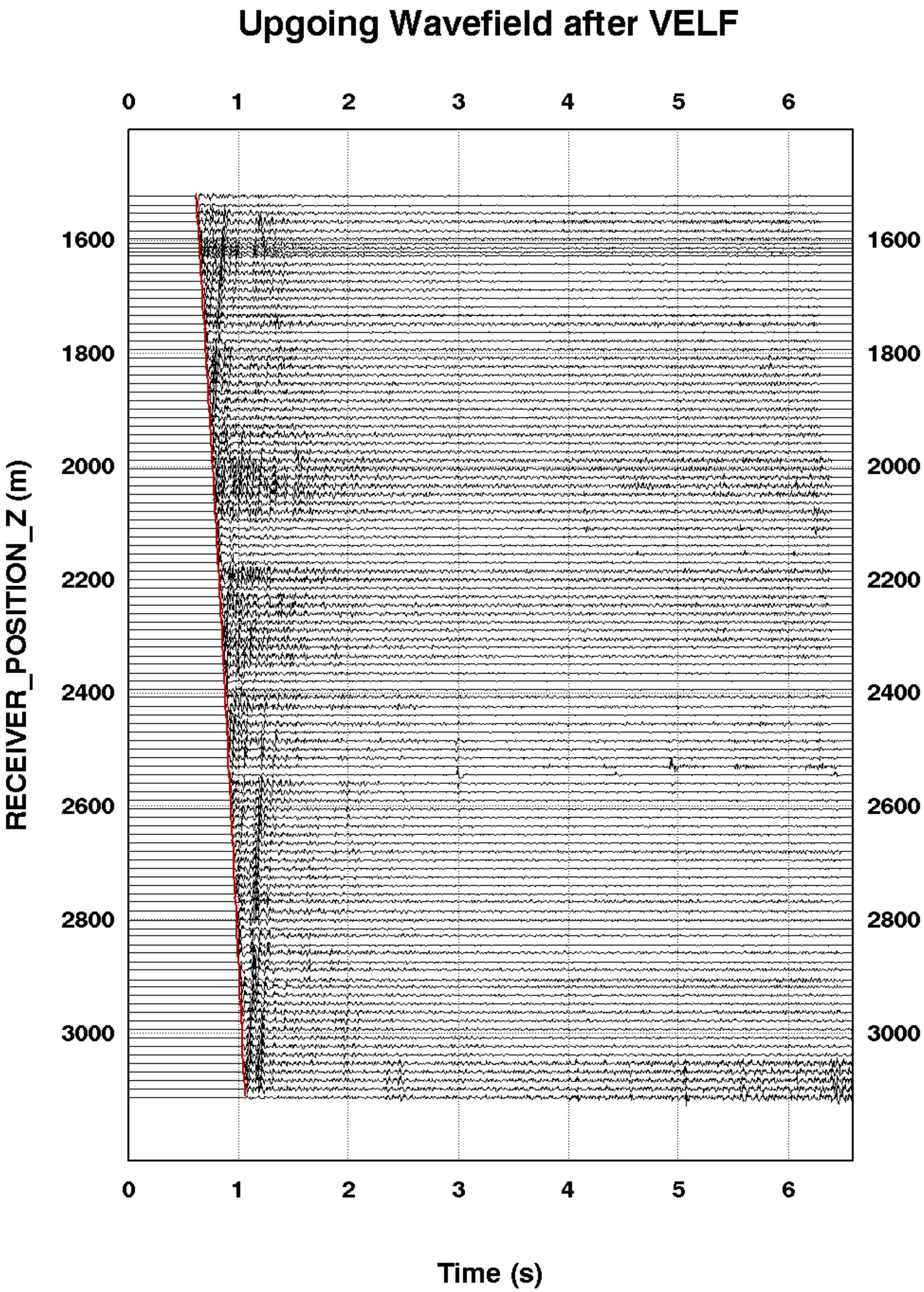


Figure 4. Upgoing Wavefield after VELF

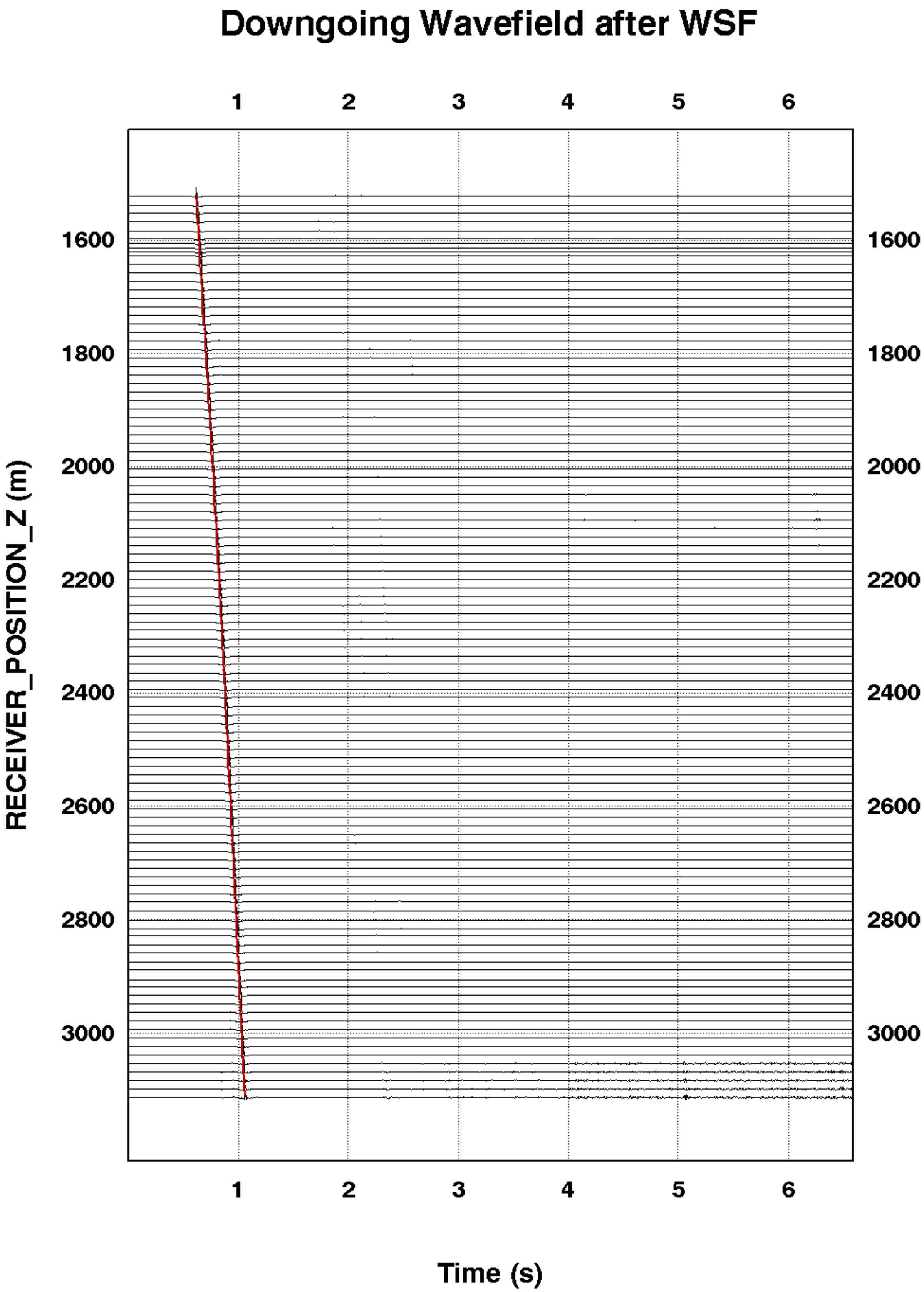


Figure 5. Downgoing Wavefield after WSF

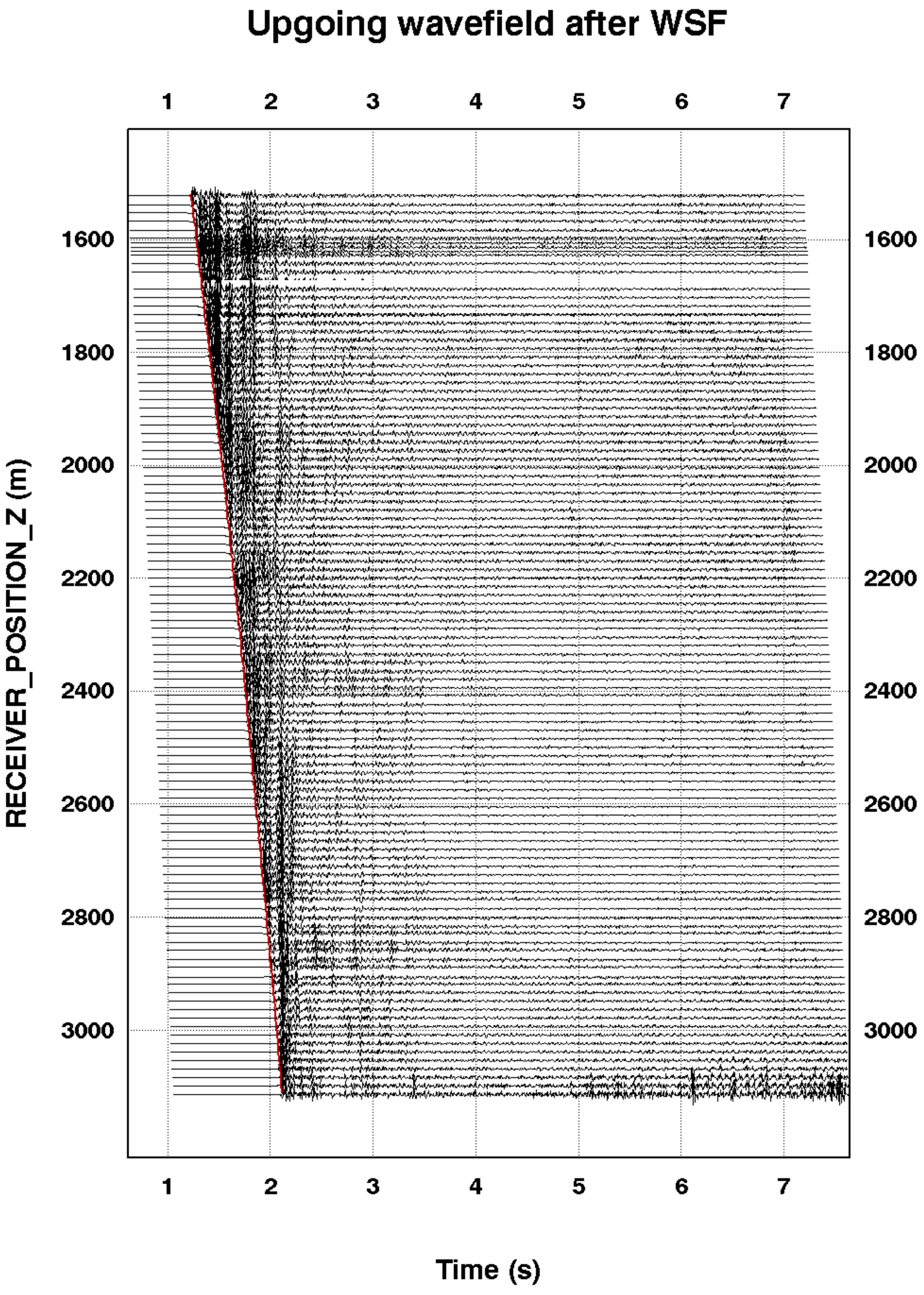


Figure 6. Upgoing Wavefield after WSF

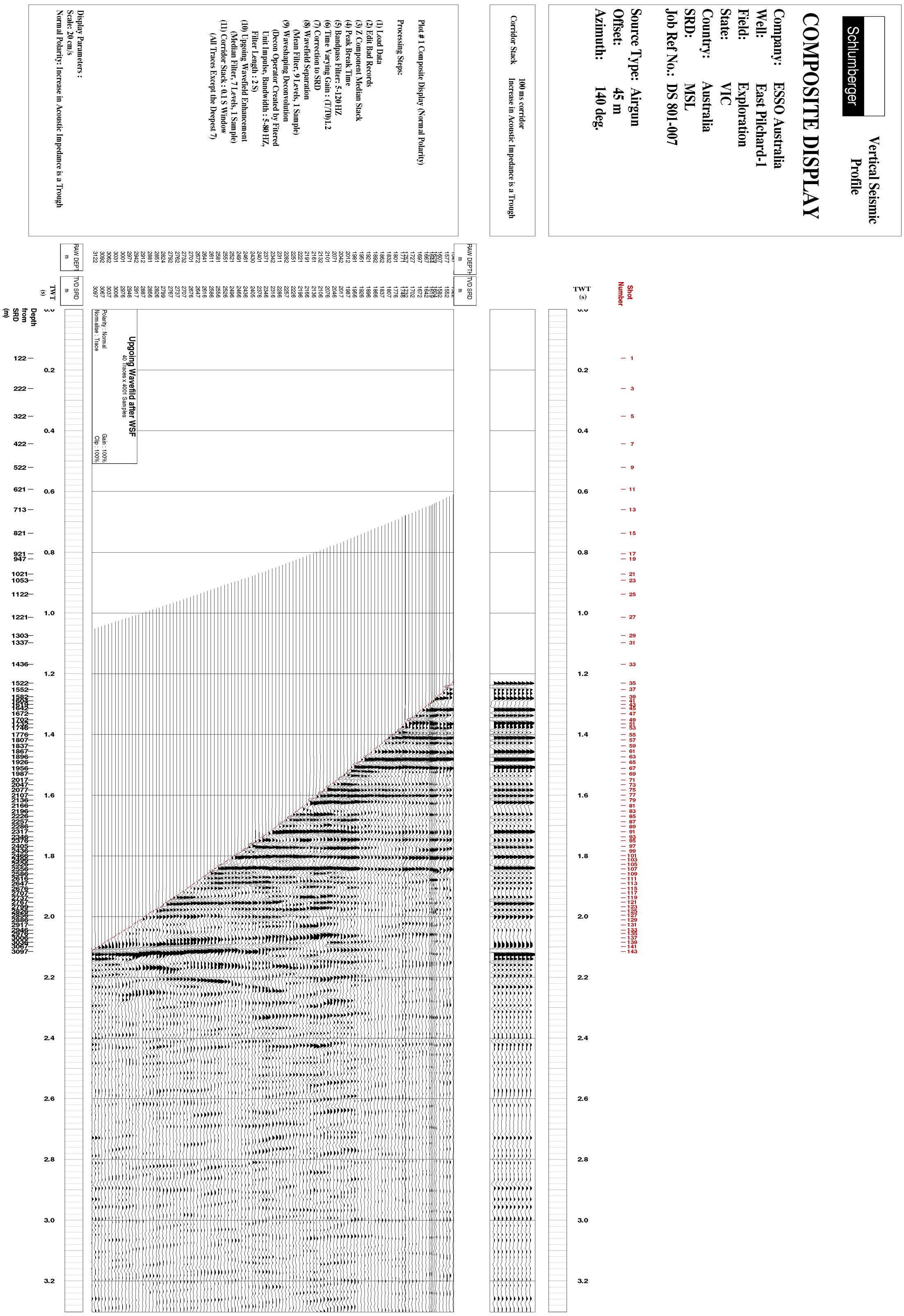


Figure 7. Composite Display

Finally, a velocity crossplot was created, using interval, average and RMS velocities, Figure 8.

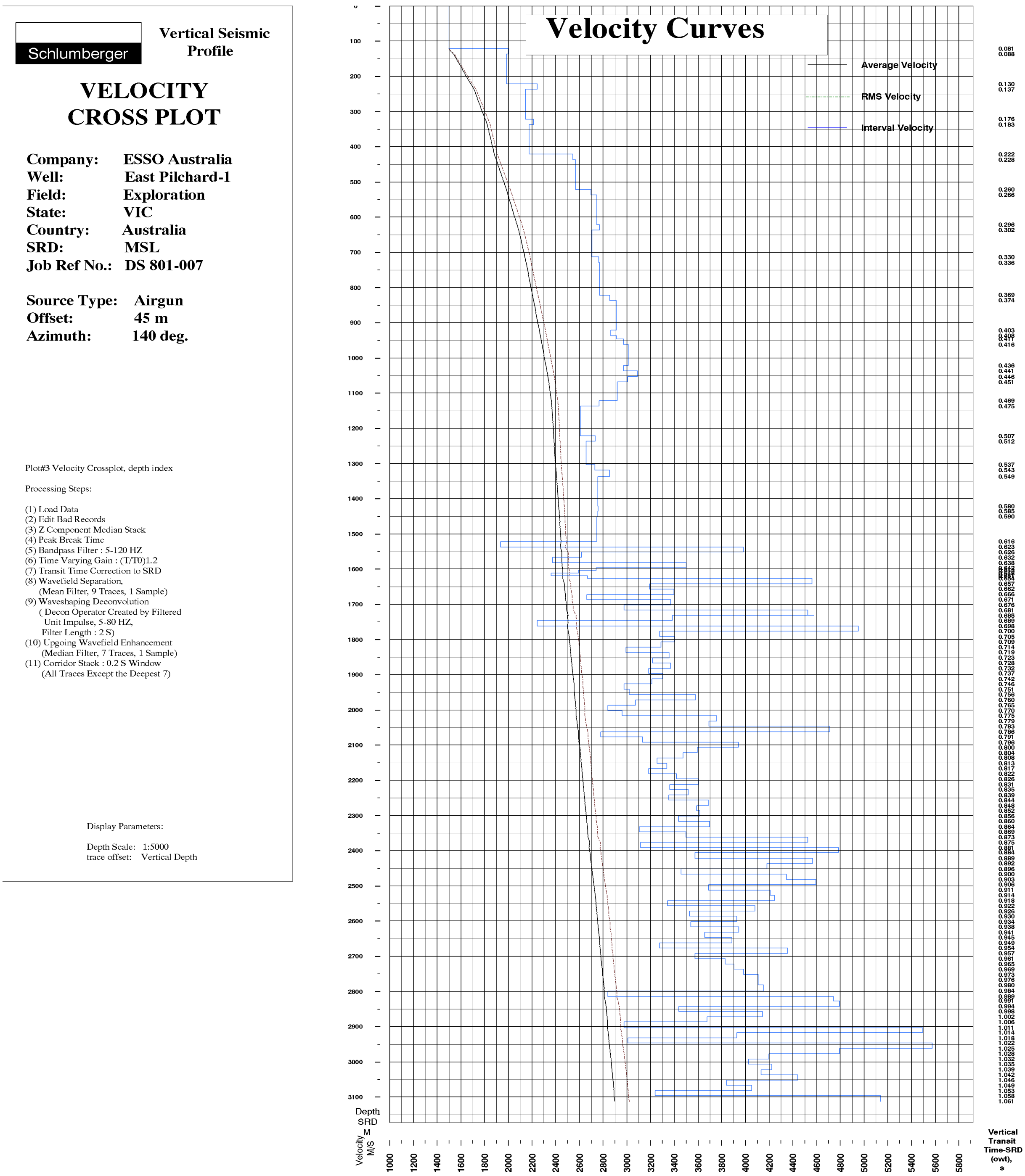


Figure 8. Velocity Crossplot

A Summary of Geophysical Listings

One geophysical data listing is appended to this report. 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 metres from seismic reference datum.

3. Measured depth from KB: *dkb*, the depth in metres from kelly bushing.

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: Δ*depth*, the vertical distance between each level.

7. Delta time between shots: Δ*time*, the difference in vertical travel time (*shtm*),between each level.

8. Interval velocity between shots: the average seismic velocity between each level, Δ*depth/*Δ*time*

9. Average velocity SRD to GEO: the average seismic velocity from datum to the corresponding checkshot level, shtm dsrd .

.

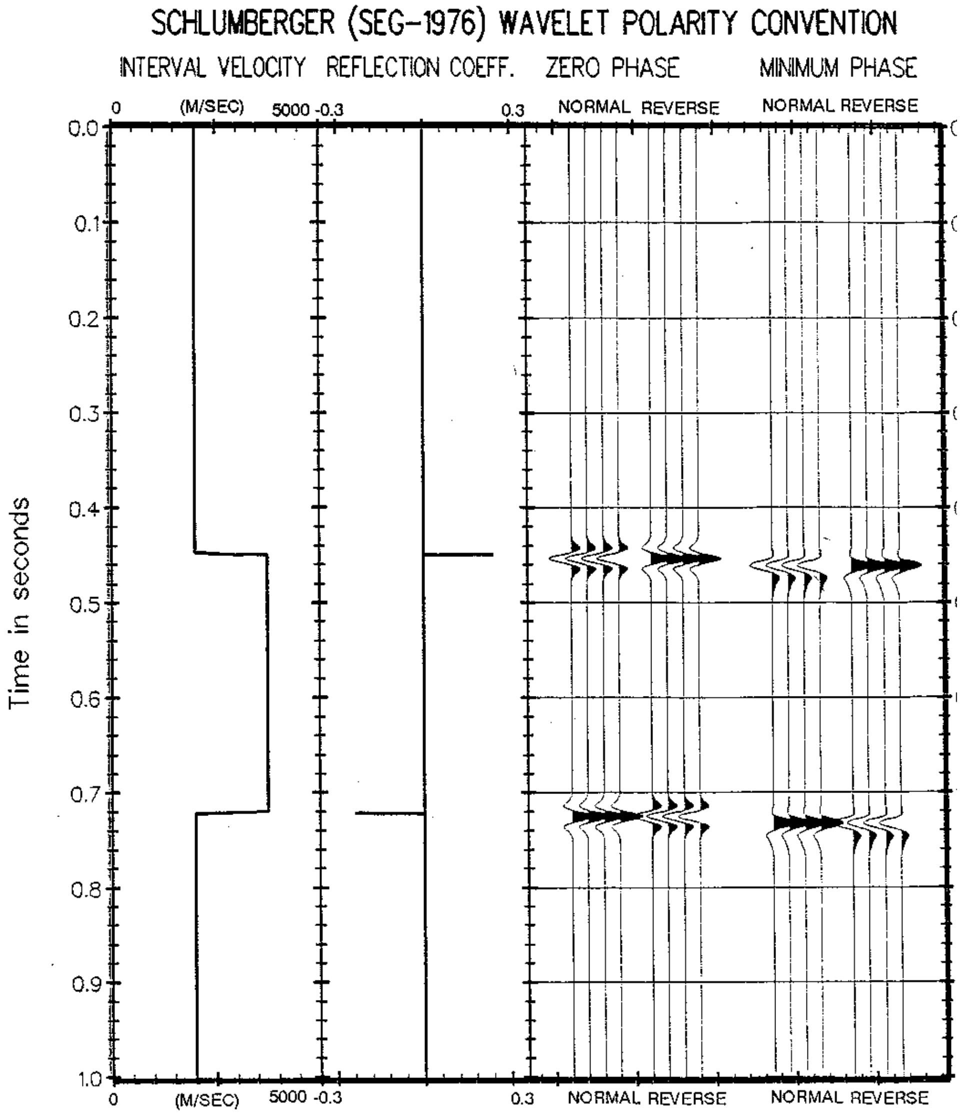


Figure 9. Schlumberger Wavelet Polarity Convention

Client and Well Information

Country	AUSTRALIA
State	VICTORIA
Logging Date	3-Aug-2001
Company	ESSO AUSTRALIA
Field	WILDCAT EXPLORATION
Well	EAST PILCHARD-1

Check Shot Data (Continued)

LEVEL NUMBER	VERTICAL DEPTH FROM SRD m	MEASURED DEPTH FROM KB m	OBSERVED TRAVEL TIME (owt) s	Vertical Transit Time-SRD (owt) s	DELTA DEPTH m	DELTA TIME s	SEISMIC INTERVAL VELOCITY m/s	SEISMIC AVERAGE VELOCITY m/s
1	0.0			0.0000				
							1524	
2	121.5	146.5	0.0795	0.0805				1524
					15.4	0.0076	2021	
3	136.9	161.9	0.0864	0.0882				1553
					84.6	0.0423	2002	
4	221.5	246.5	0.1266	0.1304				1698
					15.4	0.0068	2265	
5	236.9	261.9	0.1332	0.1372				1726
					84.6	0.0391	2165	
6	321.5	346.5	0.1715	0.1763				1824
					15.5	0.0069	2234	
7	337.0	362.0	0.1783	0.1832				1839
					84.6	0.0385	2196	
8	421.6	446.6	0.2165	0.2218				1901
					15.4	0.0060	2571	
9	437.0	462.0	0.2224	0.2278				1919
					84.5	0.0326	2593	
10	521.5	546.5	0.2548	0.2603				2003
					15.5	0.0057	2724	
11	537.0	562.0	0.2604	0.2660				2019
					84.5	0.0304	2775	
12	621.5	646.5	0.2907	0.2965				2096
					15.3	0.0055	2797	
13	636.8	661.8	0.2961	0.3019				2109
					76.7	0.0281	2734	
14	713.5	738.5	0.3241	0.3300				2162
					15.5	0.0055	2793	
15	729.0	754.0	0.3296	0.3356				2173
					92.5	0.0331	2797	
16	821.5	846.5	0.3626	0.3686				2229
					15.3	0.0053	2887	
17	836.8	861.8	0.3679	0.3739				2238
					84.7	0.0288	2943	

18	921.5	946.5	0.3966	0.4027				2288
					15.4	0.0053	2896	
19	936.9	961.9	0.4019	0.4080				2296
					9.7	0.0033	2945	
20	946.6	971.6	0.4052	0.4113				2301
					15.4	0.0051	3003	
21	962.0	987.0	0.4103	0.4164				2310
					59.5	0.0195	3046	
22	1021.5	1046.5	0.4298	0.4360				2343
					15.4	0.0051	3005	
23	1036.9	1061.9	0.4350	0.4411				2351
					16.5	0.0053	3123	
24	1053.4	1078.4	0.4402	0.4464				2360
					15.4	0.0051	3040	
25	1068.8	1093.8	0.4453	0.4514				2368
					52.8	0.0179	2950	
26	1121.6	1146.6	0.4632	0.4693				2390
					15.4	0.0055	2796	
27	1137.0	1162.0	0.4687	0.4749				2394
					84.5	0.0321	2636	
28	1221.5	1246.5	0.5007	0.5069				2410
					15.4	0.0056	2762	
29	1236.9	1261.9	0.5063	0.5125				2414
					66.5	0.0248	2684	
30	1303.4	1328.4	0.5310	0.5373				2426
					15.4	0.0056	2760	
31	1318.8	1343.8	0.5366	0.5429				2429
					18.1	0.0063	2886	
32	1336.9	1361.9	0.5429	0.5491				2435
					84.6	0.0304	2783	
33	1421.5	1446.5	0.5732	0.5795				2453
					14.0	0.0050	2788	
34	1435.5	1460.5	0.5783	0.5845				2456
					15.4	0.0055	2783	
35	1450.9	1475.9	0.5838	0.5901				2459
					70.7	0.0255	2777	
36	1521.6	1546.6	0.6092	0.6155				2472
					15.5	0.0079	1952	
37	1537.1	1562.1	0.6172	0.6235				2465
					14.5	0.0025	4031	
38	1551.6	1576.6	0.6197	0.6260				2479
					15.0	0.0057	2646	
39	1566.6	1591.6	0.6254	0.6317				2480
					15.4	0.0064	2397	
40	1582.0	1607.0	0.6318	0.6381				2479
					14.5	0.0041	3543	
41	1596.5	1621.5	0.6359	0.6422				2486
					7.1	0.0026	2771	
42	1603.6	1628.6	0.6385	0.6448				2487
					8.3	0.0032	2617	
43	1611.9	1636.9	0.6416	0.6479				2488
					7.1	0.0030	2383	
44	1619.0	1644.0	0.6446	0.6509				2487
					7.4	0.0027	2697	
45	1626.4	1651.4	0.6473	0.6537				2488
					15.5	0.0034	4621	
46	1641.9	1666.9	0.6507	0.6570				2499

					14.5	0.0045	3229	
47	1656.4	1681.4	0.6552	0.6615				2504
					15.4	0.0045	3437	
48	1671.8	1696.8	0.6597	0.6660				2510
					14.7	0.0055	2690	
49	1686.5	1711.5	0.6651	0.6714				2512
					15.4	0.0045	3410	
50	1701.9	1726.9	0.6696	0.6760				2518
					14.4	0.0048	3010	
51	1716.3	1741.3	0.6744	0.6807				2521
					15.3	0.0022	4585	
52	1731.6	1756.6	0.6766	0.6829				2536
					0.1	0.0022	4638	
53	1731.7	1756.7	0.6788	0.6851				2527
					14.6	0.0042	3424	
54	1746.3	1771.3	0.6830	0.6893				2533
					15.5	0.0082	2264	
55	1761.8	1786.8	0.6912	0.6976				2526
					14.7	0.0029	5017	
56	1776.5	1801.5	0.6942	0.7005				2536
					15.4	0.0046	3314	
57	1791.9	1816.9	0.6988	0.7051				2541
					14.7	0.0043	3444	
58	1806.6	1831.6	0.7031	0.7094				2547
					15.5	0.0047	3327	
59	1822.1	1847.1	0.7077	0.7141				2552
					14.5	0.0048	3026	
60	1836.6	1861.6	0.7125	0.7189				2555
					15.4	0.0045	3397	
61	1852.0	1877.0	0.7170	0.7234				2560
					14.5	0.0045	3255	
62	1866.5	1891.5	0.7215	0.7278				2564
					15.4	0.0045	3410	
63	1881.9	1906.9	0.7260	0.7324				2570
					14.5	0.0045	3220	
64	1896.4	1921.4	0.7305	0.7369				2574
					15.5	0.0046	3340	
65	1911.9	1936.9	0.7352	0.7415				2578
					14.5	0.0045	3248	
66	1926.4	1951.4	0.7396	0.7460				2582
					15.4	0.0051	3010	
67	1941.8	1966.8	0.7447	0.7511				2585
					14.6	0.0048	3053	
68	1956.4	1981.4	0.7495	0.7559				2588
					15.4	0.0043	3620	
69	1971.8	1996.8	0.7538	0.7601				2594
					14.8	0.0048	3107	
70	1986.6	2011.6	0.7585	0.7649				2597
					15.4	0.0054	2870	
71	2002.0	2027.0	0.7639	0.7703				2599
					14.6	0.0049	2992	
72	2016.6	2041.6	0.7688	0.7751				2602
					15.4	0.0040	3804	
73	2032.0	2057.0	0.7728	0.7792				2608
					14.5	0.0039	3736	
74	2046.5	2071.5	0.7767	0.7831				2613
					15.4	0.0032	4772	

75	2061.9	2086.9	0.7799	0.7863				2622
					14.6	0.0052	2810	
76	2076.5	2101.5	0.7851	0.7915				2624
					15.4	0.0049	3167	
77	2091.9	2116.9	0.7900	0.7963				2627
					14.6	0.0037	3990	
78	2106.5	2131.5	0.7936	0.8000				2633
					15.4	0.0042	3637	
79	2121.9	2146.9	0.7979	0.8042				2638
					14.2	0.0040	3515	
80	2136.1	2161.1	0.8019	0.8083				2643
					15.5	0.0047	3294	
81	2151.6	2176.6	0.8066	0.8130				2647
					14.7	0.0044	3376	
82	2166.3	2191.3	0.8110	0.8173				2650
					15.4	0.0048	3220	
83	2181.7	2206.7	0.8157	0.8221				2654
					14.6	0.0042	3460	
84	2196.3	2221.3	0.8200	0.8263				2658
					15.5	0.0042	3648	
85	2211.8	2236.8	0.8242	0.8306				2663
					14.6	0.0043	3399	
86	2226.4	2251.4	0.8285	0.8349				2667
					15.4	0.0043	3561	
87	2241.8	2266.8	0.8328	0.8392				2671
					14.8	0.0044	3392	
88	2256.6	2281.6	0.8372	0.8436				2675
					15.4	0.0041	3731	
89	2272.0	2297.0	0.8413	0.8477				2680
					14.4	0.0040	3632	
90	2286.4	2311.4	0.8453	0.8517				2685
					15.4	0.0042	3657	
91	2301.8	2326.8	0.8495	0.8559				2689
					14.7	0.0042	3476	
92	2316.5	2341.5	0.8537	0.8601				2693
					15.5	0.0041	3743	
93	2332.0	2357.0	0.8578	0.8642				2698
					14.3	0.0046	3139	
94	2346.3	2371.3	0.8624	0.8688				2701
					15.4	0.0044	3539	
95	2361.7	2386.7	0.8668	0.8732				2705
					14.6	0.0018	4585	
96	2376.3	2401.3	0.8686	0.8750				2716
					15.4	0.0064	3150	
97	2391.7	2416.7	0.8750	0.8814				2714
					13.3	0.0027	4847	
98	2405.0	2430.0	0.8777	0.8841				2720
					16.7	0.0046	3617	
99	2421.7	2446.7	0.8824	0.8888				2725
					14.6	0.0032	4627	
100	2436.3	2461.3	0.8855	0.8919				2732
					15.4	0.0036	4235	
101	2451.7	2476.7	0.8891	0.8956				2738
					14.6	0.0042	3497	
102	2466.3	2491.3	0.8933	0.8997				2741
					15.4	0.0035	4401	
103	2481.7	2506.7	0.8968	0.9032				2748

					14.7	0.0032	4654	
104	2496.4	2521.4	0.9000	0.9064				2754
					15.4	0.0041	3735	
105	2511.8	2536.8	0.9041	0.9105				2759
					14.6	0.0034	4262	
106	2526.4	2551.4	0.9075	0.9139				2764
					15.4	0.0036	4299	
107	2541.8	2566.8	0.9111	0.9175				2770
					14.6	0.0043	3382	
108	2556.4	2581.4	0.9154	0.9218				2773
					15.4	0.0037	4132	
109	2571.8	2596.8	0.9191	0.9256				2779
					14.6	0.0041	3570	
110	2586.4	2611.4	0.9232	0.9297				2782
					15.4	0.0039	3978	
111	2601.8	2626.8	0.9271	0.9335				2787
					14.7	0.0041	3581	
112	2616.5	2641.5	0.9312	0.9376				2791
					15.4	0.0039	3991	
113	2631.9	2656.9	0.9351	0.9415				2795
					14.7	0.0040	3703	
114	2646.6	2671.6	0.9390	0.9455				2799
					15.4	0.0039	3934	
115	2662.0	2687.0	0.9429	0.9494				2804
					14.5	0.0044	3312	
116	2676.5	2701.5	0.9473	0.9538				2806
					15.4	0.0035	4413	
117	2691.9	2716.9	0.9508	0.9572				2812
					14.7	0.0041	3618	
118	2706.6	2731.6	0.9549	0.9613				2816
					15.4	0.0040	3874	
119	2722.0	2747.0	0.9588	0.9653				2820
					14.6	0.0037	3953	
120	2736.6	2761.6	0.9625	0.9690				2824
					15.4	0.0038	4035	
121	2752.0	2777.0	0.9664	0.9728				2829
					14.6	0.0035	4159	
122	2766.6	2791.6	0.9699	0.9763				2834
					15.4	0.0037	4161	
123	2782.0	2807.0	0.9736	0.9800				2839
					16.6	0.0039	4204	
124	2798.6	2823.6	0.9775	0.9839				2844
					15.4	0.0054	2870	
125	2814.0	2839.0	0.9829	0.9893				2844
					12.5	0.0018	4805	
126	2826.5	2851.5	0.9847	0.9911				2852
					15.5	0.0027	4856	
127	2842.0	2867.0	0.9874	0.9939				2859
					14.5	0.0042	3480	
128	2856.5	2881.5	0.9916	0.9981				2862
					15.5	0.0037	4196	
129	2872.0	2897.0	0.9953	1.0017				2867
					14.5	0.0039	3720	
130	2886.5	2911.5	0.9992	1.0056				2870
					16.9	0.0056	3009	
131	2903.4	2928.4	1.0048	1.0113				2871
					13.2	0.0024	5571	

132	2916.6	2941.6	1.0072	1.0136				2877
					15.4	0.0039	3977	
133	2932.0	2957.0	1.0111	1.0175				2882
					14.4	0.0047	3044	
134	2946.4	2971.4	1.0158	1.0222				2882
					15.5	0.0027	5650	
135	2961.9	2986.9	1.0185	1.0250				2890
					14.6	0.0030	4856	
136	2976.5	3001.5	1.0215	1.0280				2895
					15.5	0.0036	4252	
137	2992.0	3017.0	1.0252	1.0316				2900
					14.5	0.0036	4077	
138	3006.5	3031.5	1.0287	1.0352				2904
					15.5	0.0036	4276	
139	3022.0	3047.0	1.0324	1.0388				2909
					14.5	0.0035	4186	
140	3036.5	3061.5	1.0358	1.0423				2913
					15.5	0.0034	4498	
141	3052.0	3077.0	1.0393	1.0457				2919
					14.6	0.0038	3888	
142	3066.6	3091.6	1.0430	1.0495				2922
					15.4	0.0038	4103	
143	3082.0	3107.0	1.0468	1.0532				2926
					14.6	0.0045	3276	
144	3096.6	3121.6	1.0512	1.0577				2928
					15.4	0.0030	5211	
145	3112.0	3137.0	1.0542	1.0606				2934

Attachment 1. Transit Time Picking Algorithms

The time picking can be broken down into several tasks:

First of all focus on the relevant parts of a data trace by selecting time intervals in form of constraints. To this end the user can select velocity, time header and/or initial guess constraints.

Detect a signal or a first break using a detection algorithm.

Tune on a particular phase of the event (e.g. zero-crossing, peak, trough, etc). It should be clear that tuning is only happening if a pick was either detected by an algorithm or retrieved from a header as initial guess.

Despike the picked transit time curve in order to eliminate mispicks either by median filtering or by cross-correlation. The cross-correlation option does not only have filtering features but also allows to pick correlated events within a section after having picked only one event.

Detection algorithm

Energy break: the algorithm determines the maximum of the so-called energy function, which is the integrated signal energy within a sliding time window normalized by the total energy accumulated since the first time of data.

For a trace S(t) an energy function F(`) is calculated with algorithm proposed by (Coppens, 1985)

Geophone break: finds the first break of a downhole sensor. The algorithm compares amplitudes and slopes in consecutive arches. Input parameters are the center frequency of the data to be picked, a linear fit gate time which should be about half a wavelet period, and a detection threshold between 0.0
and 0.5.

Hydrophone break: provides the first break of a downhole sensor. The routine finds the global minimum and maximum amplitude along a trace, takes the smaller one of the corresponding sample indices and outputs the time of the preceding zero-crossing as the first break. The zero-crossing time is determined by linear regression over a selected length (linear fit gate time).

Tuning:

Peak: finds the time of the closest local maximum amplitude in the vicinity of an input break time.

Trough: finds the time of closest local minimum amplitude in the vicinity of an input break time.

Zero-crossing: finds the time of the closest zero-crossing in the vicinity of an input break time. The routine stores the sign of the derivative at the zero-crossing which can be passed on for the tuning of the following trace. Thus artifacts created by cycle skipping can be reduced.

Inflection: finds the time of the closest inflection point in the vicinity of an input break time. The routine stores the sign of the derivative at the inflection point which can be passed on for the tuning of the following trace. Thus artifacts created by cycle skipping can be reduced.

Inflection point tangent: finds the time of the closest inflection point in the vicinity of an input break time. The tuned break time is the zero-crossing time of the corresponding tangent at this inflection point. The routine stores the sign of the derivative at the inflection point which can be passed on for the tuning of the following trace. Thus artifacts created by cycle skipping can be reduced.

Cross-correlation

This option allows to tune transit times by considering the picked phase of a selected reference trace. The cross-correlation gate in time or length units can be specified in the Motif parameter panel of this option. The default value for the gate is three times the estimated center frequency of the first five traces of the seismic section to be picked. The window is put symmetrically around the transit times of the two traces to be cross-correlated if the option Use Existing Picks for the Gate Center Time is enabled and the
transit times are not absent.

If the option Use Existing Picks for the Gate Center Time is disabled then the cross-correlation is started with the ambient traces around the reference trace. Those two traces, in turn, will be taken to set the time gates for the following ones, and so on. Thus an automatic picking can be provided after having picked only the reference trace.

Retuning can be selected to follow the cross-correlation. In this case the cross-correlation serves as a transit time curve despiker.

The cross correlation process can be stopped automatically if the picking quality degrades. This happens if the time difference between the break of the current and the previous trace exceeds a threshold value derived from a user-specified apparent velocity.

A polynomial amplitude interpolation is proposed in order provide “real” extreme values instead of extreme values at the nearest sample. The algorithm works as follows: the global extreme values are detected with the gate together with the corresponding sample indices. A minimum and maximum amplitude tuning provides an exact time estimate of these amplitudes. Polynomial interpolation determines the amplitudes at these times which generally fall in between samples.

There are a variety of selectable and non-exclusive constraints available in order to stabilize the time picking process . The objective is to extract only the relevant part of the trace for the detection, tuning and/or cross-correlation process using.

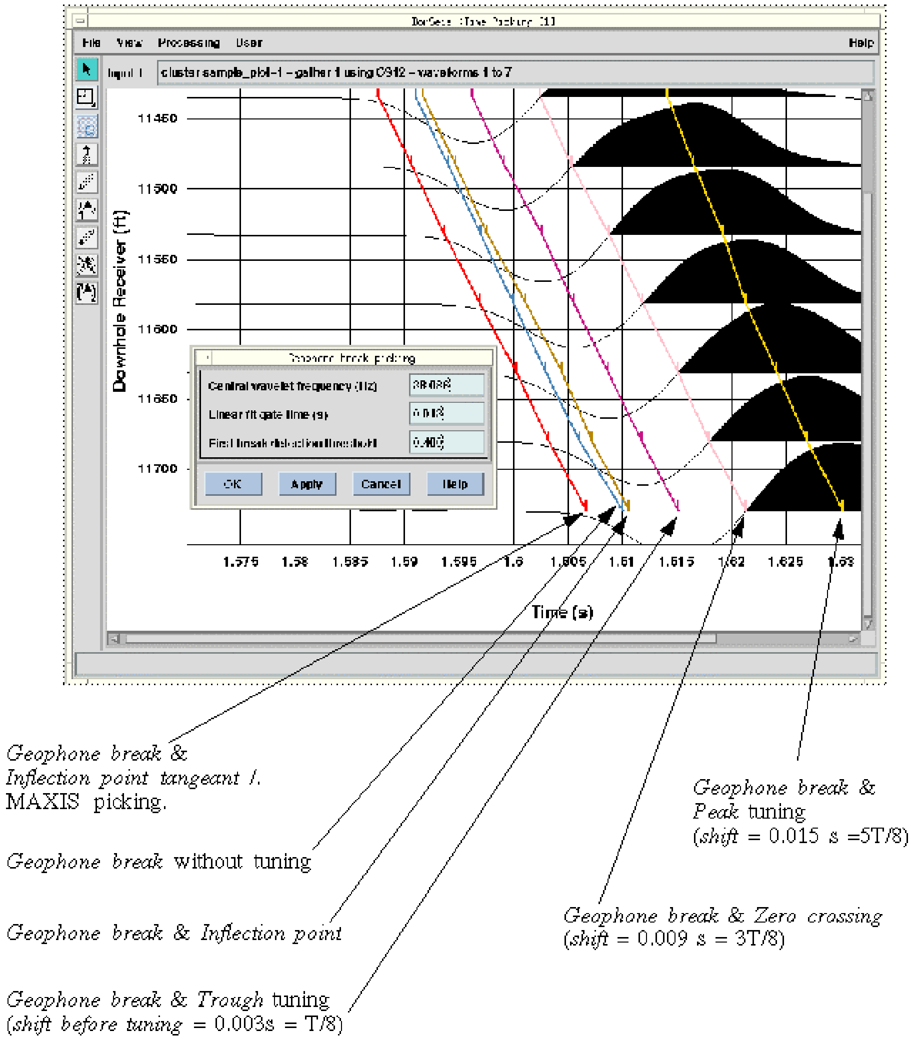
Reference:

Coppens, F., 1985, First arrival picking on common offset trace collections for automatic estimation of static corrections, Geophys. Prosp. 33, 1212-1231.

Lee, D. and Morf, M., 1980, A novel innovations based time –domain pitch detection.

Example:¶

¶



Note: the period of the signal (T) is computed from the central frequency.
the default linear fit gate time =T/2.

§