



SEISMIC REFRACTION SURVEY

Location: Fort field of CMU

CAUE HESS

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DEPARTMENT OF GEOLOGICAL SCIENCES

CHIANG MAI UNIVERSITY



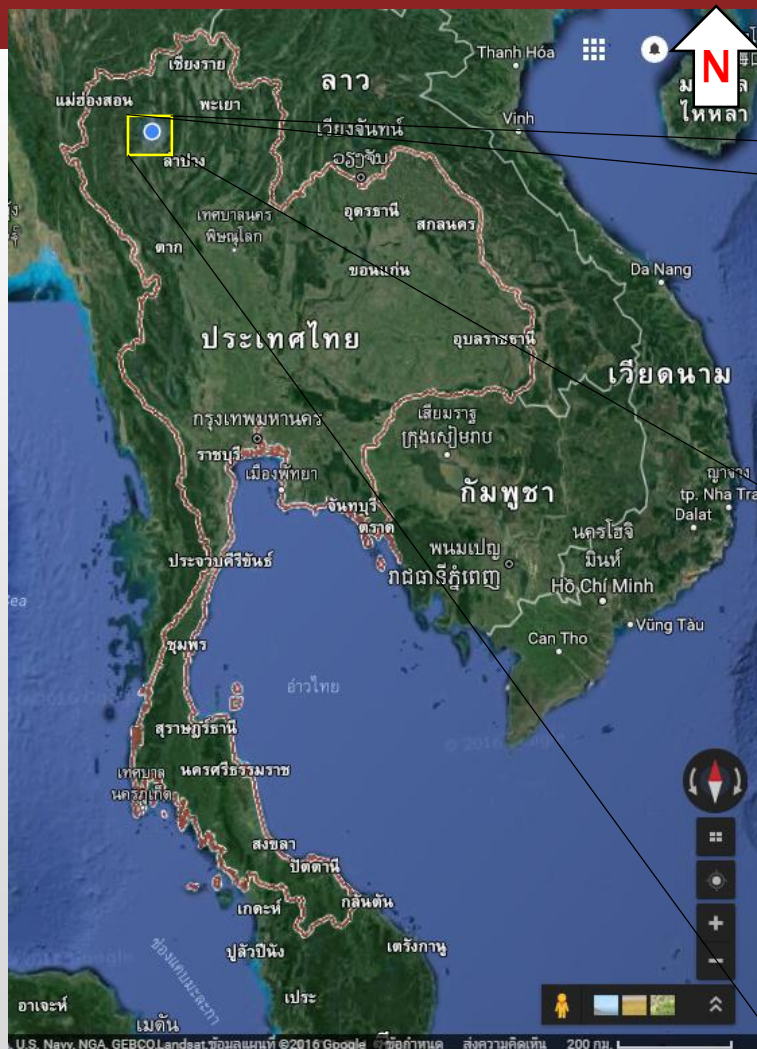
Outline

- Objective
- Study area
- Acquisition parameters
- GRM Method
- F-K analysis
- Walk-Away Noise Test
- Conclusions

Objectives

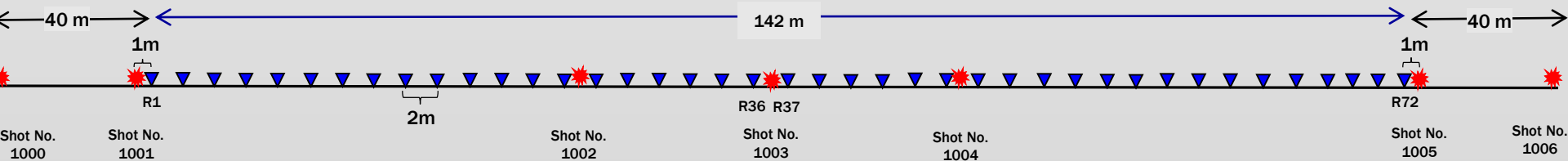
- Perform a seismic refraction survey using a 72 channels array with a Weight Drop (Thumper) as a source;
- Estimate velocity of each layer;
- Determine thickness;
- Analysis of a Walk Away Noise Test;
- Design an ideal array to attenuate GR.

Study Area

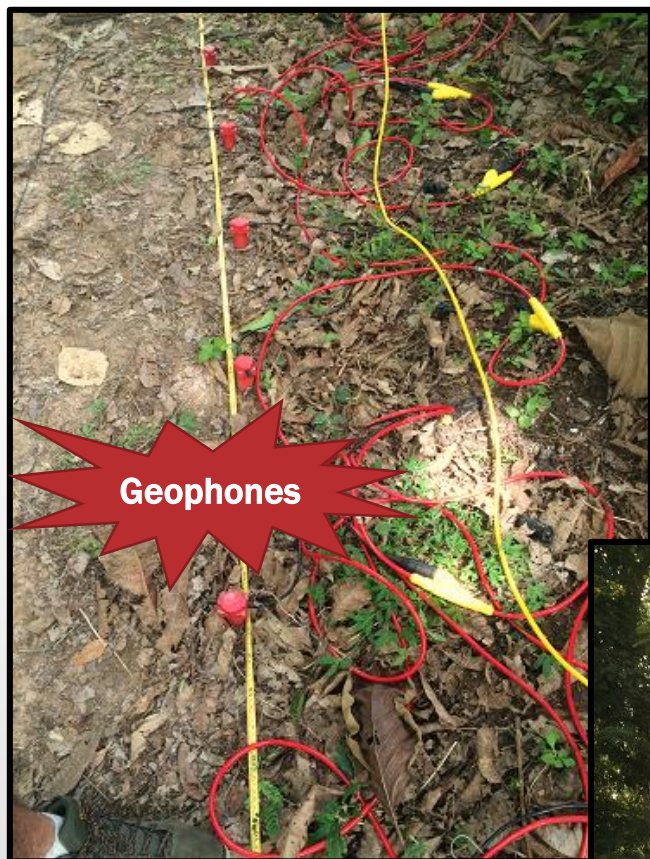


Acquisition Parameters

Parameters	
Source Type	Weight Drop
Number of shots	7
Geophone spacing	2m
Near offset	1 m
Far offset	182, 143, 71, 47, 40
Number of Geophones	72
Record Length	2s
Sample Interval	1ms



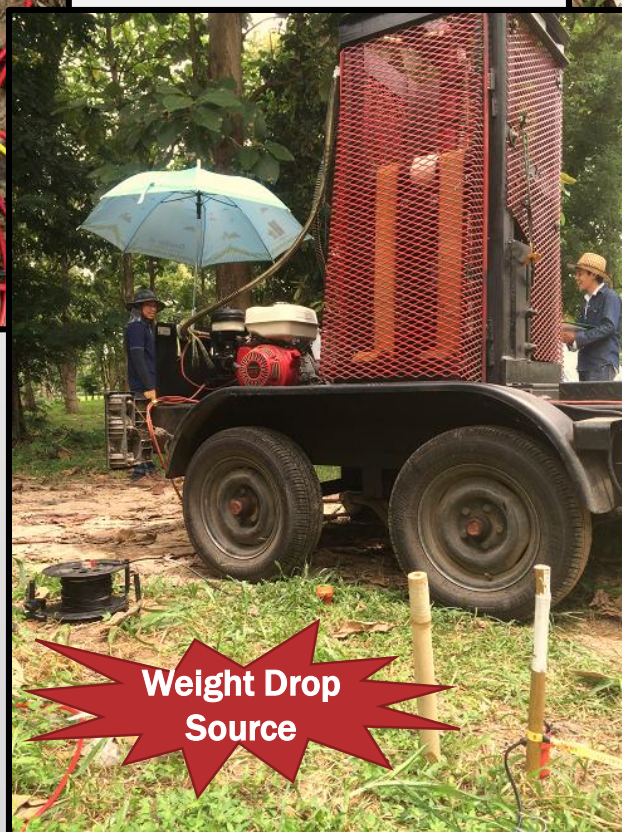
Refraction survey geometry



Geophones



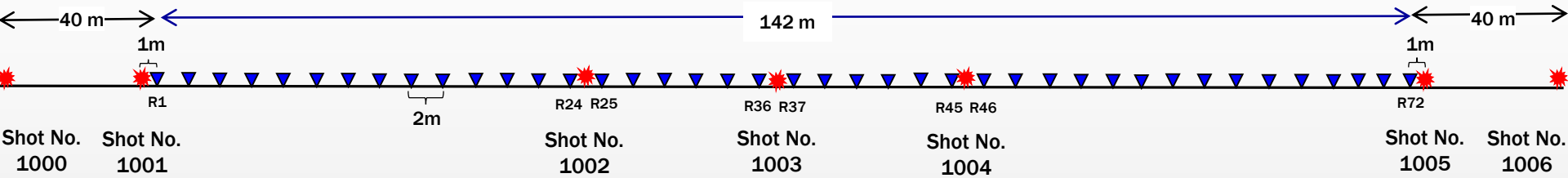
**Recording
Station**



**Weight Drop
Source**

Seismograph - Geode (Geometrics)

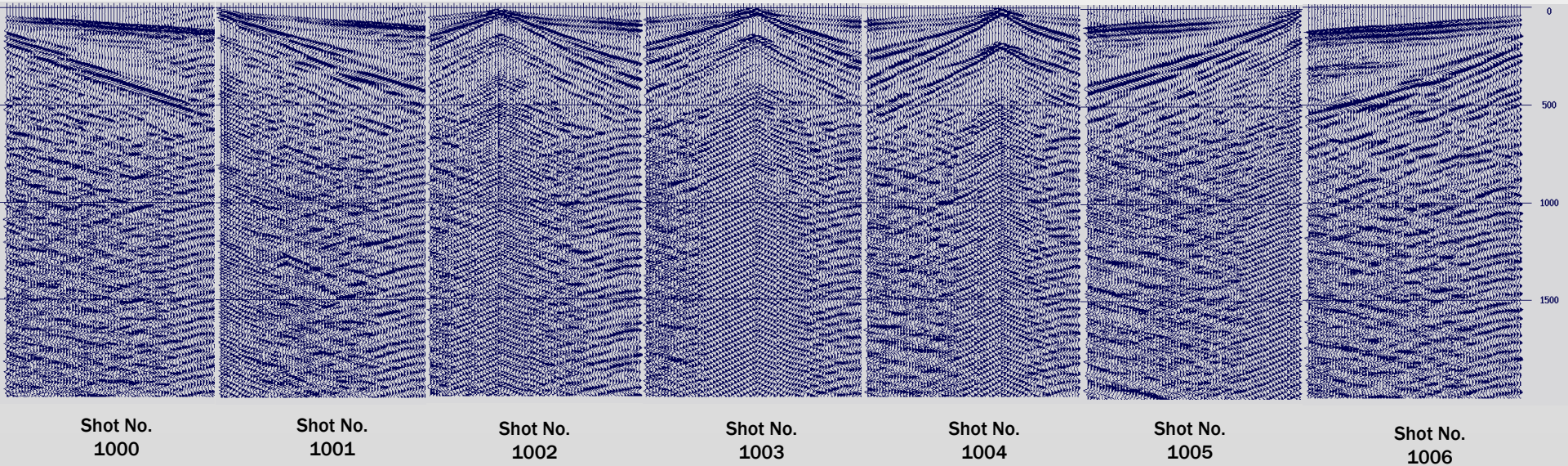
Shot and receivers schematic

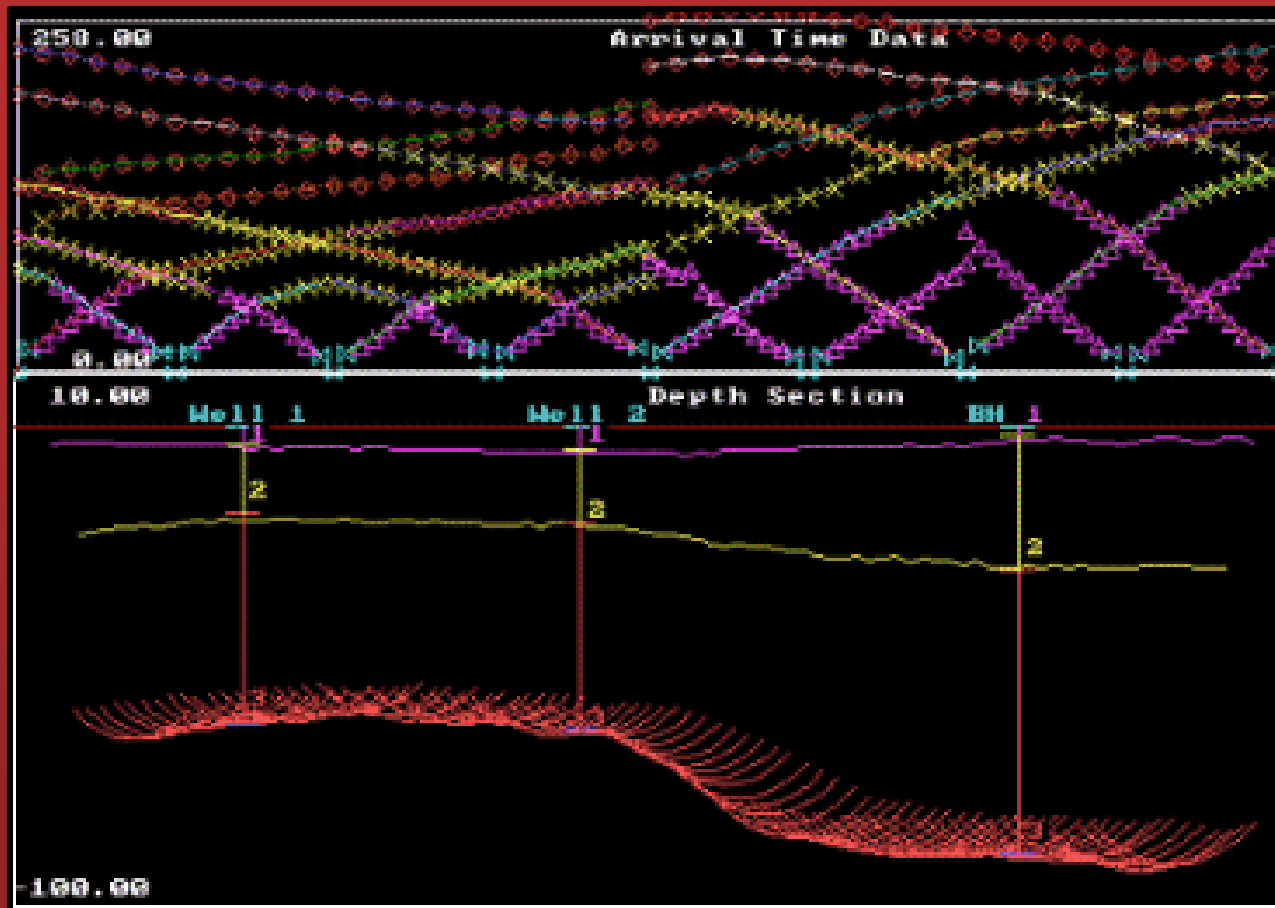


WNW

Refraction survey geometry

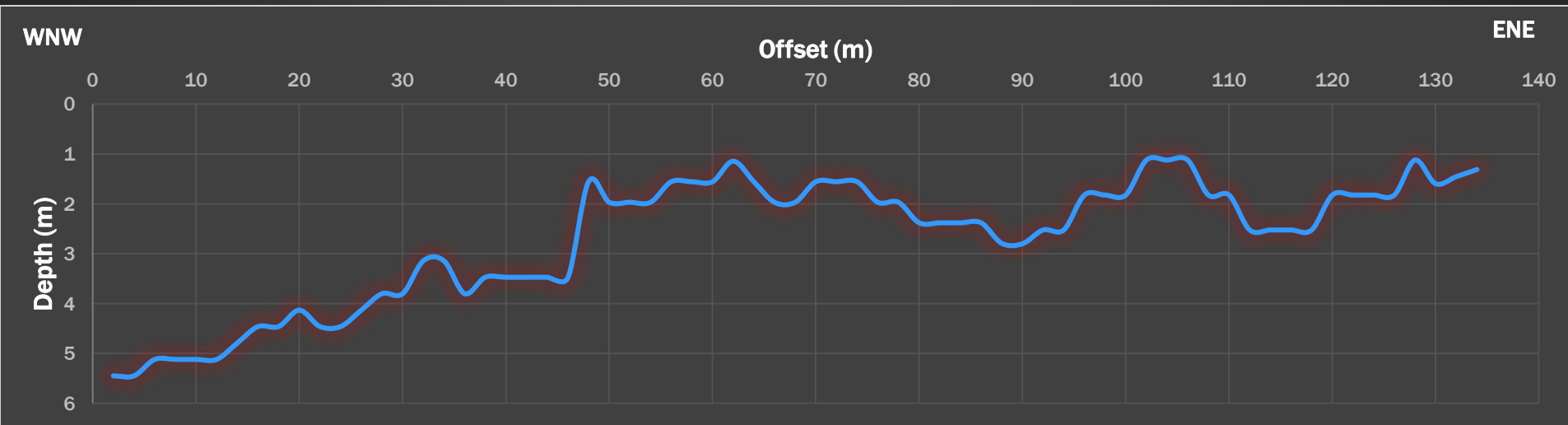
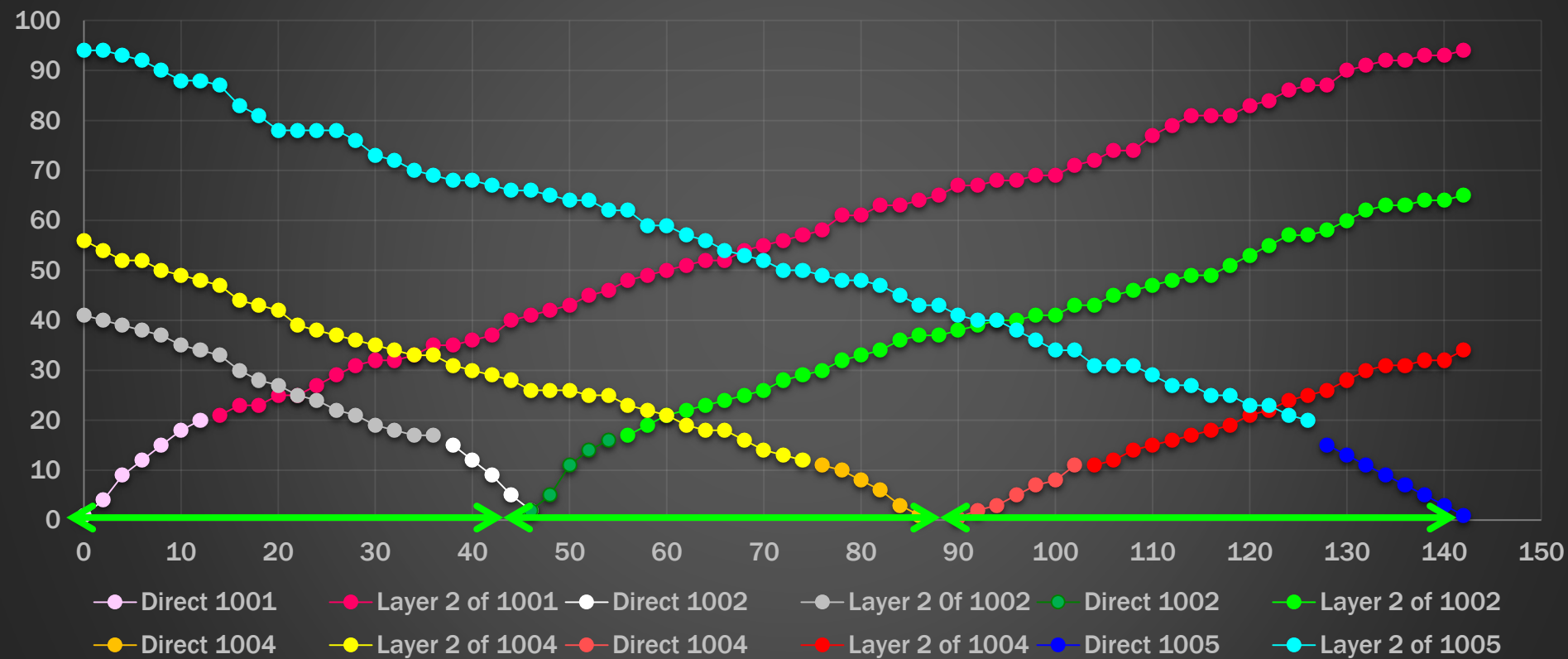
ENE



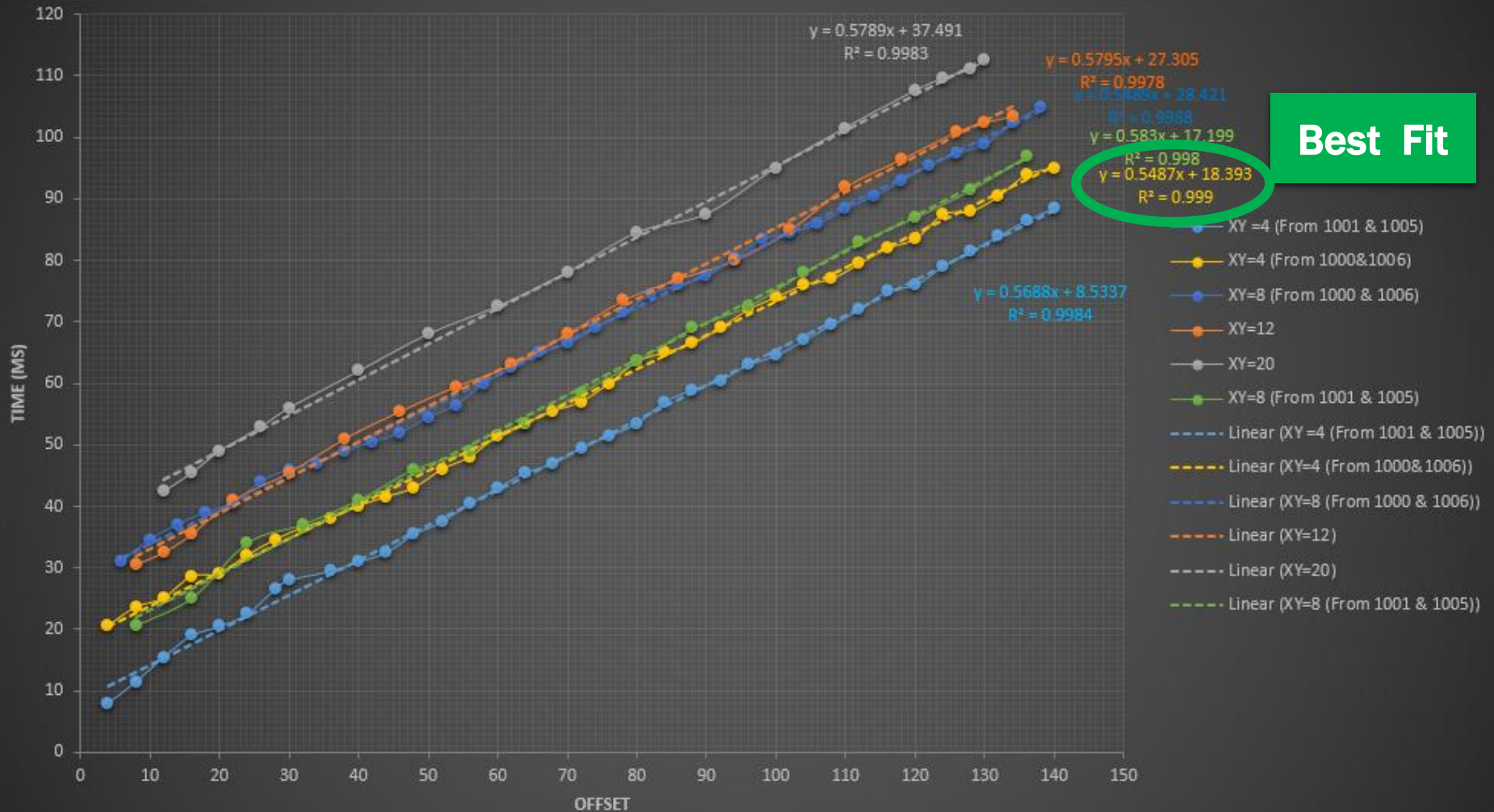


GRM METHOD

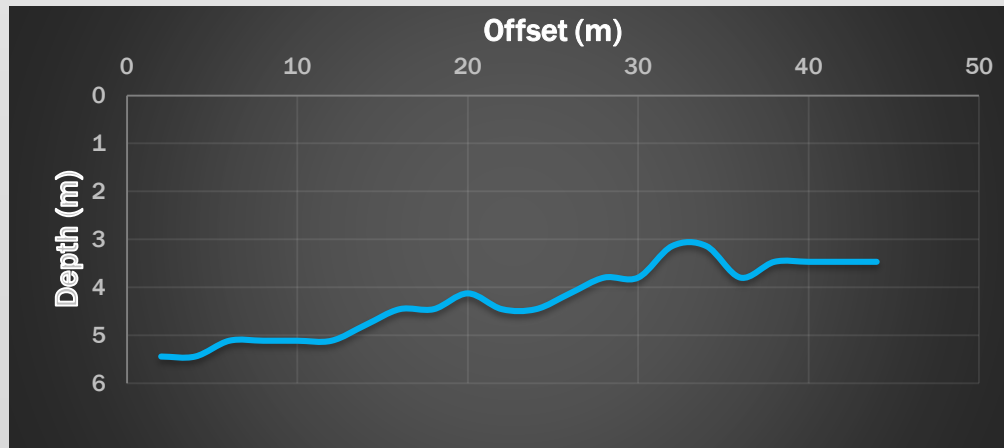
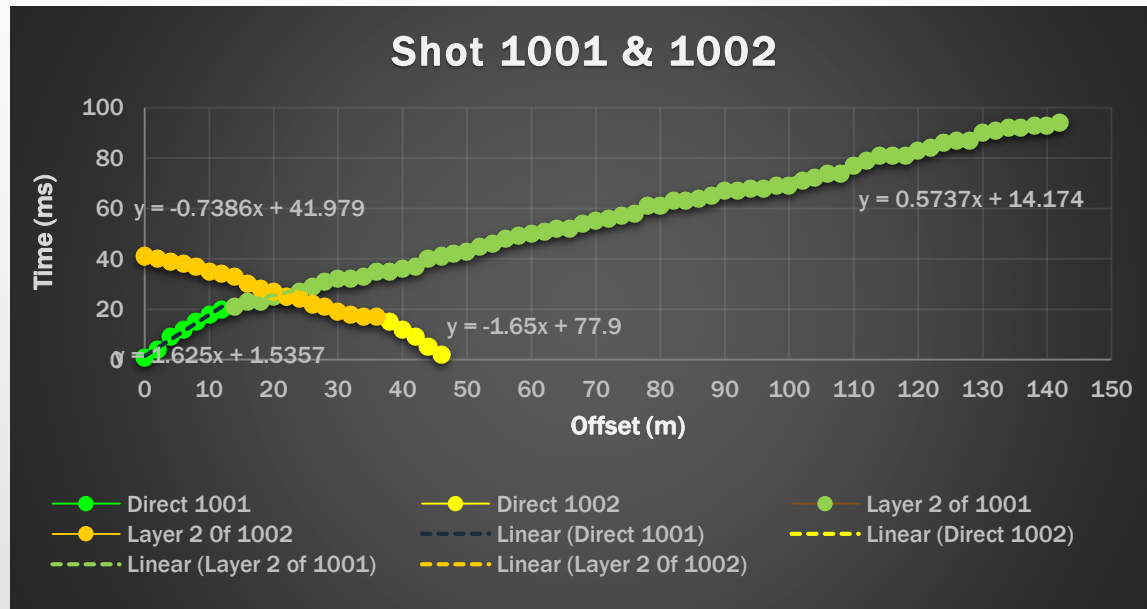
All shot data



GRM Method: Velocity Analysis Function

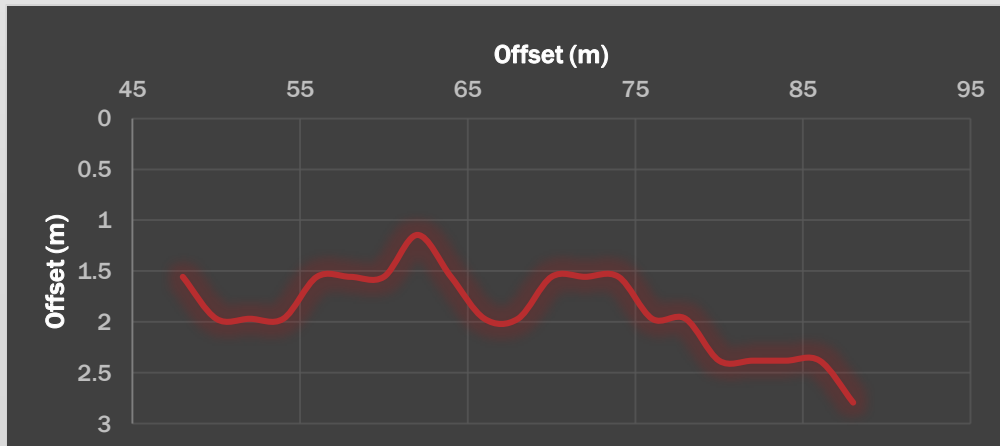
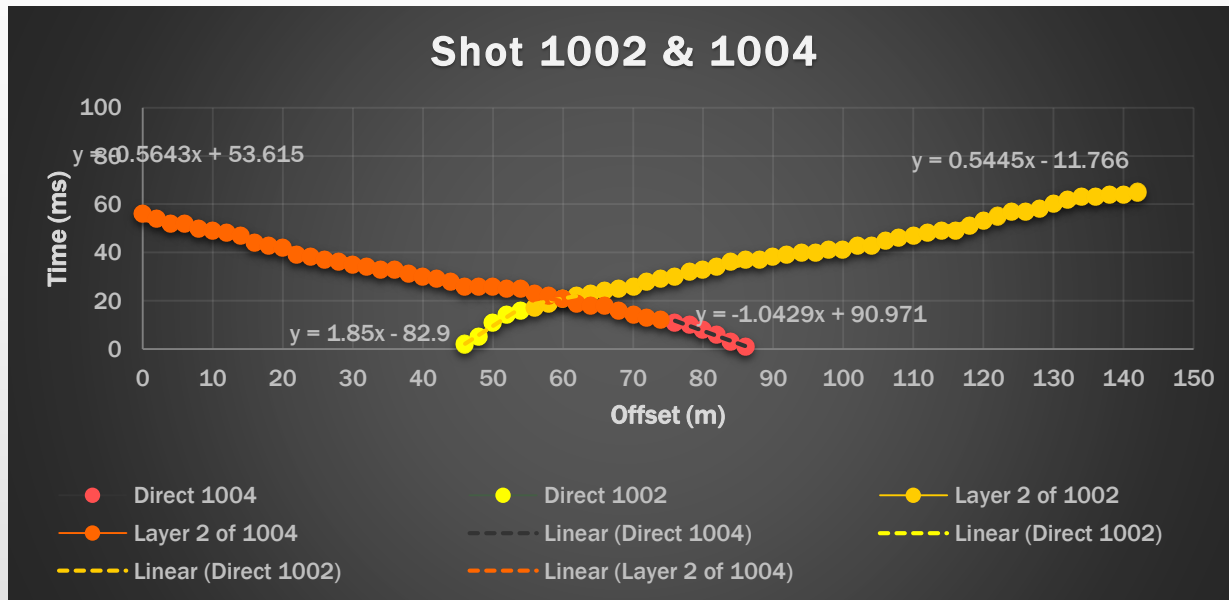


GRM: Shots 1001 & 1002



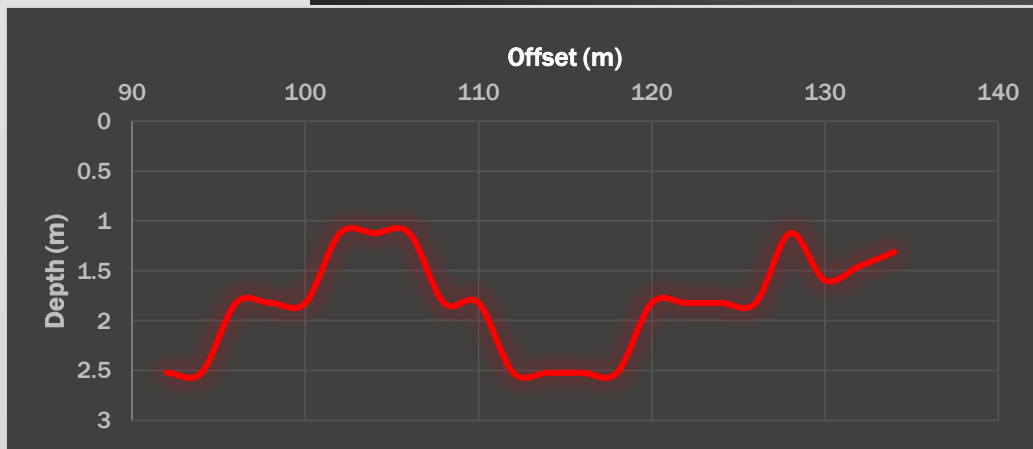
Distance	0 – 44 m
Velocity 1	610.5 m/s
Velocity 2	1630.3 m/s
V12	658.4 m/s
Average thickness	4.07 m

GRM: Shots 1002 & 1004



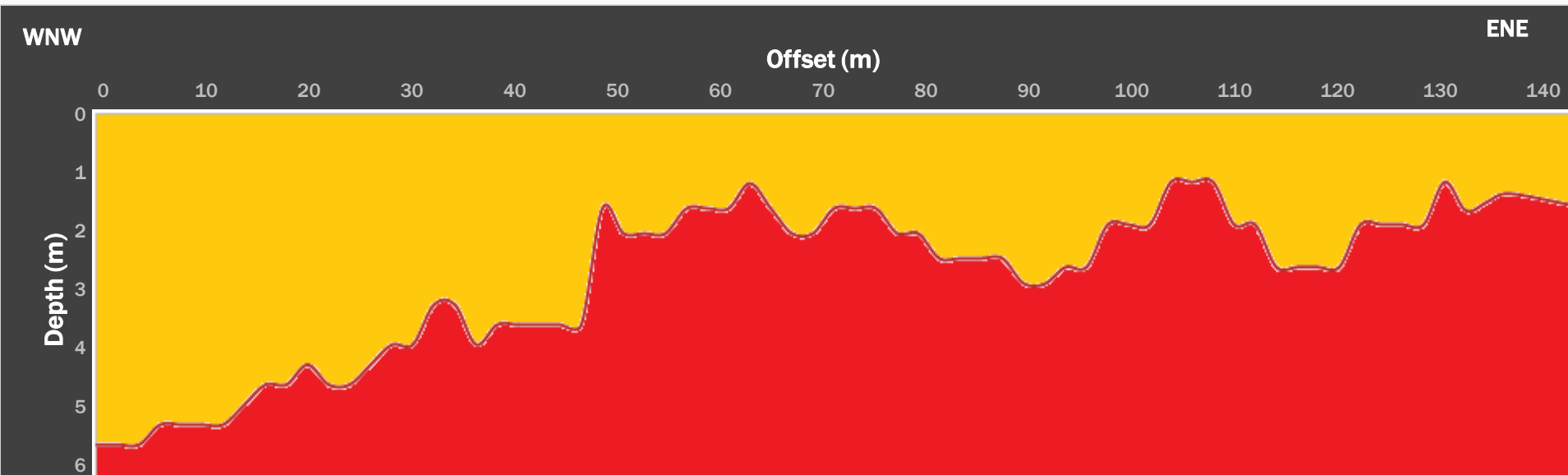
Distance	44 – 88 m
Velocity 1	749 m/s
Velocity 2	1804 m/s
V12	823.3 m/s
Average thickness	1.89 m

GRM: Shots 1004 & 1005



Distance	88 – 140 m
Velocity 1	1090 m/s
Velocity 2	1670 m/s
V12	1438.7 m/s
Average thickness	1.84 m

GRM: Results

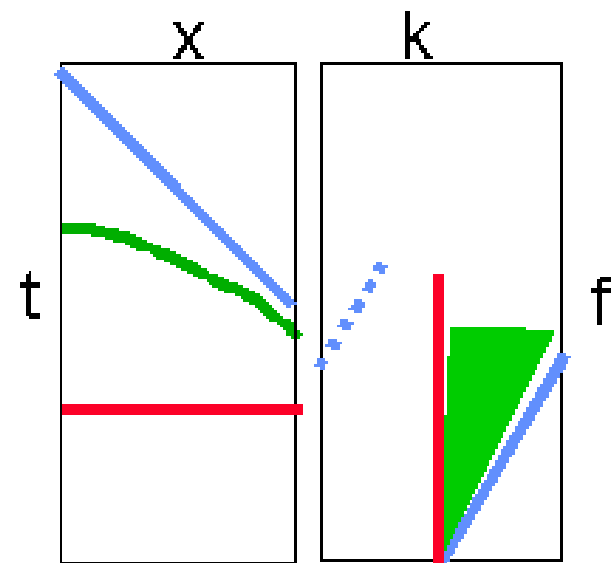
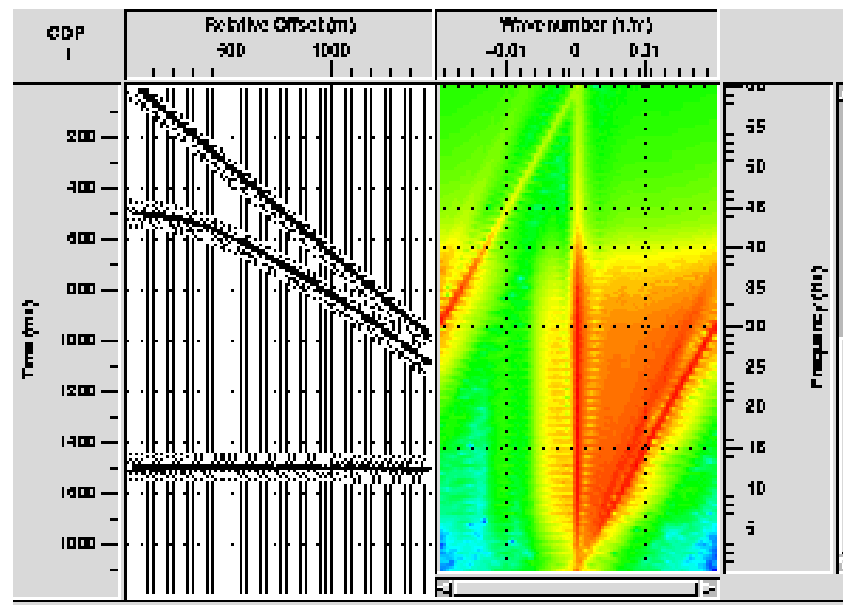


Distance	0 - 44 m	44 - 88 m	88 - 140 m
Velocity 1	610.5 m/s	749 m/s	1090 m/s
Velocity 2	1630.3 m/s	1804 m/s	1670 m/s
V12	658.4 m/s	823.3 m/s	1438.7 m/s
Average thickness of each part	4.7 m	1.89 m	1.84 m
Average thickness	2.60 m		

FK TRANSFORM

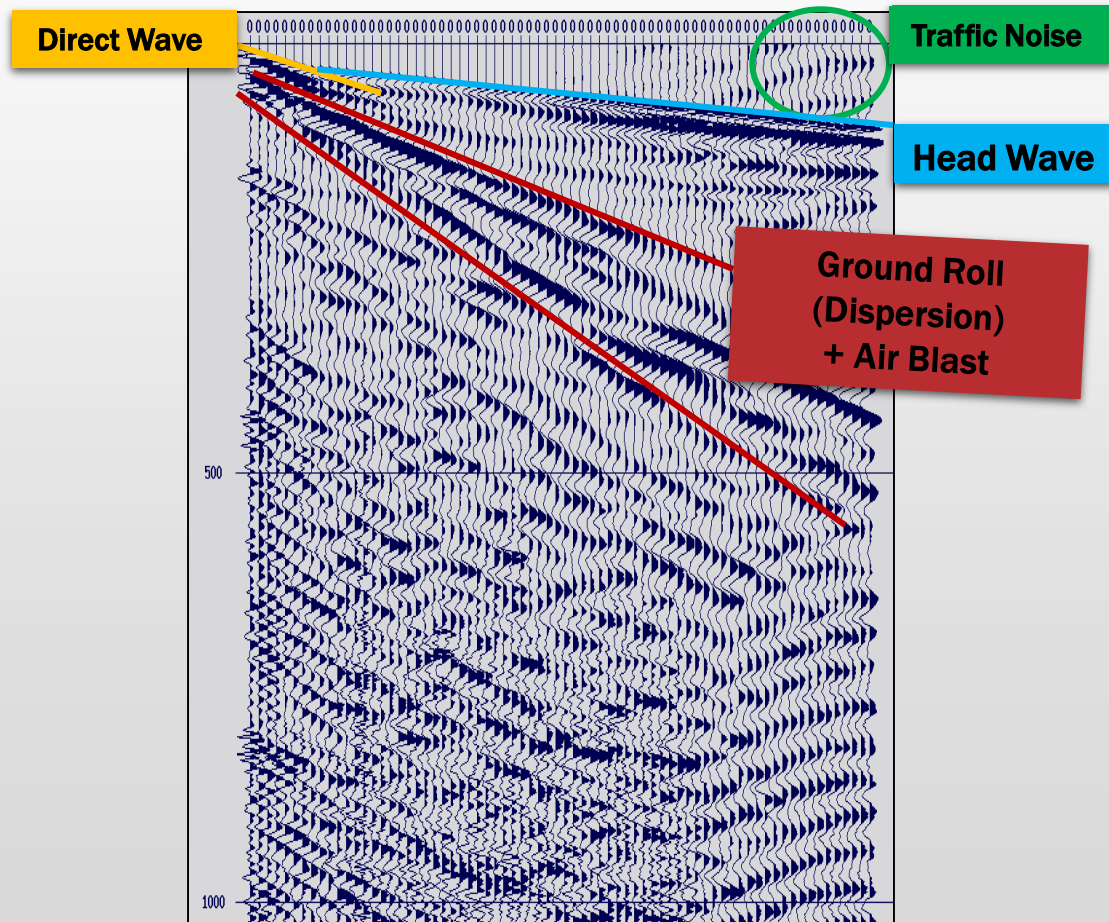
TIME DOMAIN

F-K DOMAIN

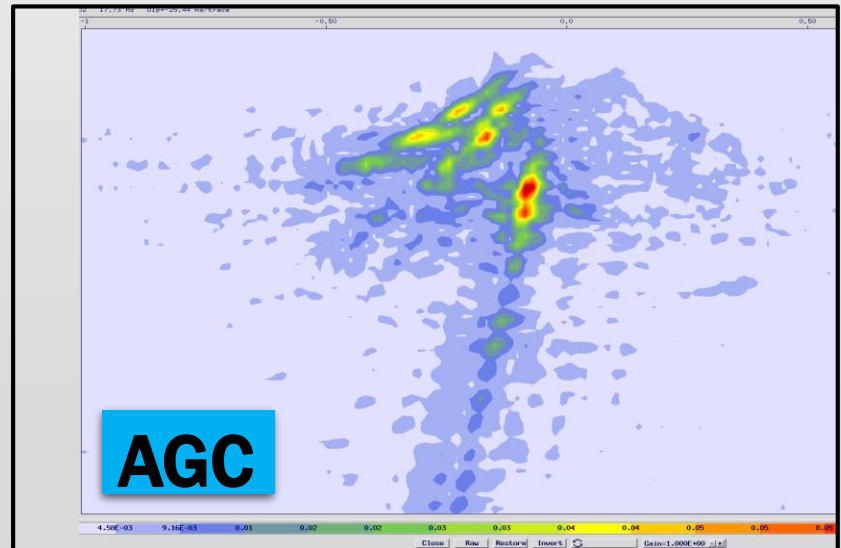
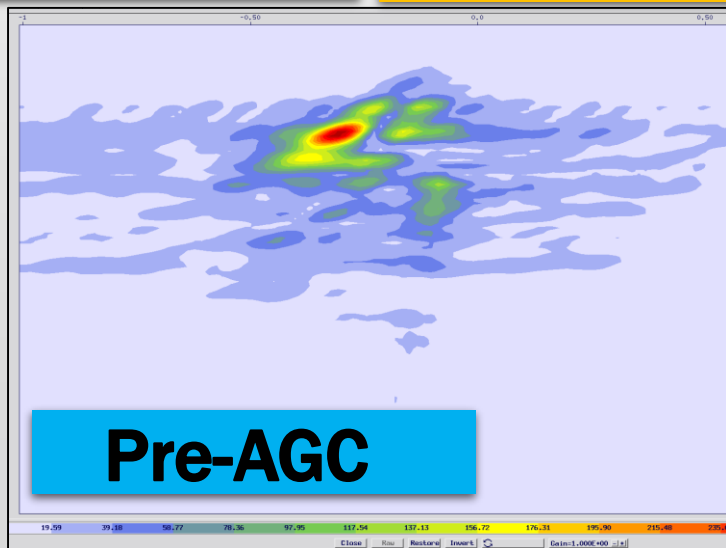
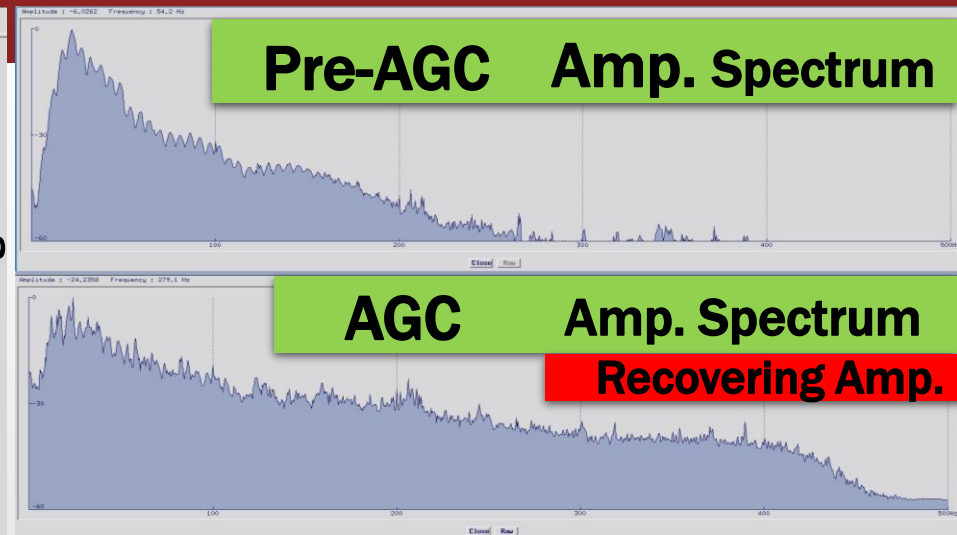
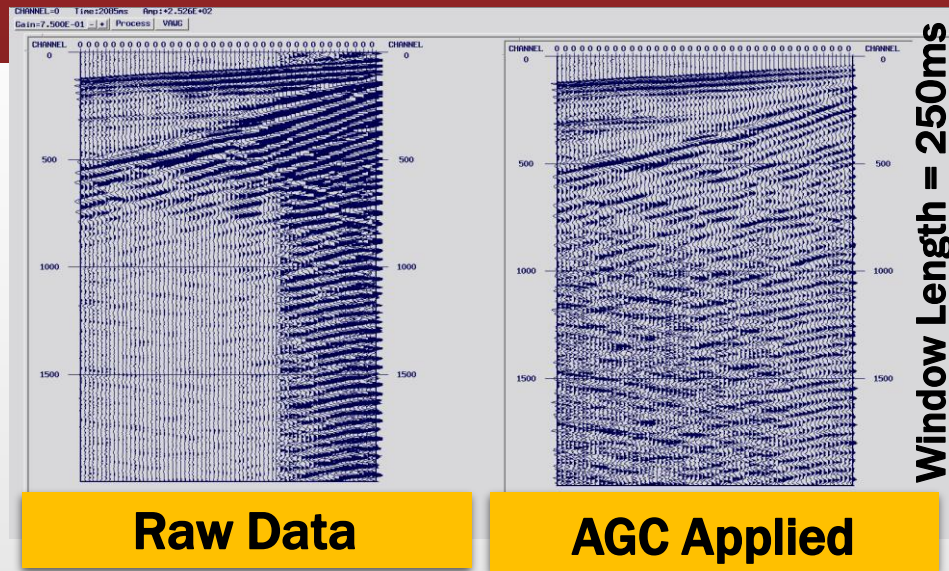


F-K ANALYSIS

Main Arrivals: SHOT 1001

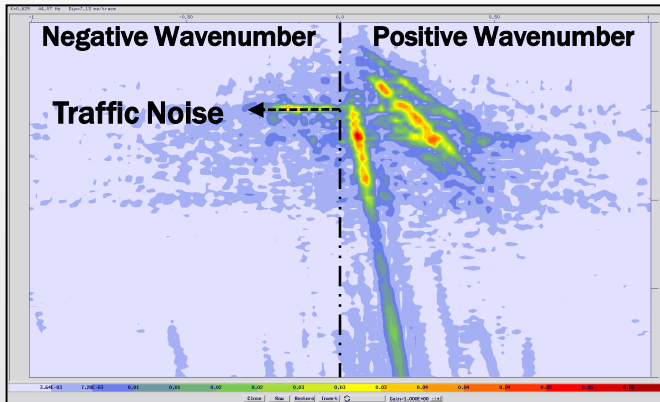


SHOT 1006



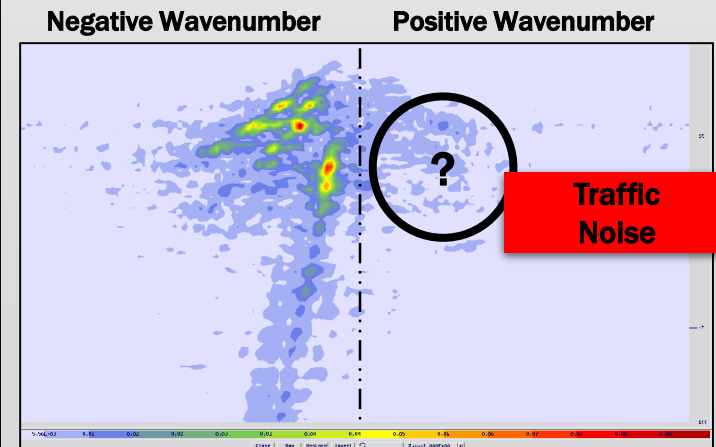
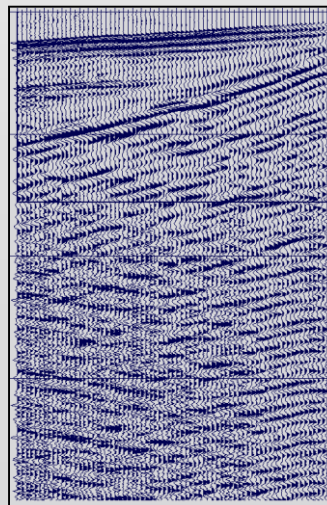
FK analysis

SHOT 1000



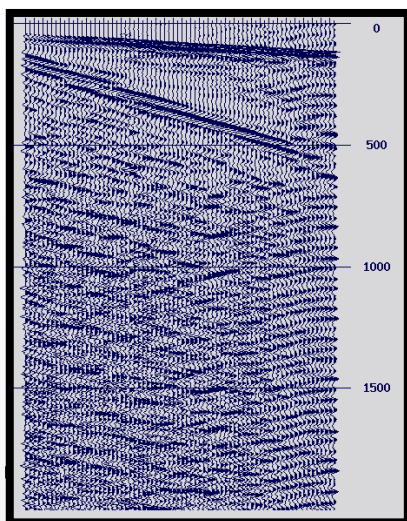
Events will appear at opposite sides of FK domain in 'Forward & Reverse Shots'

SHOT 1006

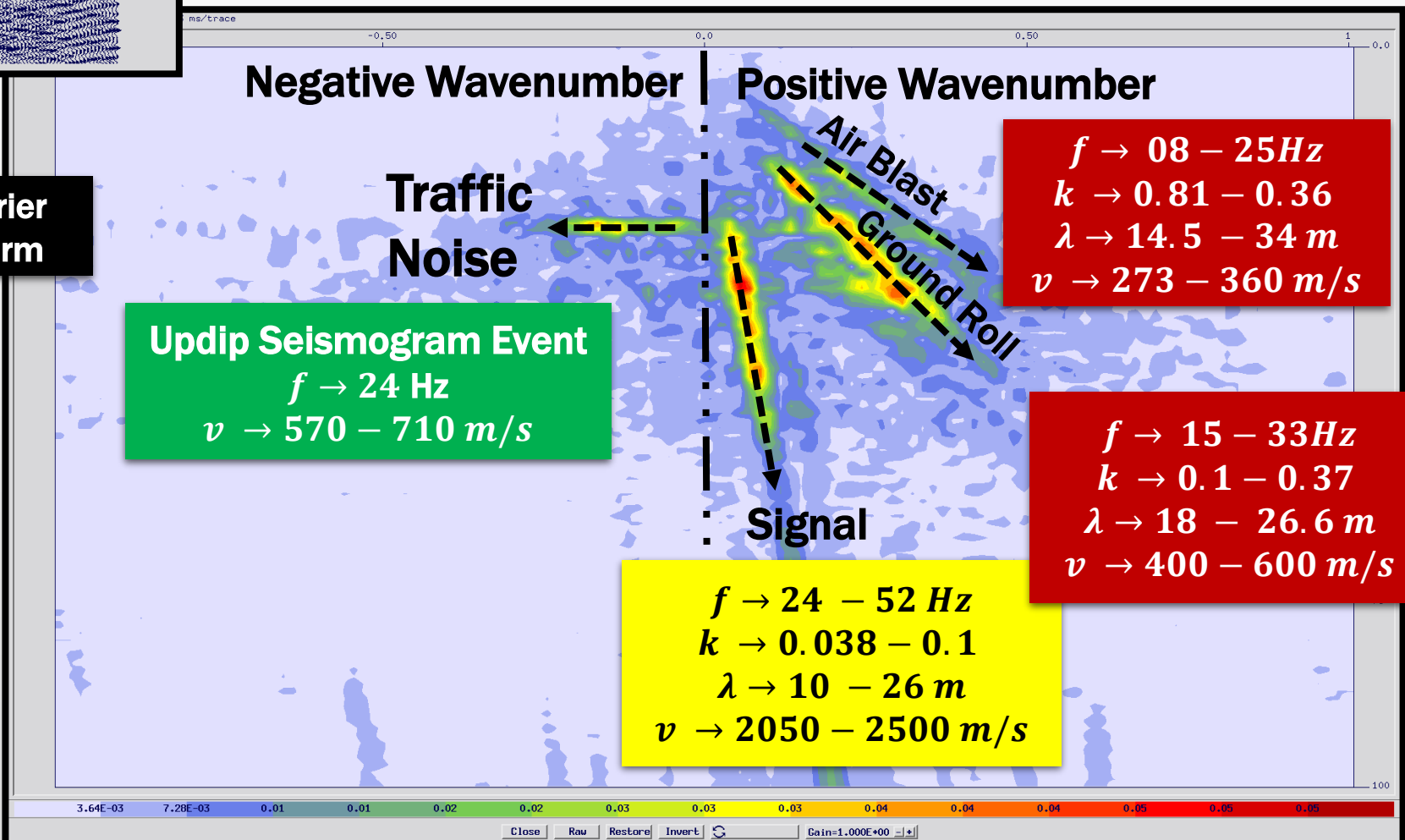


SHOT 1000

Signal & Noise Properties (F-K Domain)



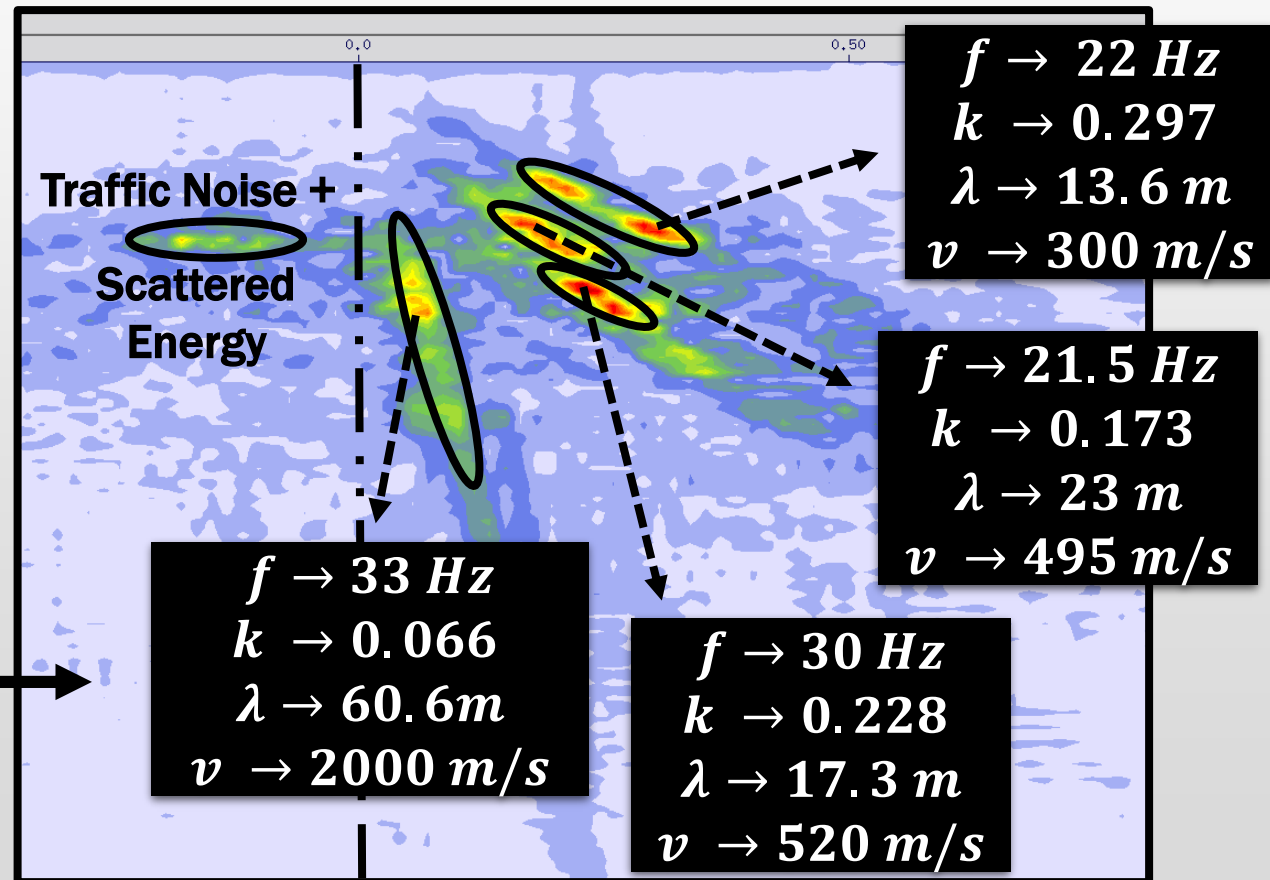
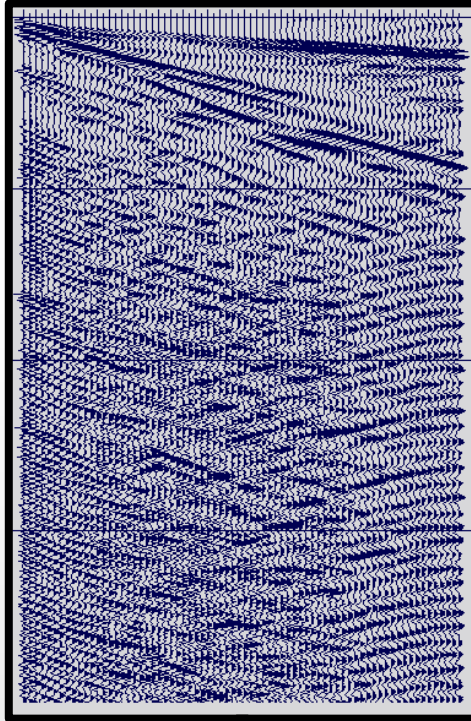
2D Fourier Transform



SHOT 1001

Time-Distance
Domain

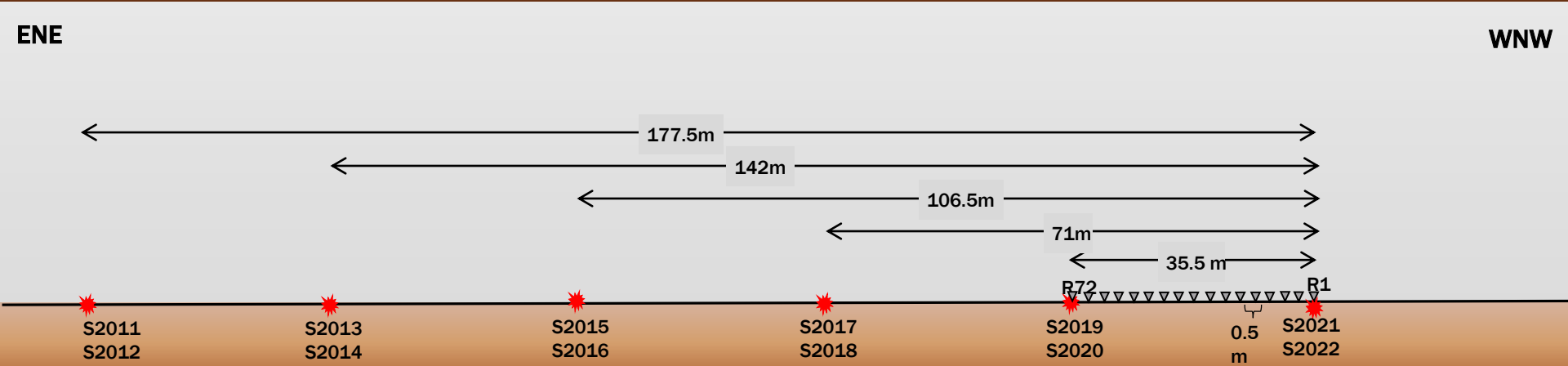
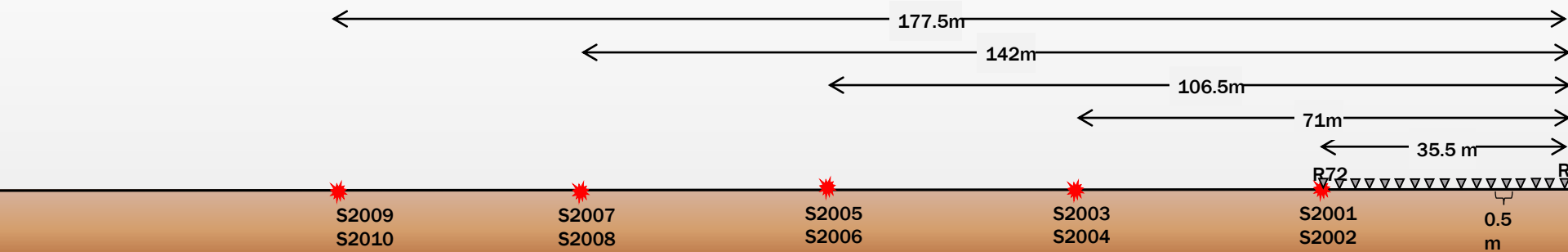
F-K Domain



2D Fourier
Transform

WALK-AWAY NOISE TEST

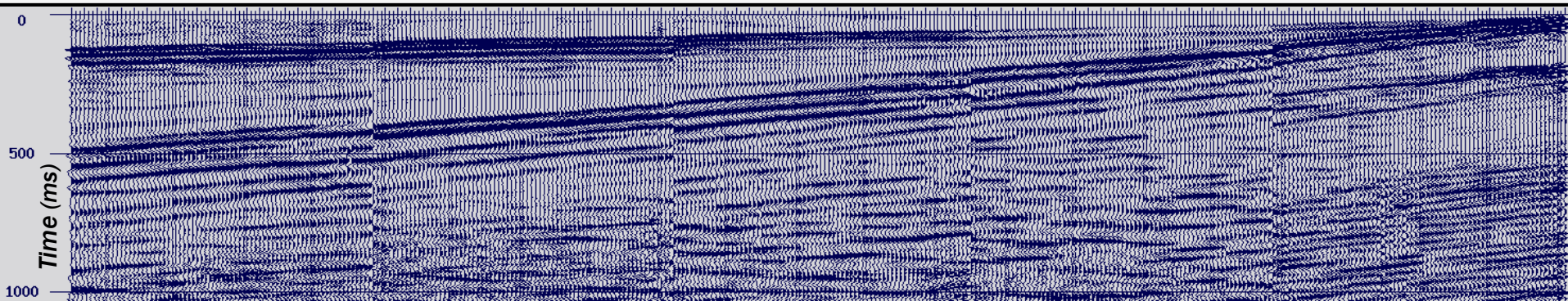
Walk-Away Noise Test → Geometry



Walk-Away Noise Test → Raw Data

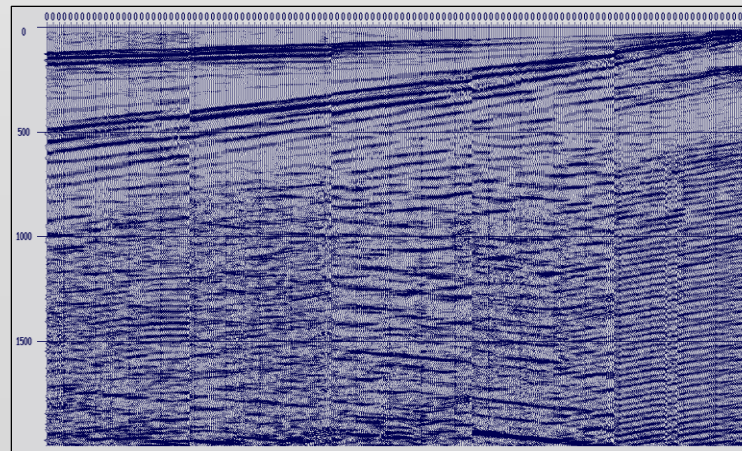
~1000 ms

Offset (m) ← 35.5 m → 



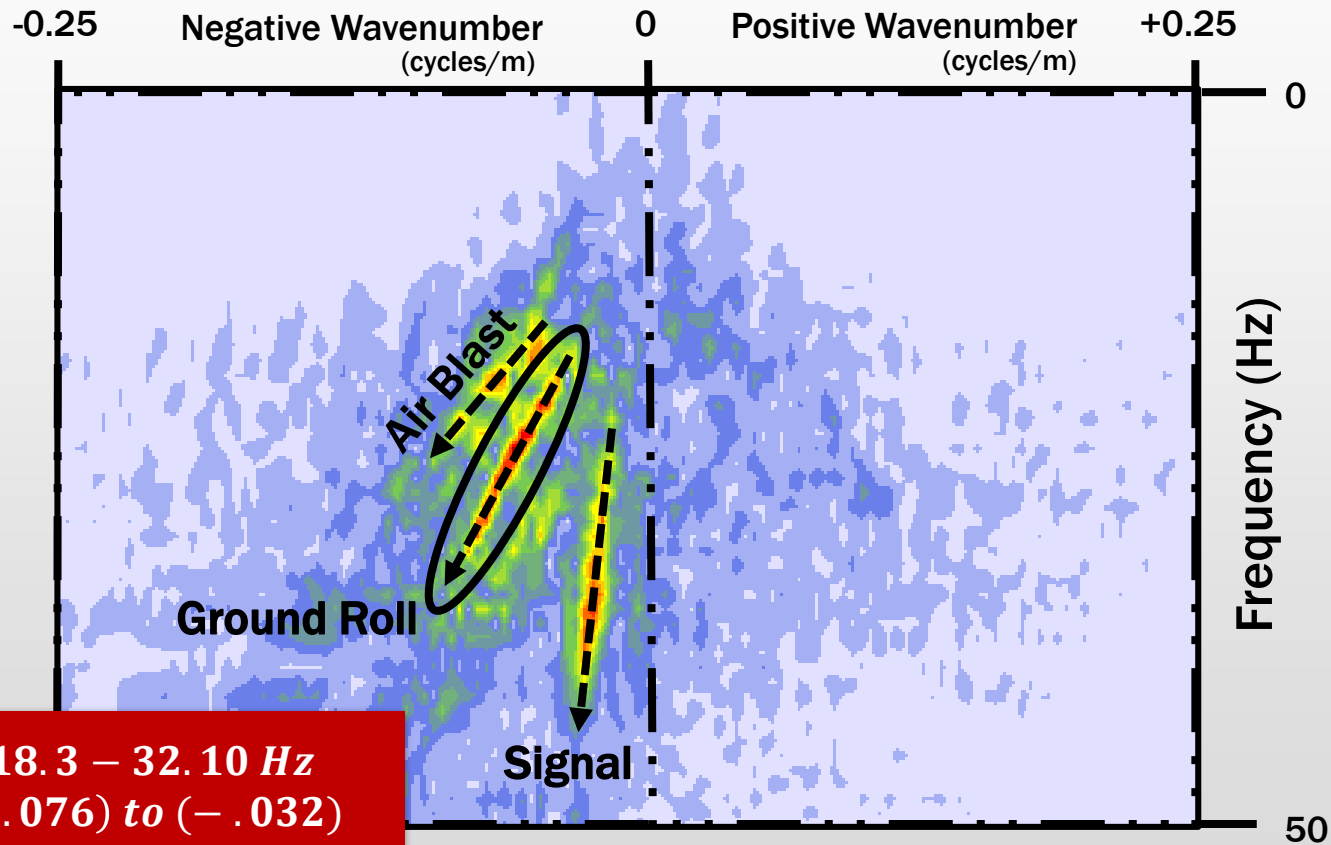
ENE

WNW



Total Record Length

Walk-Away / FK Analysis



$f \rightarrow 18.3 - 32.10 \text{ Hz}$
 $k \rightarrow (-.076) \text{ to } (-.032)$
 $\lambda \rightarrow 13 - 31.5 \text{ m}$
 $v \rightarrow 420 - 575 \text{ m/s}$

Array Response

$$\square \text{ N}^\circ \text{ of Elements } (n) = \frac{\lambda_{\max} + \lambda_{\min}}{\lambda_{\min}}$$

$$\lambda_{\max} = 31.5 \mid \lambda_{\min} = 13$$

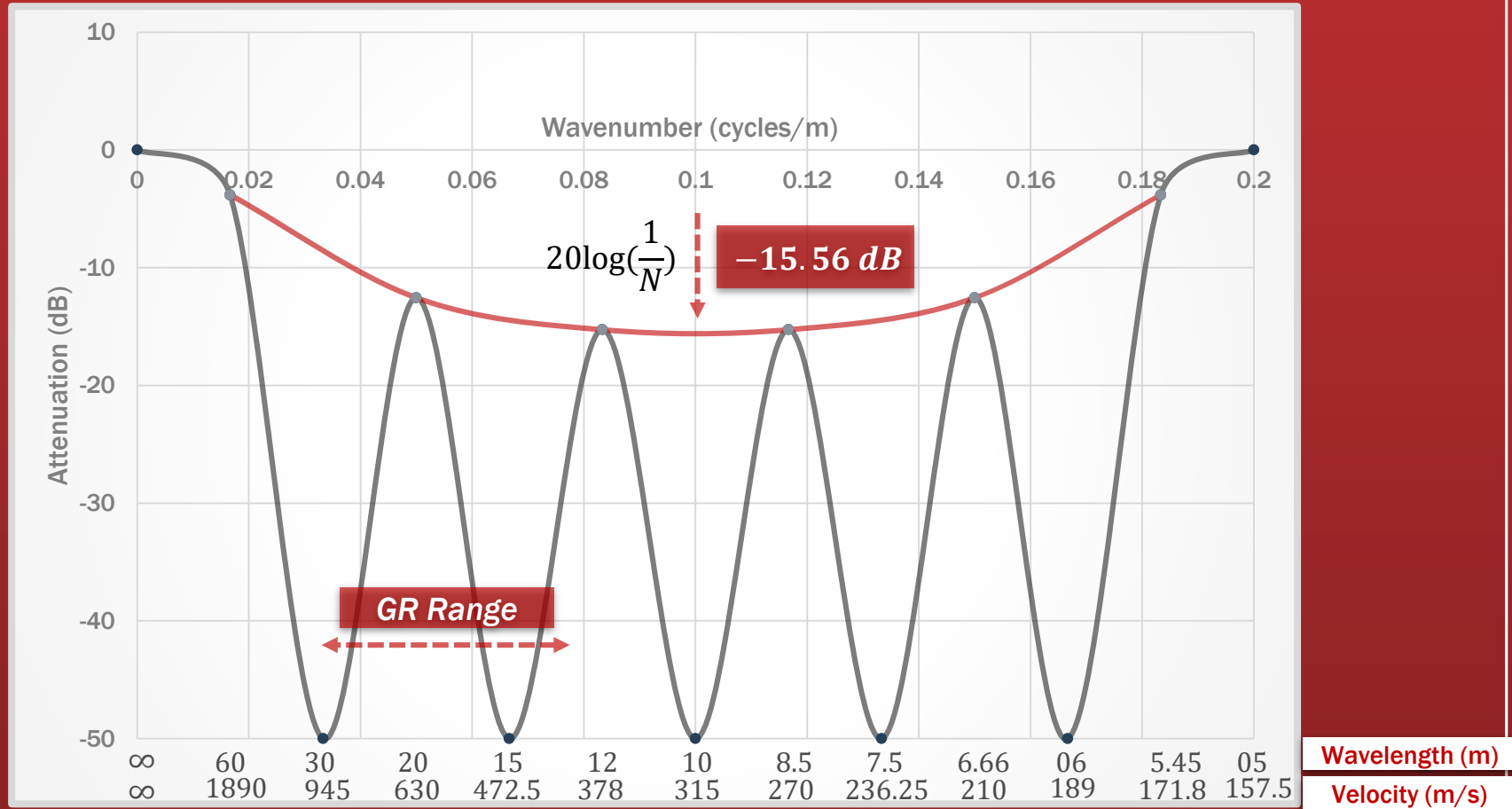
$$n = 3.42 \leq 6$$

$$n = 6$$

$$\square \text{ First Notch } (k_1) = \frac{1}{31.5} = \frac{1}{6\Delta x}$$

$$\Delta x \cong 5$$

Array Response



$$n = 6 / \Delta x = 5 \text{ m}$$

n = number of Geophones
 Δx = element spacing

Conclusions

From GRM method

- Average Velocity of Layer 1 is 610 - 1090 m/s
- Average Velocity of Layer 2 is 1630 - 1804 m/s
- Average thickness: 2.00 - 4.75 m

From F-K analysis & Walk-Away Noise Test

- Range of ground roll velocity: 400 - 600 m/s
- Frequency of ground roll: 13 - 33Hz

Array Design (based on Walk Away Noise Test)

- No. of geophones: 06
- Element spacing: 05 m

THANK YOU FOR YOUR ATTENTION