Assembled Dataset ID: 11-010 Laramide Basement Faulting

Description:

All three lines used fixed spreads where the geophones were not moved for any of the shots. The line geometries are listed in Table 1.

Prior to data acquisition, each profile was surveyed, measured, and flagged. Profile surveys were conducted using a SOKKIA Total Station and were completed simultaneously with measuring and flagging of geophone locations. Total station surveys included measuring source and receiver elevations and line-length distance. The data acquired from each survey was incorporated into final data processing to account for source and receiver elevation changes. Following profile surveying, each profile line, Sheep mountain Line 1, Sheep mountain Line 2, and Sheep mountain X-Line, was shot separately using a fixed spread layout (Table 1). For each line, 0.5 meter deep shot holes were dug and filled with water to increase coupling and signal to noise ratio (the holes were immediately filled following each experiment). Each shot was transmitted and recorded to a field laptop computer and compiled using Geometrics software. The total number of shots used for each profile line is also listed in Table 3.

1A) Sheep Mnt
Line 1

Data Acquisition Parameters	Details
Source Type	Betsy Seisgun- 10 ga.
Source Depth	~1.5'
Receiver Type	104 x 40Hz geophones
Data Recording System	3 x 24 & 2 x 12 channel Geometrics Geodes
Recording Time	1 s
Sampling Interval	0.25 ms
Source Spacing	9 m
Receiver Spacing	3 m
CMP Spacing	1.5 m
Total Spread Length	342 m
Number of Shots	38
CMP Fold	17-fold
Offset of 1st	38

1B) Sheep Mountain
Line 2

Data Acquisition Parameters	Details
Source Type	Betsy Seisgun- 10 ga.
Source Depth	~1.5'
Receiver Type	104 x 40Hz geophones
Data Recording System	3 x 24 & 2 x 12 channel Geometrics Geodes
Recording Time	0.5 s
Sampling Interval	0.25 ms
Source Spacing	9 m
Receiver Spacing	3 m
CMP Spacing	1.5 m
Total Spread Length	342 m

Number of Shots	41
CMP Fold	17-fold
Offset of 1st shot	27m

2C) Sheep Mountain Xline

Data Acquisition Parameters	Details
Source Type	Betsy Seisgun- 12 ga.
Source Depth	~1.5'
Receiver Type	104 x 40Hz geophones
Data Recording System	3 x 24 & 2 x 12 channel Geometrics Geodes
Recording Time	1 s
Sampling Interval	0.25 ms
Source Spacing	8 m
Receiver Spacing	2 m
CMP Spacing	1 m
Total Spread Length	208 m
Number of Shots	28
CMP Fold	19-fold
1st Shot offset	8m
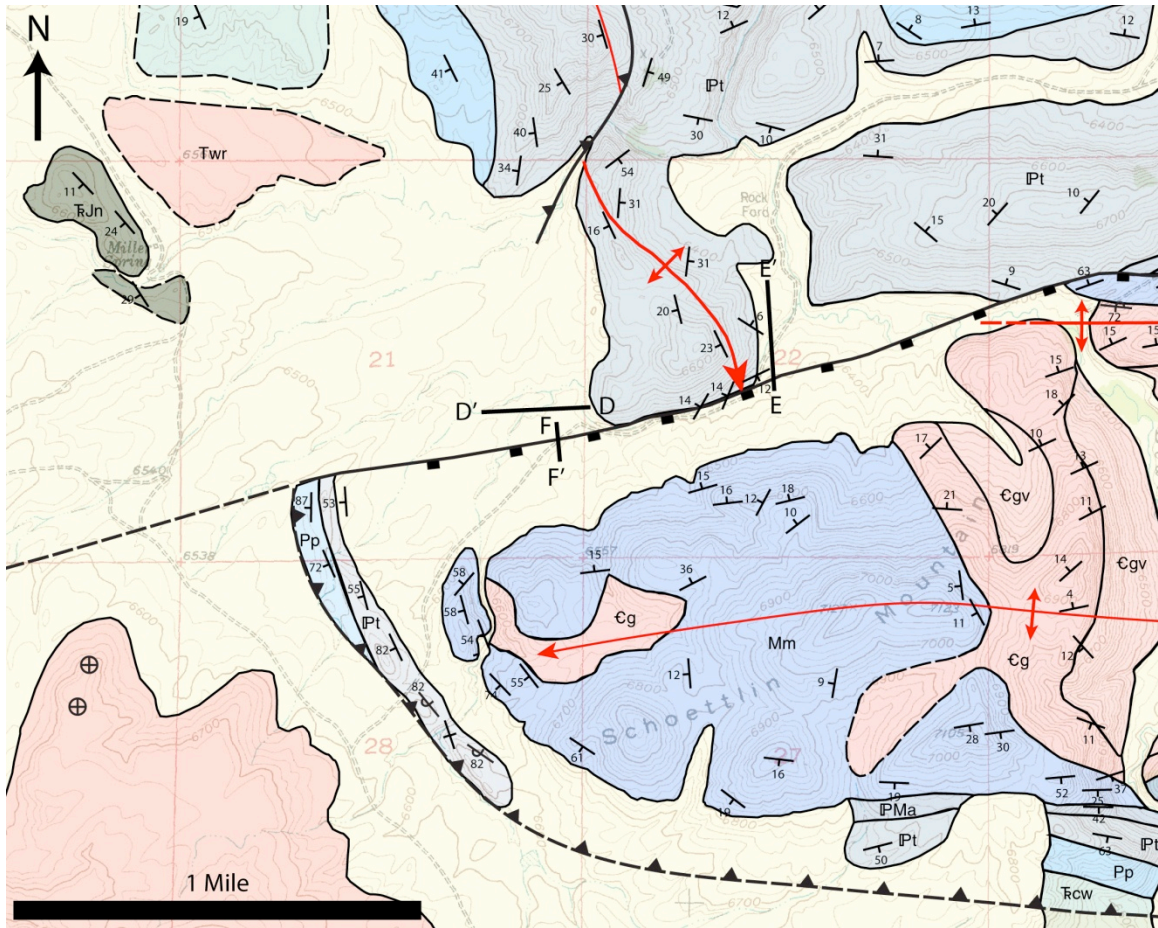
Figure 38: Zoomed map view of the seismic experiment shot lines: D-D', E-E', and F-F'

(Line 1) D-D':
Azimuth = ~087°
Lat/Long D = ~42° 33' 34.67" N, 108° 25' 20.96" W
Lat/Long D' = ~42° 33' 34.02" N, 108° 25' 38.12" W

(Line 2) E-E'
Azimuth= ~356°
Lat/Long E = ~42° 33' 34.53" N, 108° 24' 48.13" W
Lat/Long E' = ~42° 33' 50.73" N, 108° 24' 49.20" W

(Xline) F-F'
Azimuth = ~356°
Lat/Long F = ~42° 33' 31.78" N, 108° 25' 28.30" W
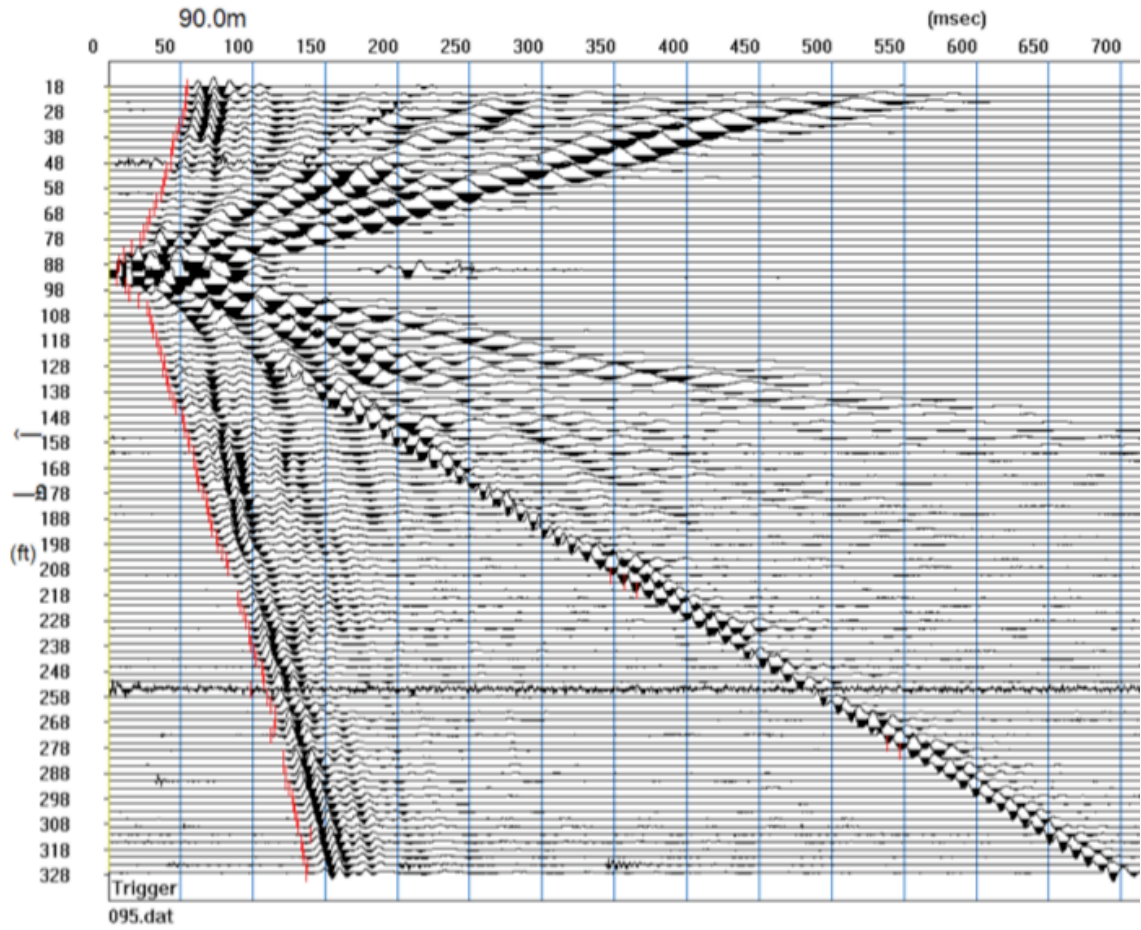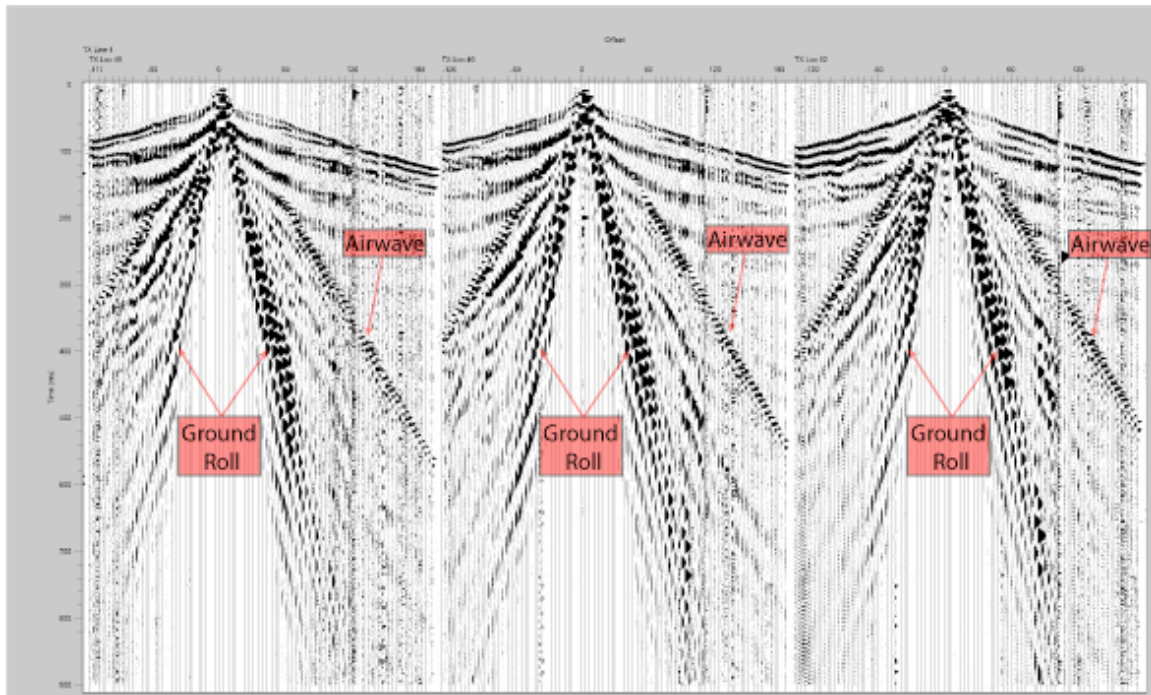Lat/Long F' = ~42° 33' 23.64" N, 108° 25' 27.07" W

Figure 39: First arrival picks in PickWin95© for the seismic refraction analysis of profile line D-D'.
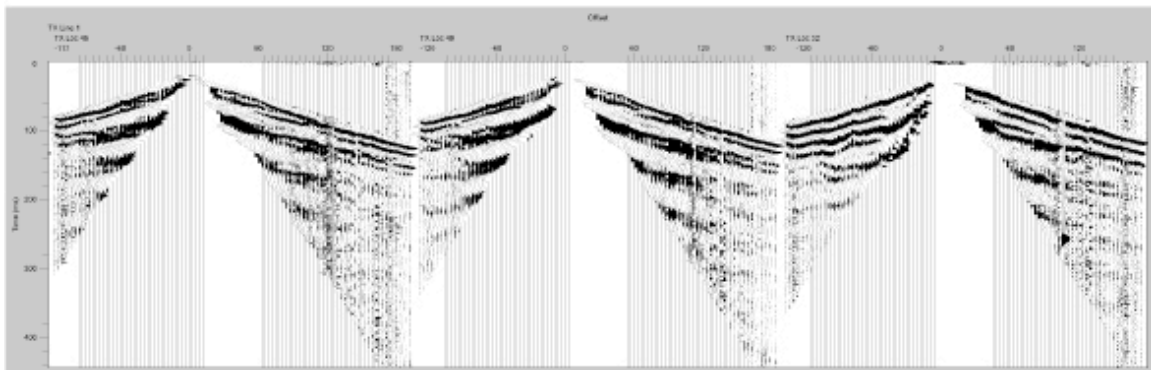
A).

B).

Figure 40: A) Shot gathers of raw seismic reflection data for line D-D'. Note labeled source generated linear noise. B) The same three shot gathers from A with the surgical linear noise and top mute applied.
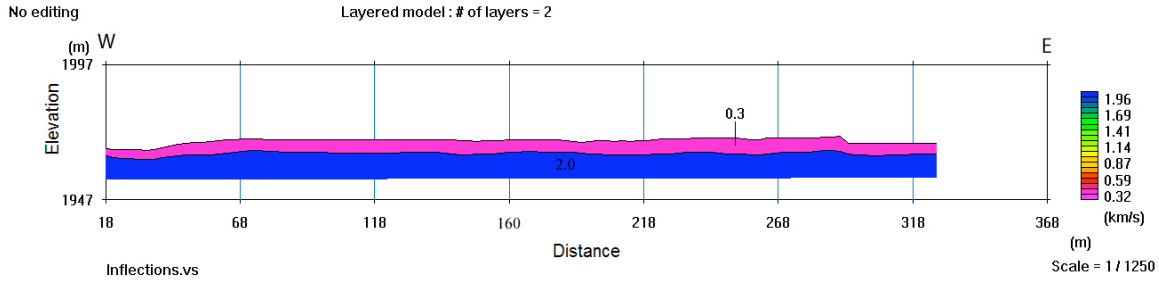
Figure 42: D-D' Time-Term inversion model used to generate the initial model prior to final tomography processing.
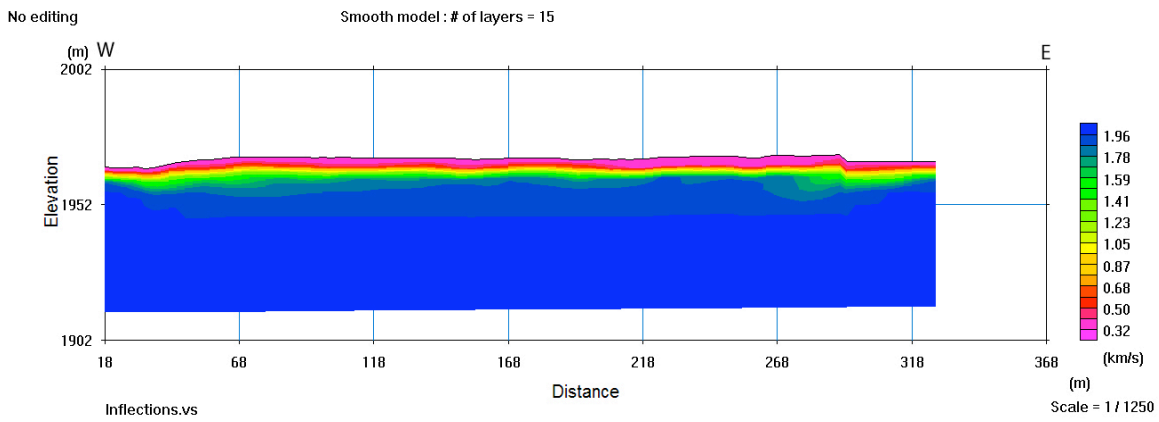

Figure 43: Refraction tomogram for line D-D'. Average error for this tomogram is 2.4 milliseconds.
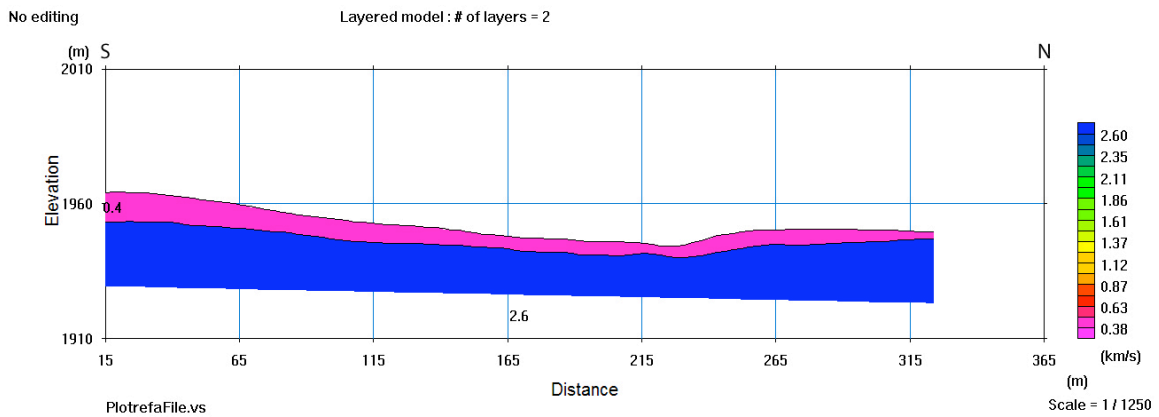

Figure 44: E-E' Time-Term inversion model used to generate the initial model prior to final tomography processing.

Smooth model : # of layers = 15

Figure 45: Refraction tomogram for line E-E'. Average error for this tomogram is 9.52 milliseconds.

No editing

Layered model : # of layers = 2
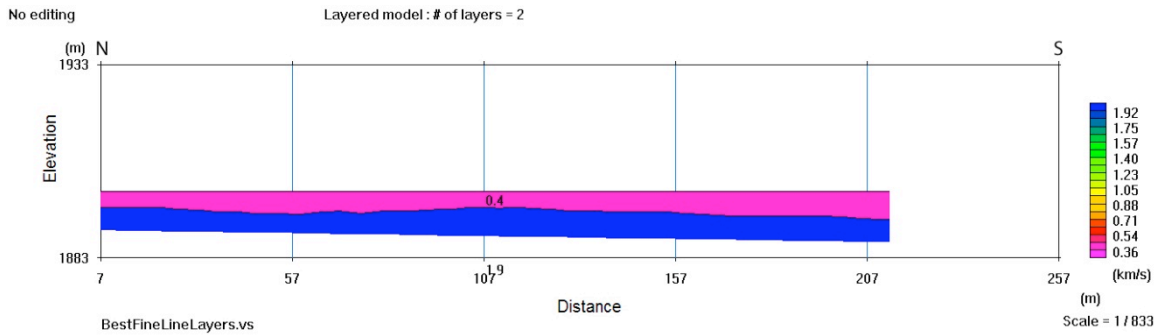
Figure 46: F-F' Time-Term inversion model used to generate the initial model prior to final tomography processing.

No editing

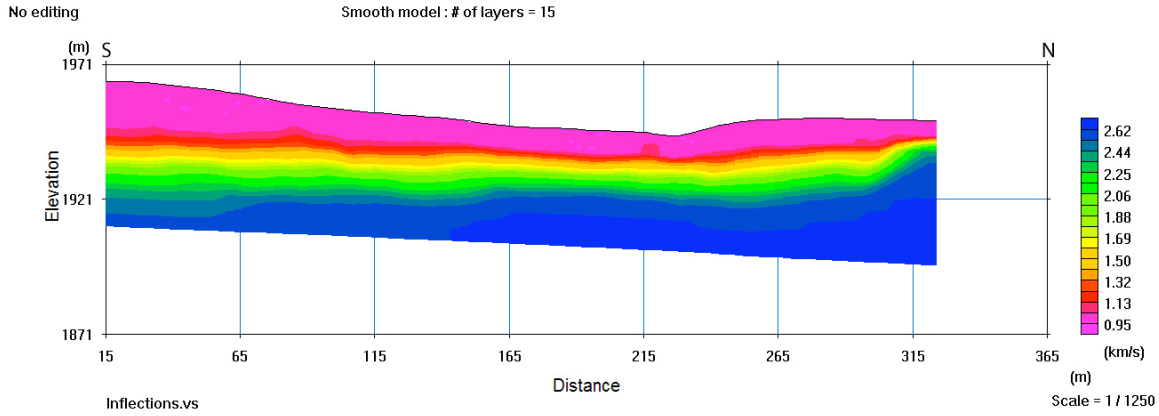Smooth model : # of layers = 10

Figure 47: Refraction tomogram for line F-F'. Average error for this tomogram is 2.09 milliseconds.

Instantaneous Phase View
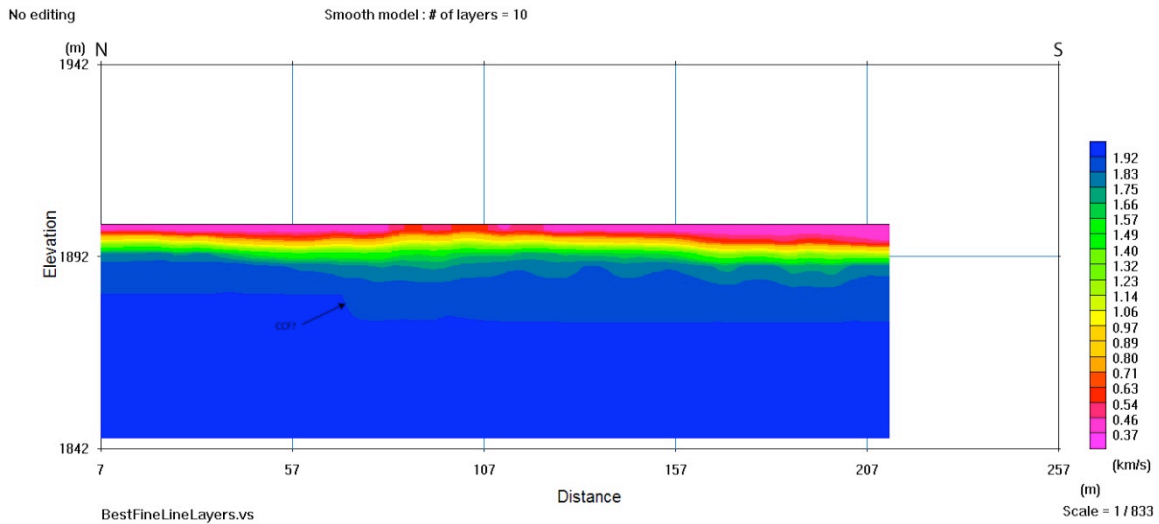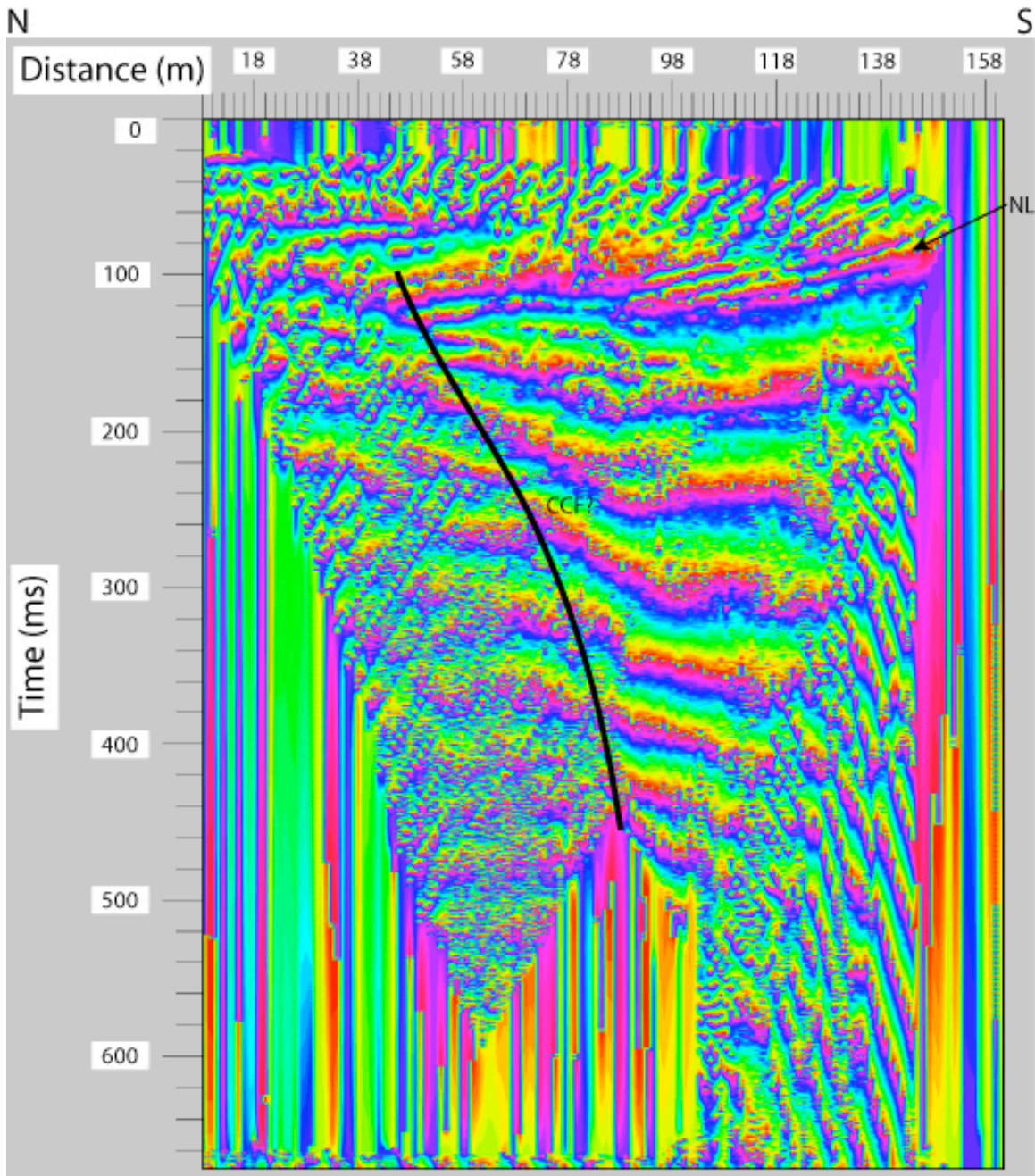

Figure 48: Instantaneous Phase seismic attribute view of line F-F'. The image is approximately 3x horizontally exaggerated at 2 km/s. Note interpreted trace of the Clear Creek Fault (CCF).

3A) D-D'

Data Acquisition Parameters	Details
Source Type	Betsy Seisgun- 10 ga.
Source Depth	~1.5'
Receiver Type	104 x 40Hz geophones
Data Recording System	3 x 24 & 2 x 12 channel Geometrics Geodes
Recording Time	1 s
Sampling Interval	0.25 ms
Source Spacing	9 m
Receiver Spacing	3 m
CMP Spacing	1.5 m
Total Spread Length	342 m
Number of Shots	38
CMP Fold	17-fold

Figure 51: F-K Spectrum Plot for a seismic reflection profile of significant length (>1km). Note the clear differentiation between source-generated noise energy and reflection energy. Image modified from SPW's Seisviewer© Manual.

Figure 50: F-K Spectrum plot of E-E' raw seismic reflection data.

3B) E-E'

Data Acquisition Parameters	Details
Source Type	Betsy Seisgun- 10 ga.
Source Depth	~1.5'
Receiver Type	104 x 40Hz geophones
Data Recording System	3 x 24 & 2 x 12 channel Geometrics Geodes

Recording Time	0.5 s
Sampling Interval	0.25 ms
Source Spacing	9 m
Receiver Spacing	3 m
CMP Spacing	1.5 m
Total Spread Length	342 m
Number of Shots	41
CMP Fold	17-fold

3C) F-F'

Data Acquisition Parameters	Details
Source Type	Betsy Seisgun- 12 ga.
Source Depth	~1.5'
Receiver Type	104 x 40Hz geophones
Data Recording System	3 x 24 & 2 x 12 channel Geometrics Geodes
Recording Time	1 s
Sampling Interval	0.25 ms
Source Spacing	8 m
Receiver Spacing	2 m
CMP Spacing	1 m
Total Spread Length	208 m
Number of Shots	28
CMP Fold	19-fold

Table 3: Data Acquisition parameters for each seismic profile: A) D-D', B) E-E', and C) F-F'. All profile lines used a fixed-spread geometry shot design.

Process Step	Parameters
First Arrival Picks in PickWin95©	
Best-fit Velocity Line Picks in Plotrefa©	
Time Term Analysis	
Initial Model	Depth to top of lowest layer = 50m Min. velocity = 0.3 km/sec Max. velocity = 3 km/sec # of layers = 10-15
Inversion Analysis	# of iterations = 10 # of nodes = 3 Horizontal Smoothing # = 1 (D-D'), 2 (E-E'), 2 (F-F') Weight = 0.5 (D-D'), 0.75 (E-E'), 0.85 (F-F') Vertical Smoothing # = 1 (D-D'), 3 (E-E'), 2 (F-F') Weight = 0.5 (D-D'), 0.75 (E-E'), 0.75 (F-F') Min. velocity = data dependent Max. velocity = data dependent

Table 4: Summary of seismic refraction data processing steps used to produce refraction tomograms. Pertinent parameters used in each step are outlined in the parameters column.

Process Step	Details
SEG-2 to SPW file conversion	
Geometry definition	
Surgical mutes	Removed source-generated noise: ground roll & airwave
Top mutes	Removed random noise above primary reflections
Trace Kills	Removal of remaining random noise
CMP-Sorting	
Interactive Velocity picking	Velocities picked from velocity semblance plots & CMP sort file
NMO correction	Velocities input from above picks
CMP Stack	
Kirchoff Post-Stack Time Migration	
Butterworth Filter	0-1000 ms: 40-120 Hz
Bandpass Filter	0-100 ms: 40-120 Hz
Spectral Whitening Filter	Lo Cut = 40Hz, High Cut = 120 Hz

Table 5: Summary of seismic reflection data processing steps and associated details.

Profile Line	Post Stack Processing Type	Parameters
D-D'	Kirchhoff Time Migration	45° dip limit
		3.0° roll-off band Input Stacking velocities
	Time Variant Butterworth Filter	40-120Hz, 0-1000ms
E-E'	Spectral Whitening Filter	40Hz start, 120Hz end 1 band, AGC = 500ms
F-F'	Time Variant Butterworth Filter Spectral Whitening Filter	40-120Hz, 0-1000ms 40Hz Start, 120Hz end 1 band, AGC = 500ms

Table 6: Summary of the post-stack processing techniques applied to each profile line.