Australian Government

Geoscience Australia

Government of **Western Australia**
Department of **Mines and Petroleum**

ROYALTIES FOR REGIONS

ACQUISITION & PROCESSING OF THE 2011 YILGARN-OFFICER-MUSGRAVE (YOM) SEISMIC SURVEY (L199)

Josef Holzschuh

Onshore Seismic and Magnetotelluric Section

Minerals and Natural Hazards Division

Geoscience Australia

Acquisition and Processing

Acquisition

- *Location*
- *Vibrator trucks*
- *Geophone stations*
- *Warburton – gap in data*
- *Technical details*

Processing

- *Overview*
- *Main processes*
- *Migration and velocities*

Data gap edge effects

Weak data

Conclusion

Further data available

Line 11GA-YO1

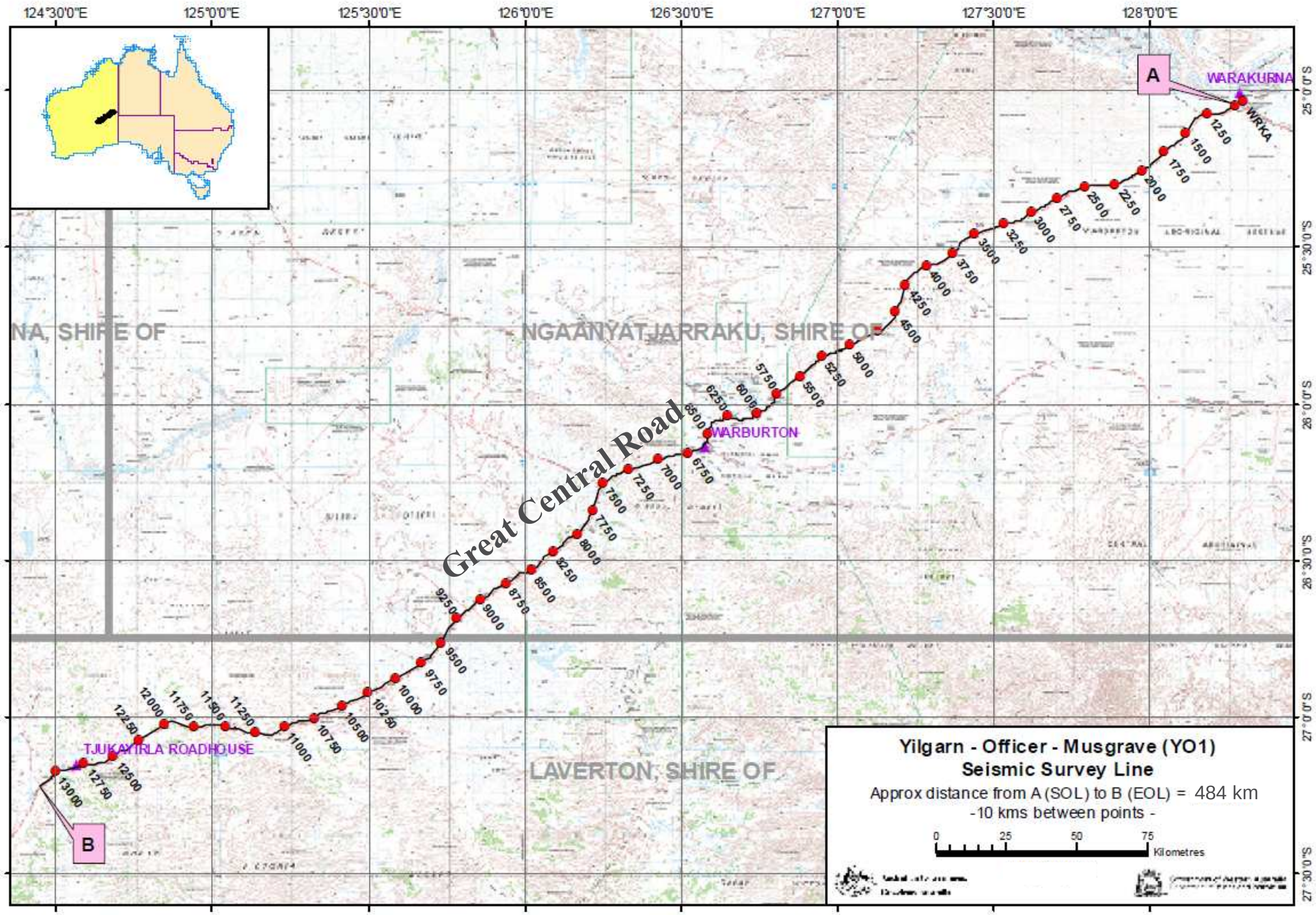
484 km deep seismic reflection data acquired 30 May – 26 June 2011.

Other data acquired:

MT

Gravity

Wide angle (refraction)



Seismic Data Acquisition

Terrex Seismic was contracted to acquire the seismic data.

Between 30 and 40 on crew at any time

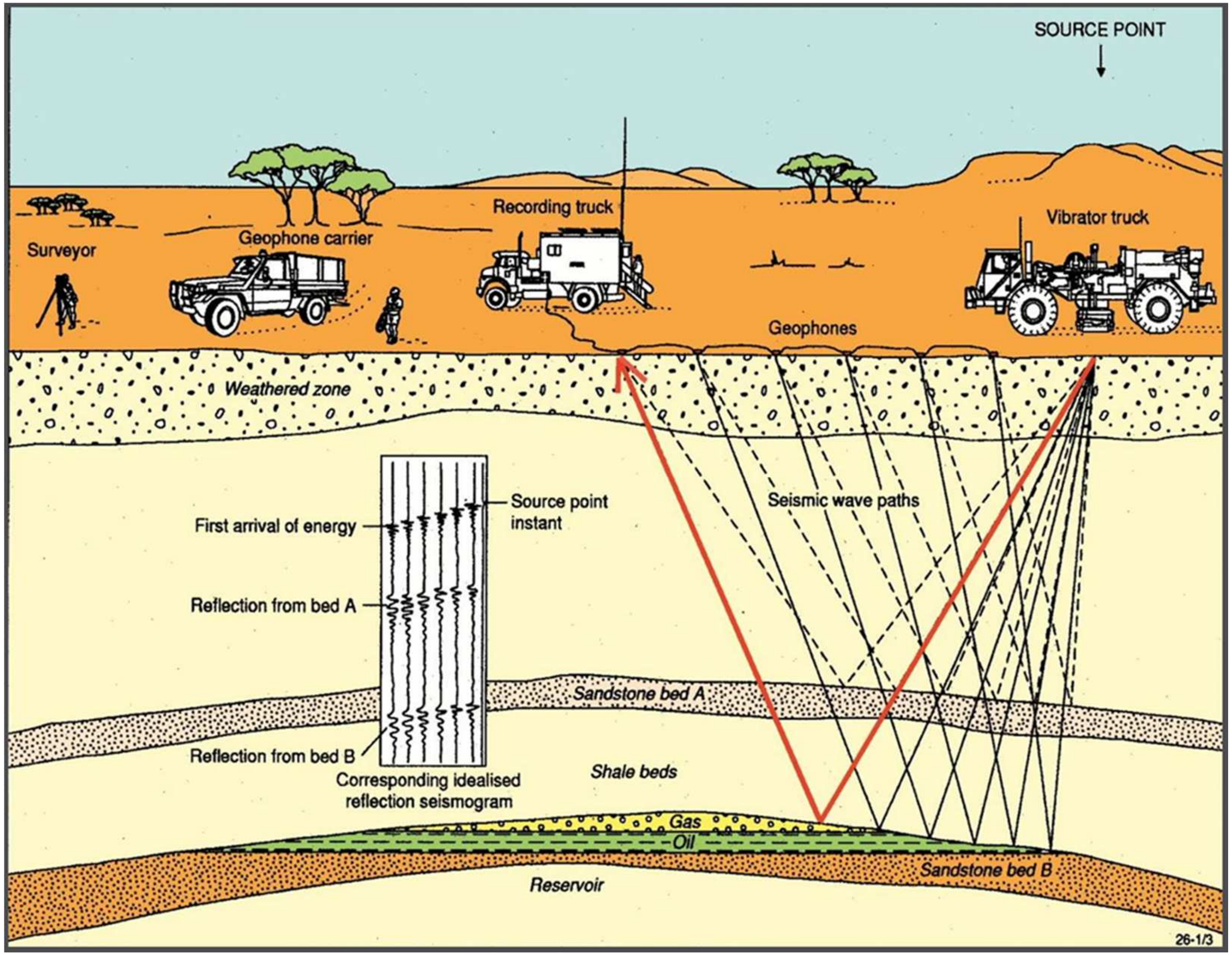
Dynamic Satellite Surveys (DSS) subcontracted by Terrex:

- Survey and peg the line,
- Collect and process gravity data

Seismic Data Acquisition

Seismic Data Acquisition

Seismic Reflection Acquisition



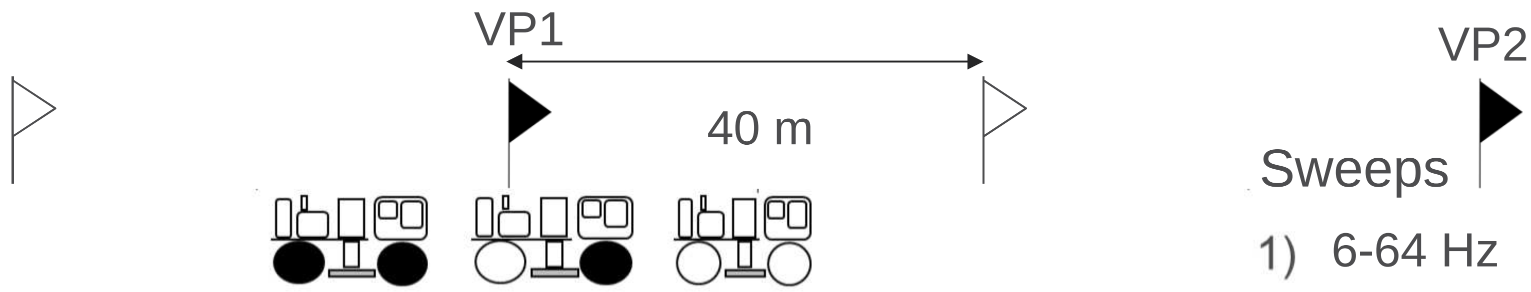
Hemi-50 Vibroseis Trucks

Hemi-50 Vibroseis Trucks

Hemi-50 Vibroseis Trucks

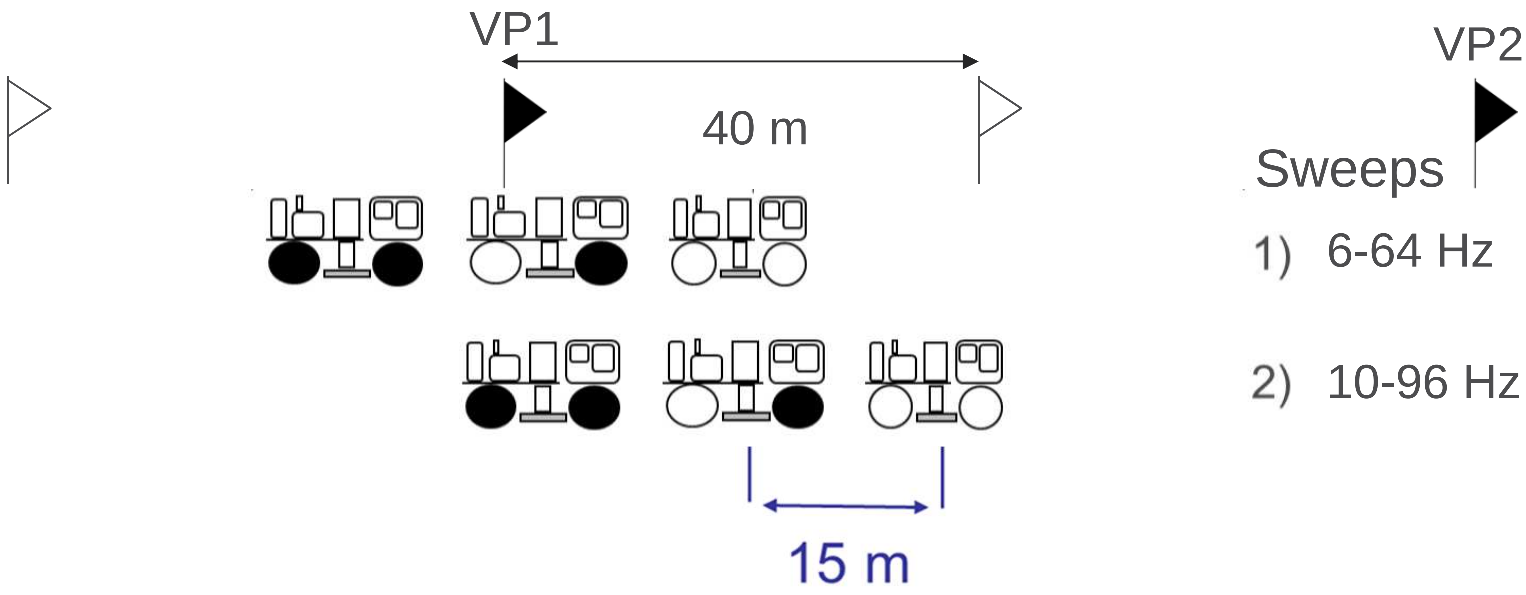
Seismic data acquisition parameters

3 variable frequency sweeps (12 s each) at every vibe point (VP)



Seismic data acquisition parameters

Vibe Config: 15 m pad to pad, 15 m move up after sweep



Sweeps

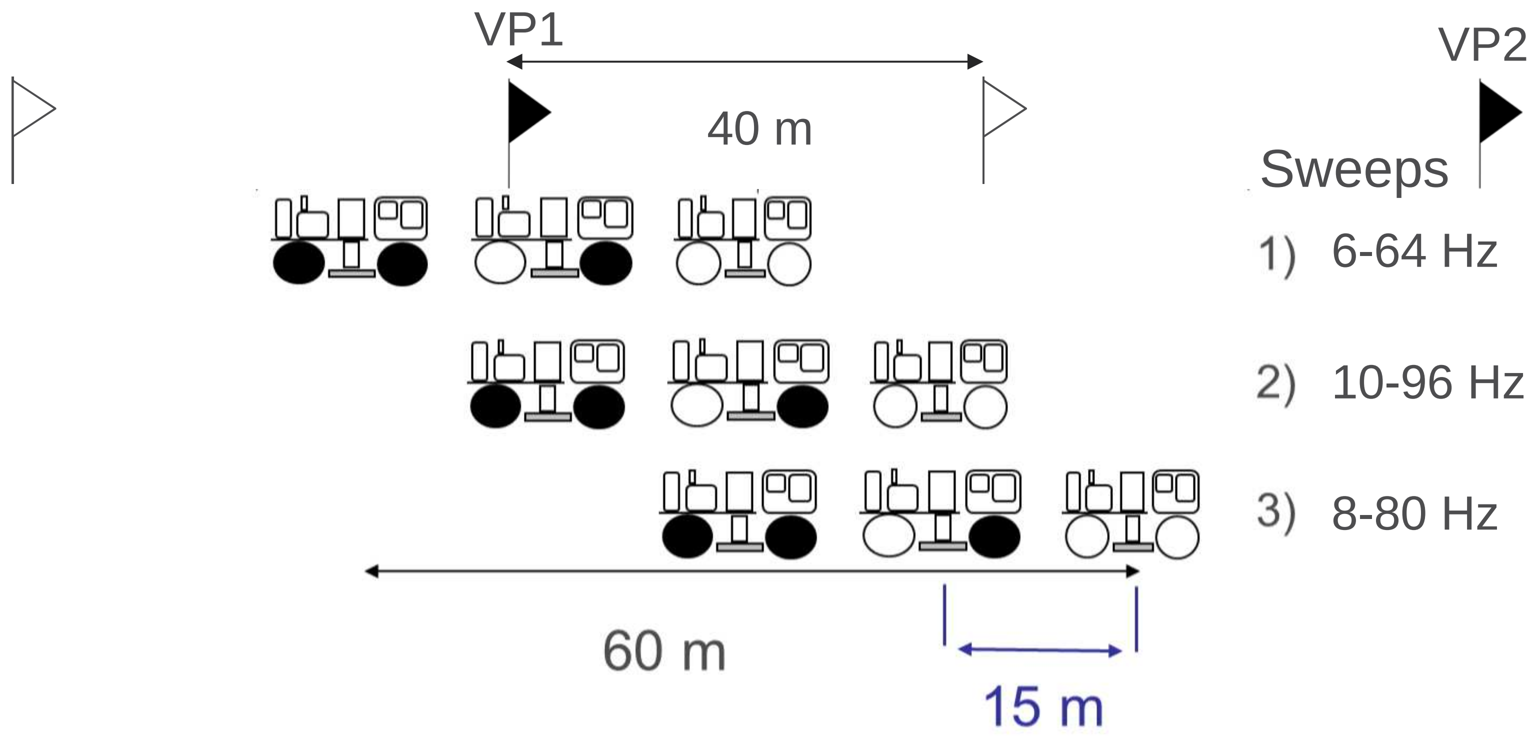
1) 6-64 Hz

2) 10-96 Hz

Seismic data acquisition parameters

Source Array: 60 m centred on half station

Vibe Point (VP) Interval: 80 m (2 x stations 40 m)



Sweeps

1) 6-64 Hz

2) 10-96 Hz

3) 8-80 Hz

Cable and geophone trucks

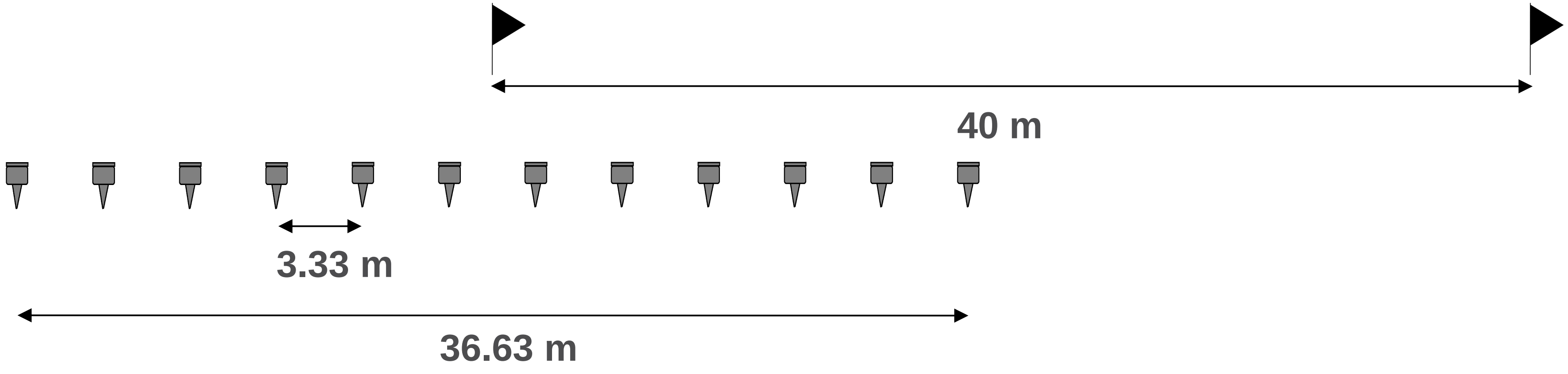
Seismic Data Acquisition Parameters

Each receiver station

Receiver array: 12 geophones spread over 40 m station spacing

- centred on surveyed peg

Receiver elements: Vertical component geophones (P-wave)



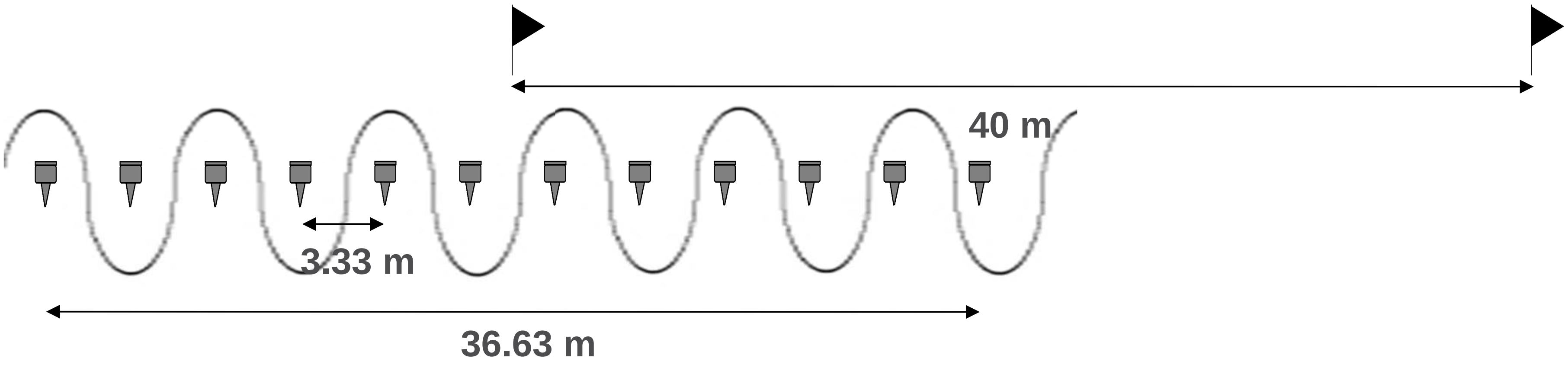
Seismic Data Acquisition Parameters

Each receiver station

Receiver array: 12 geophones spread over 40 m station spacing

- centred on surveyed peg

Arrays can help reduce some high amplitude noise in data



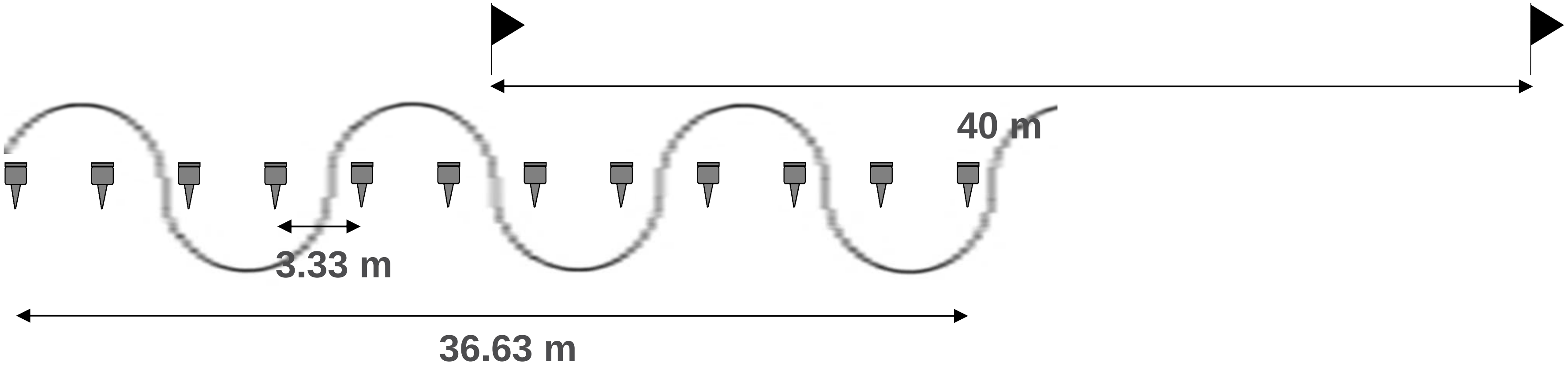
Seismic Data Acquisition Parameters

Each receiver station

Receiver array: 12 geophones spread over 40 m station spacing

- centred on surveyed peg

Arrays can help reduce some high amplitude noise in data

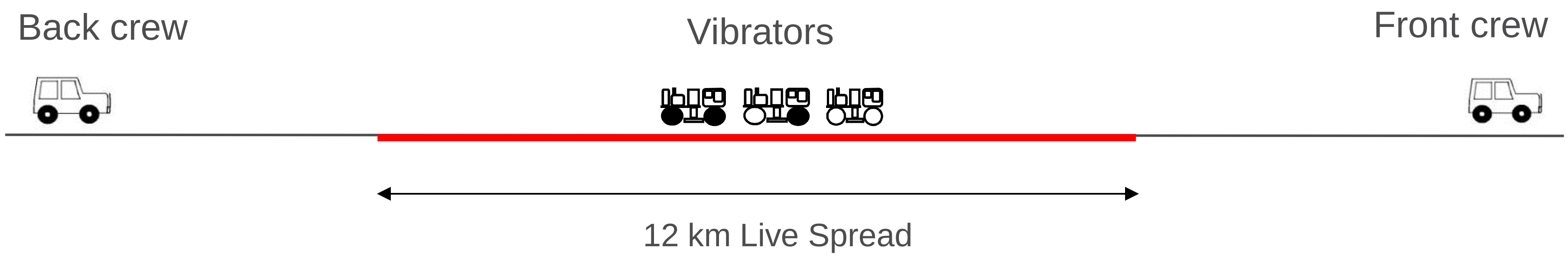


Seismic data acquisition parameters

Symmetrical split spread, offset: minimum 20 m, maximum 6 km

300 channels at 40 m intervals, 75 nominal fold data

80 m VP interval

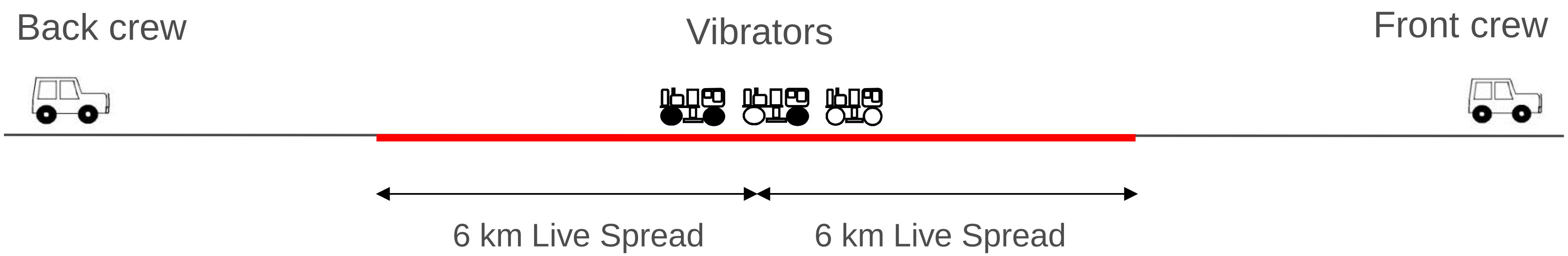


Seismic data acquisition parameters

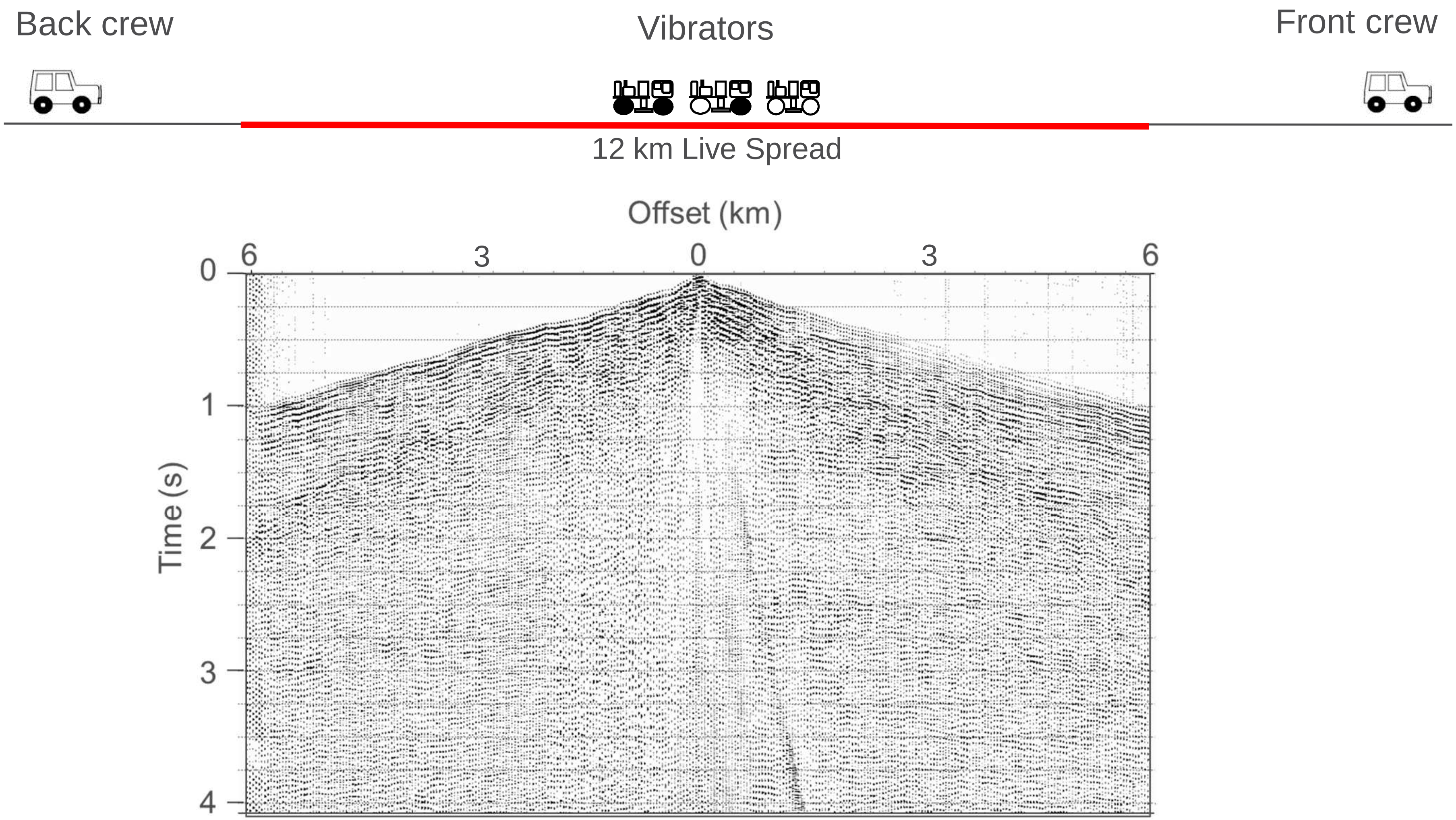
Symmetrical split spread, offset: minimum 20 m, maximum 6 km

300 channels at 40 m intervals, 75 nominal fold data

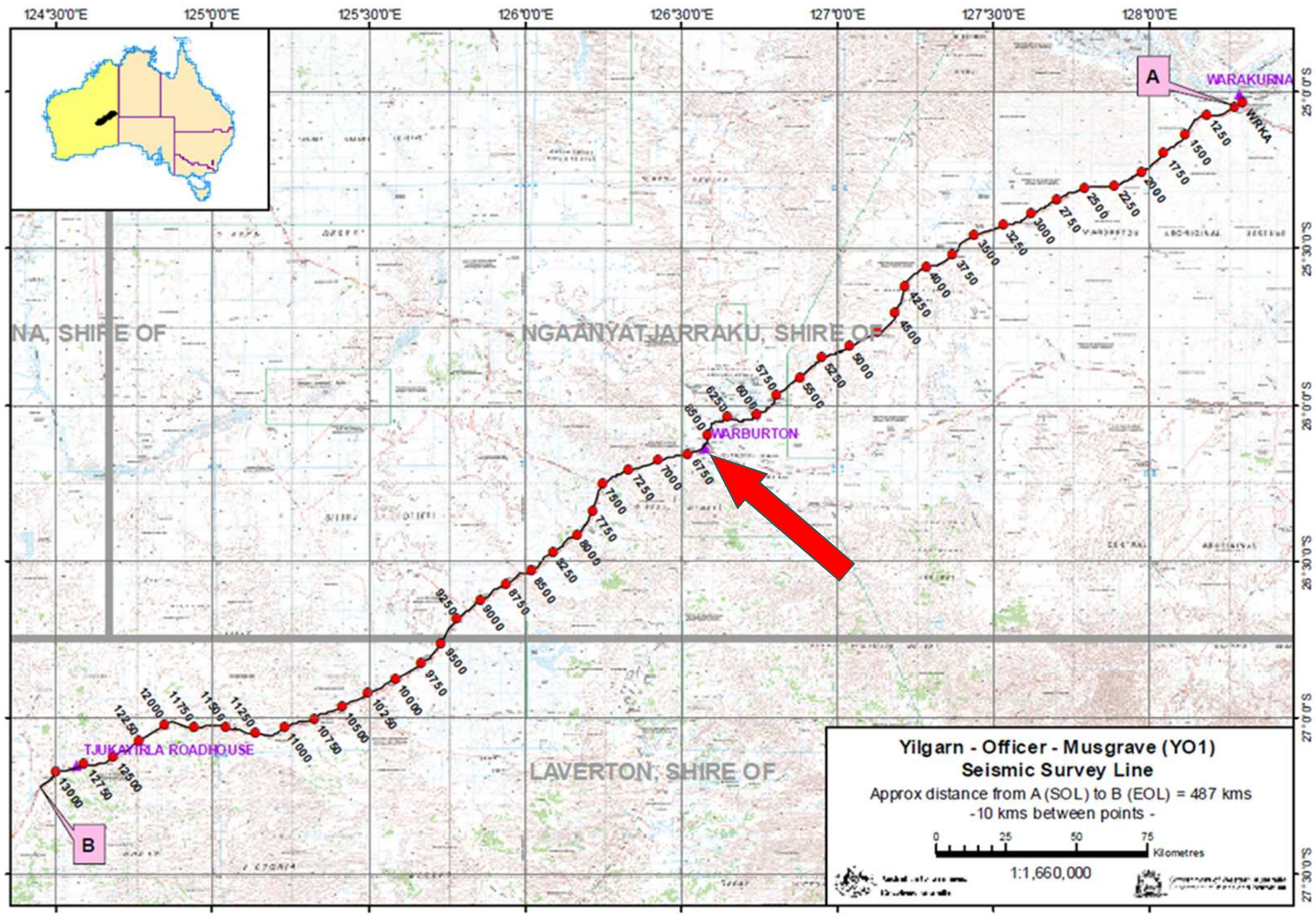
80 m VP interval



Symmetrical split spread – shot record



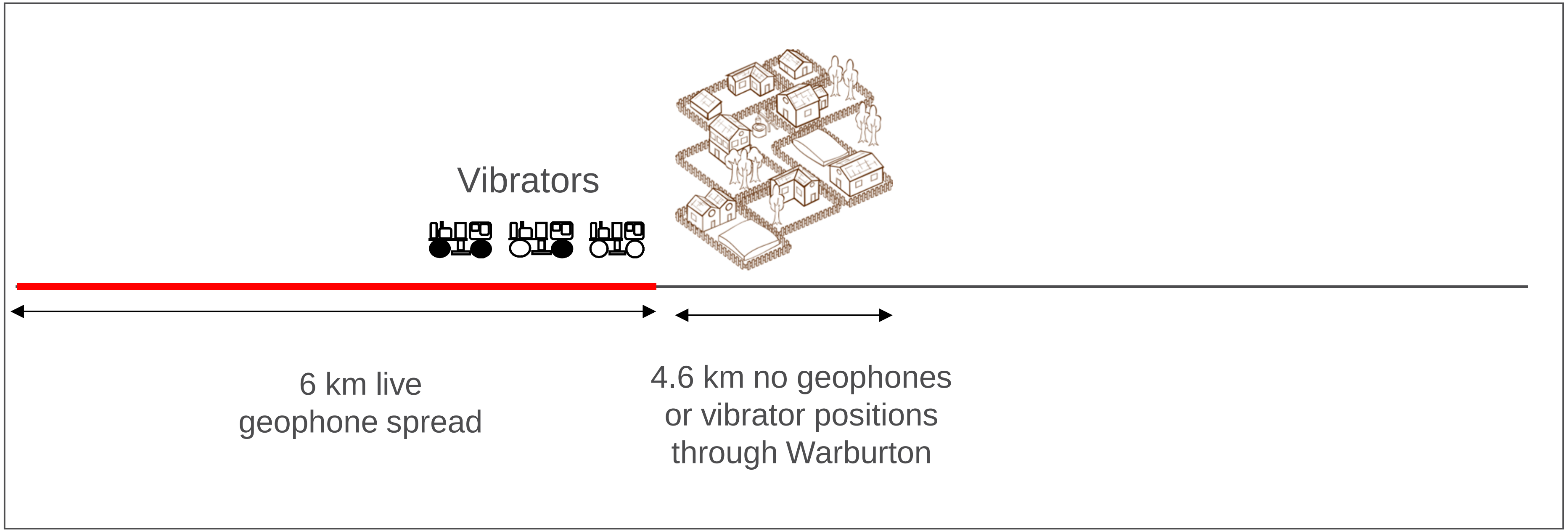
Warburton Data Gap



Warburton Data Gap

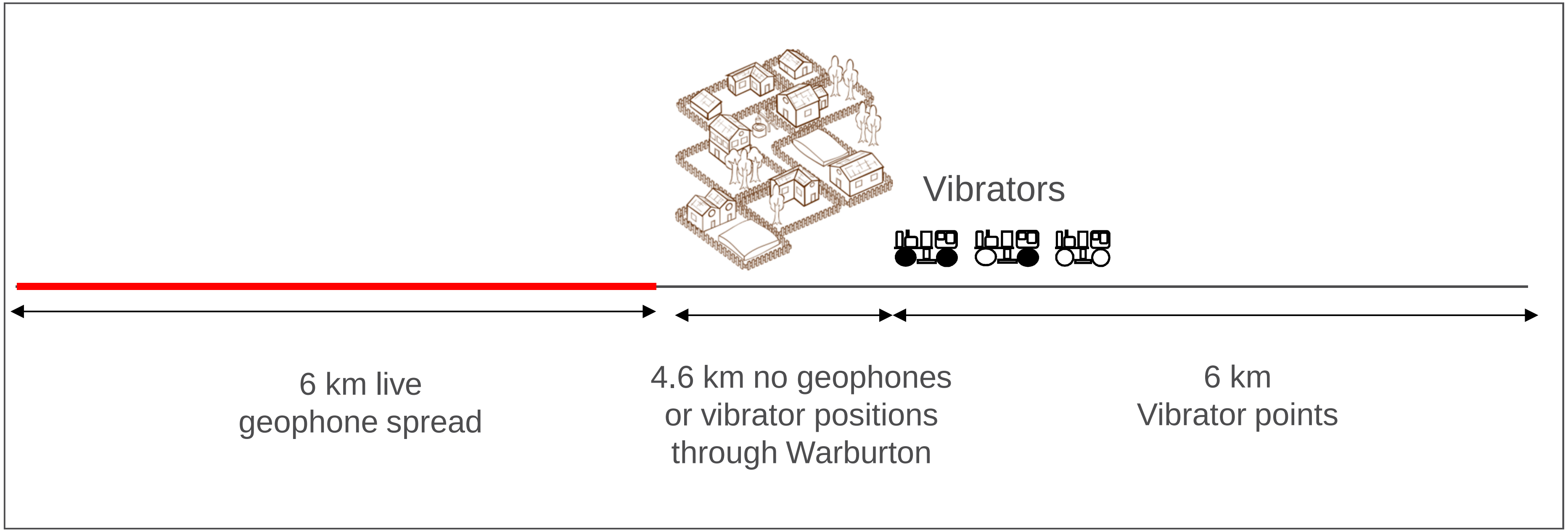
Geophones and vibrators up to Warburton town boundary

No geophones or vibrators through Warburton



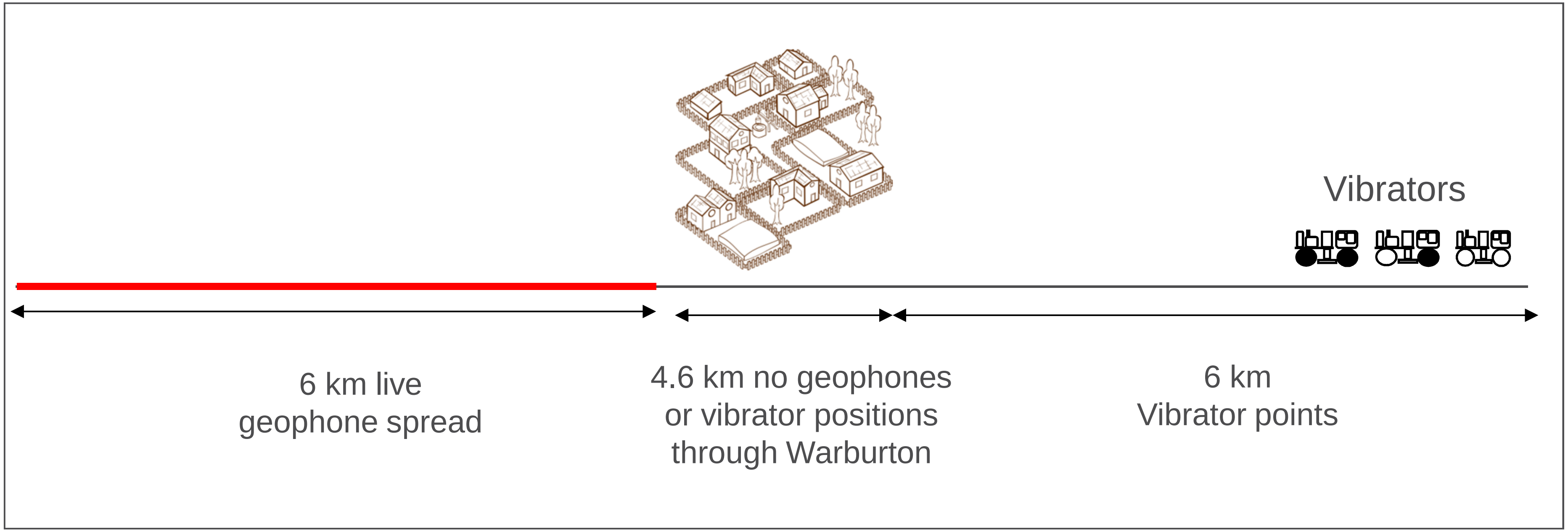
Warburton Data Gap

Repeat vibrator sweeps with vibrator trucks on other side of Warburton



Warburton Data Gap

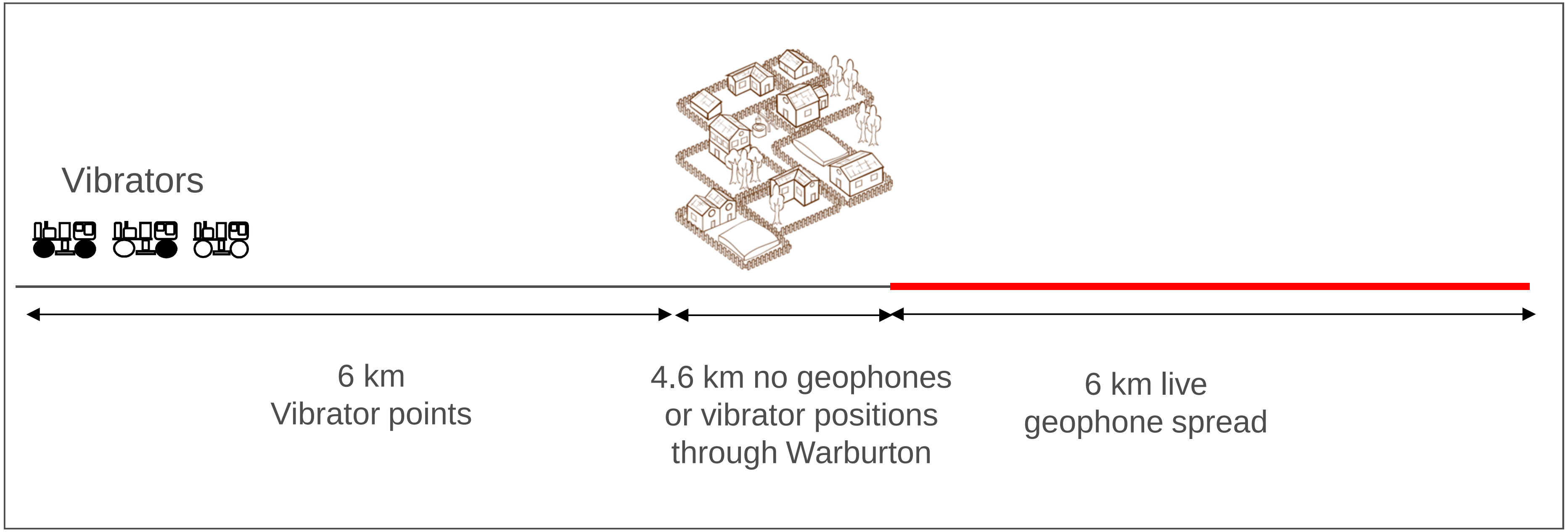
Repeat vibrator sweeps with vibrator trucks on other side of Warburton



Warburton Data Gap

Move geophones to other side of Warburton

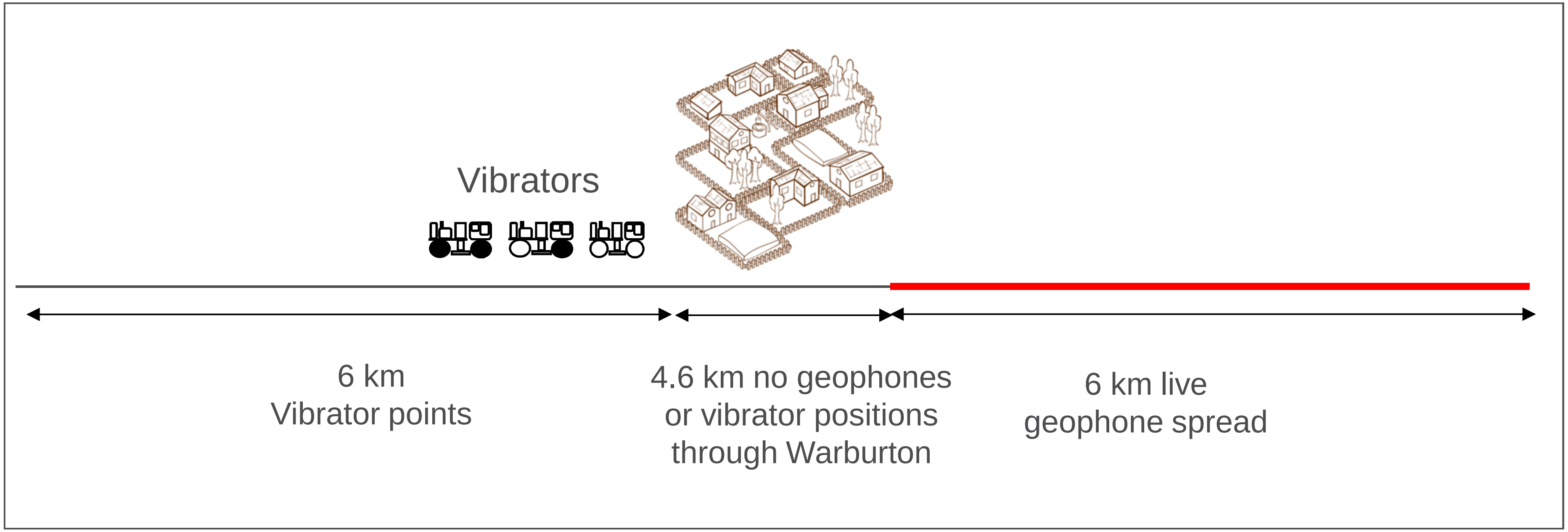
Repeat vibrator sweeps with vibrators on other side of Warburton



Warburton Data Gap

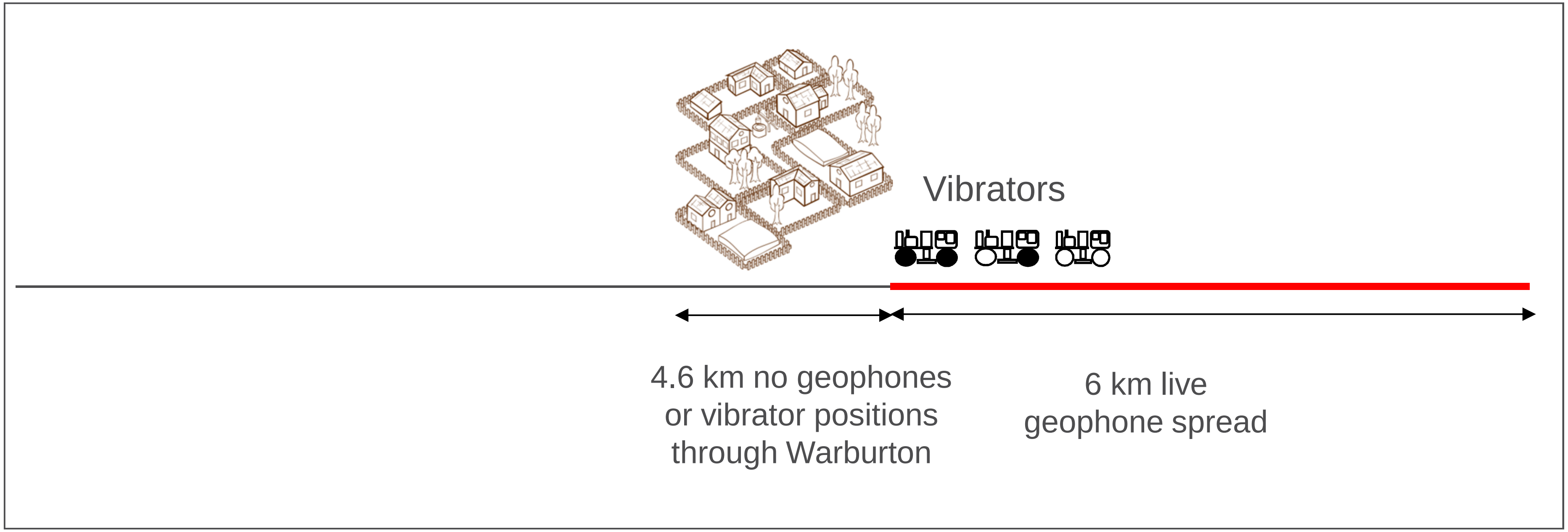
Move geophones to other side of Warburton

Repeat vibrator sweeps with vibrators on other side of Warburton

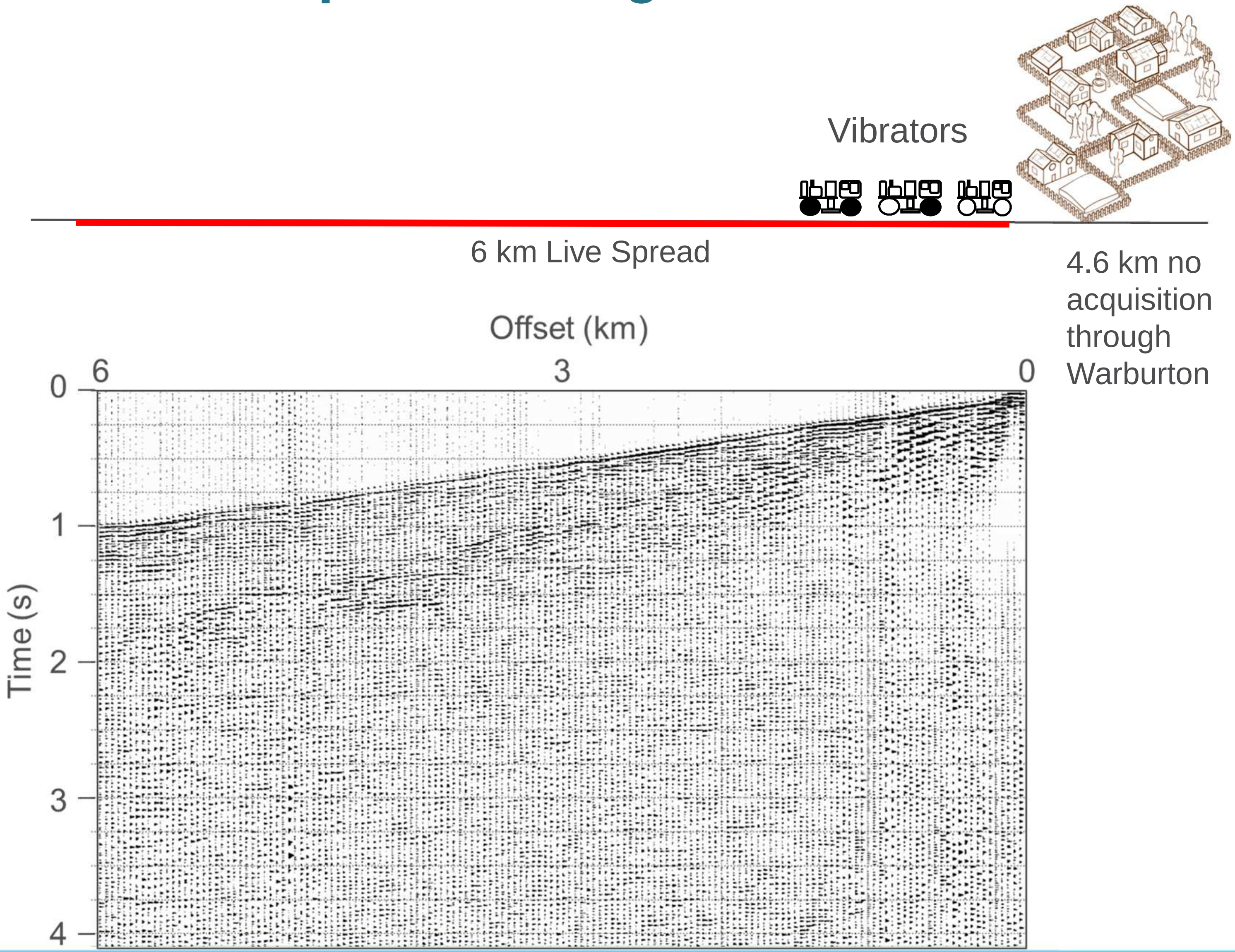


Warburton Data Gap

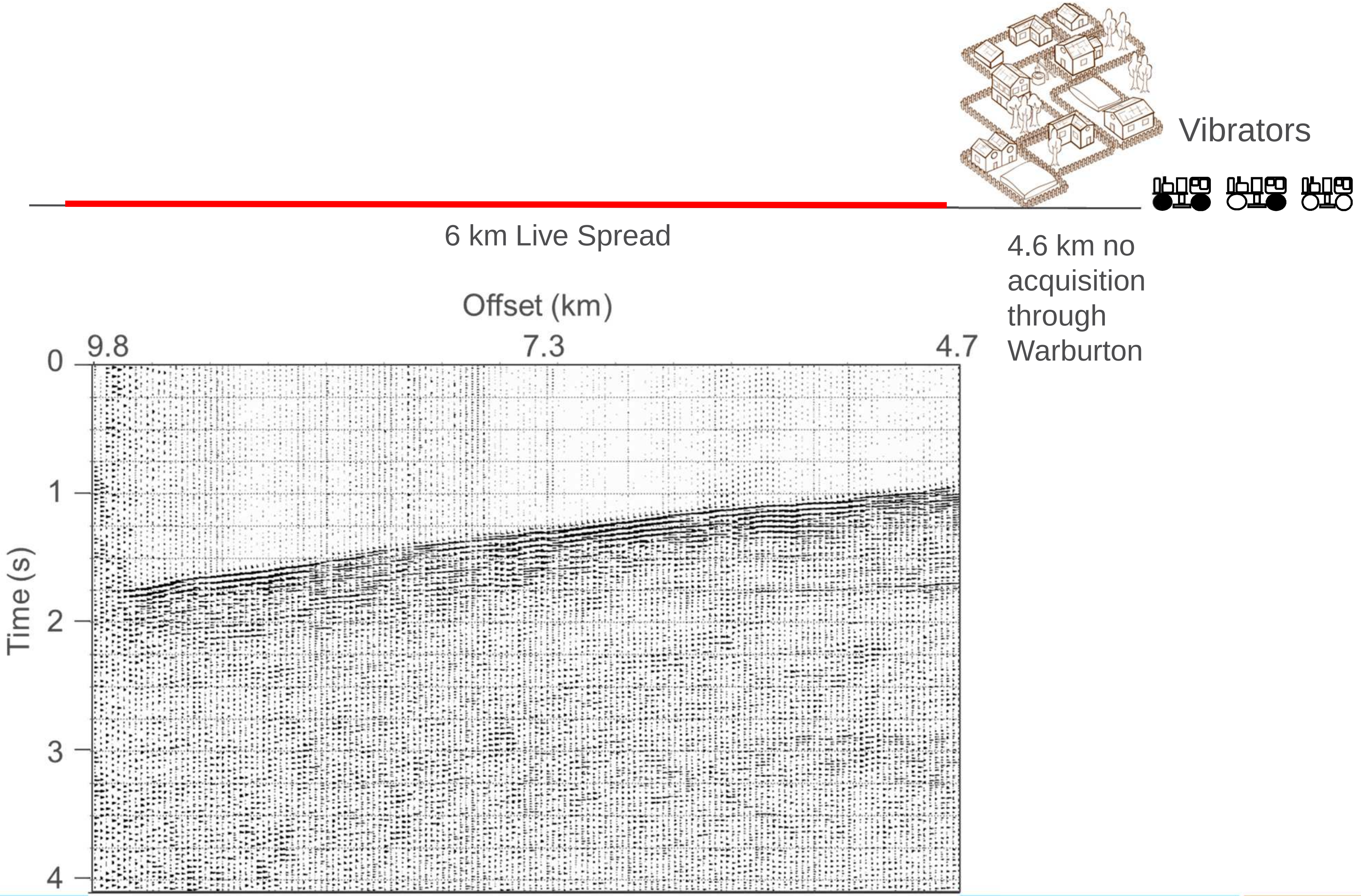
Repeat vibrator sweeps with vibrators and geophones on same side of Warburton



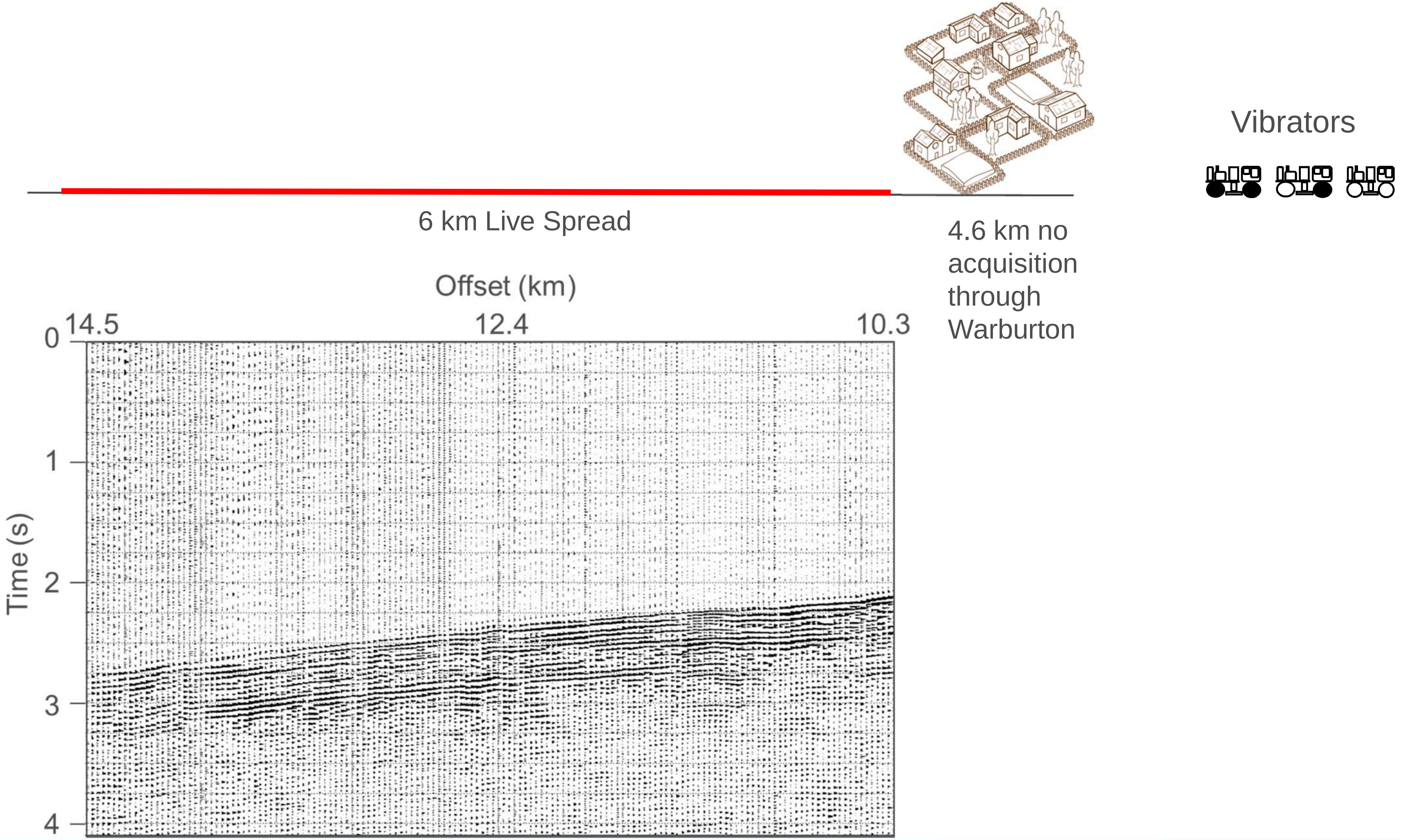
Offend spread at edge of Warburton – shot record



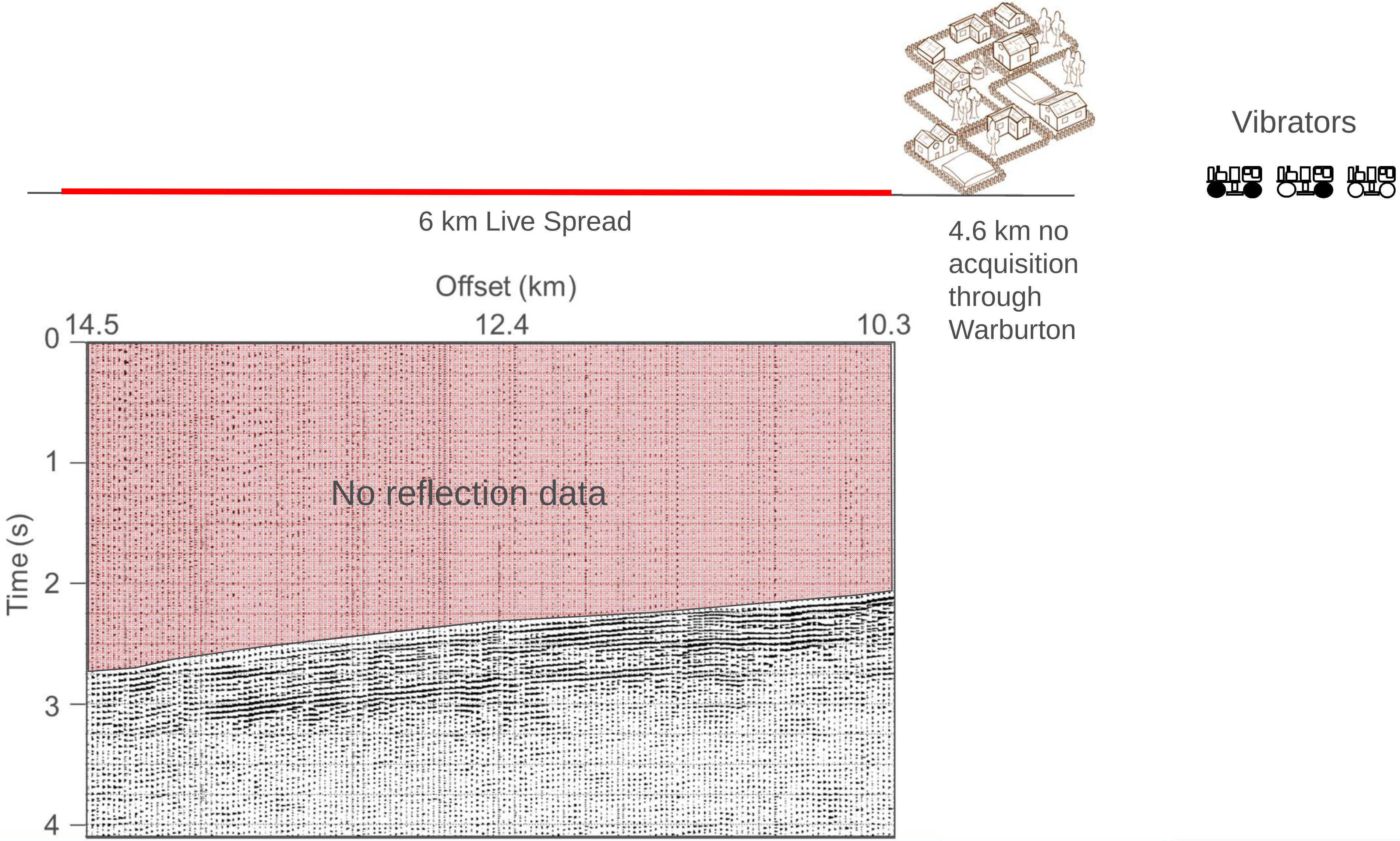
Source other side of Warburton – shot record



Source other side of Warburton – shot record

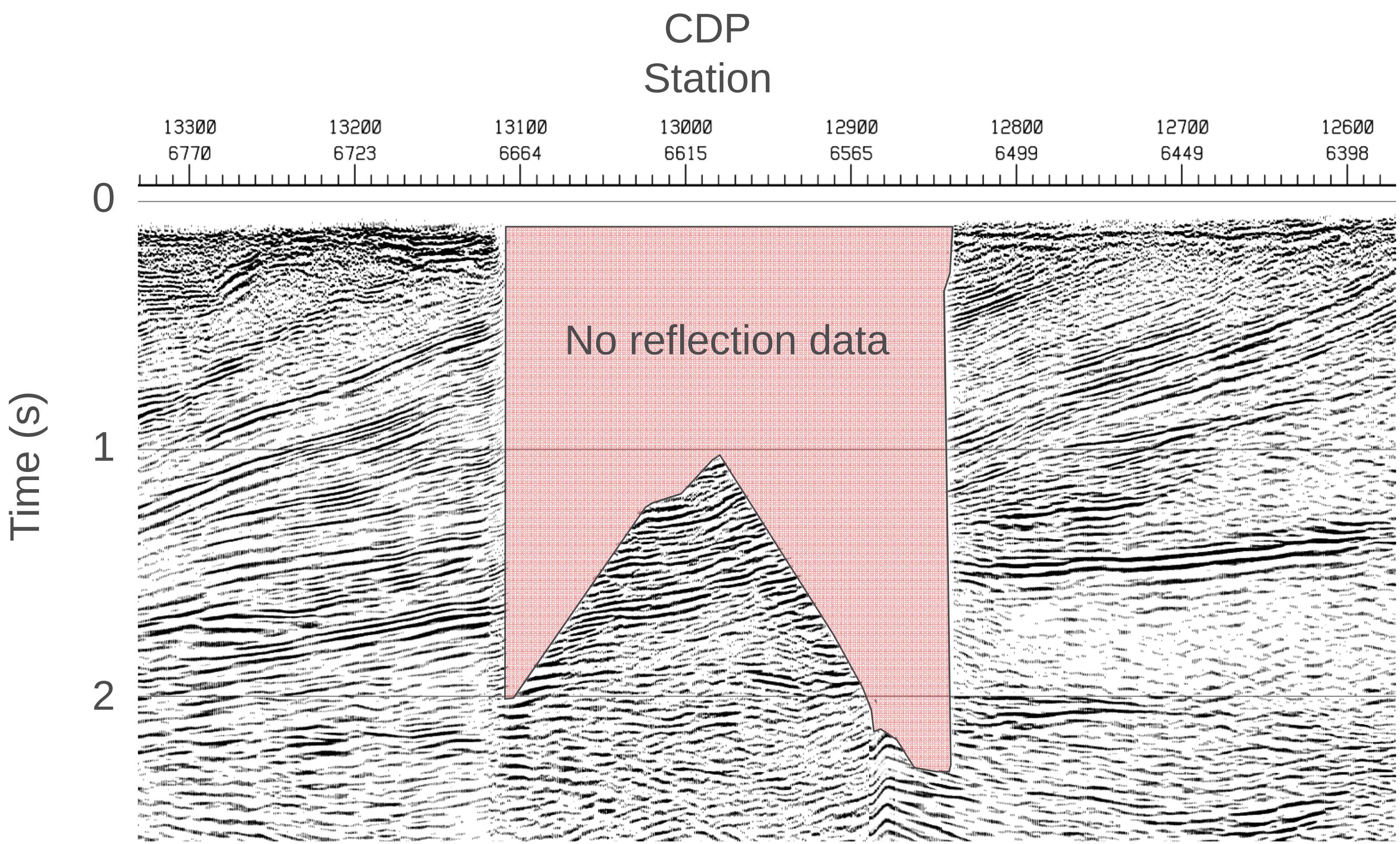


Source other side of Warburton – shot record



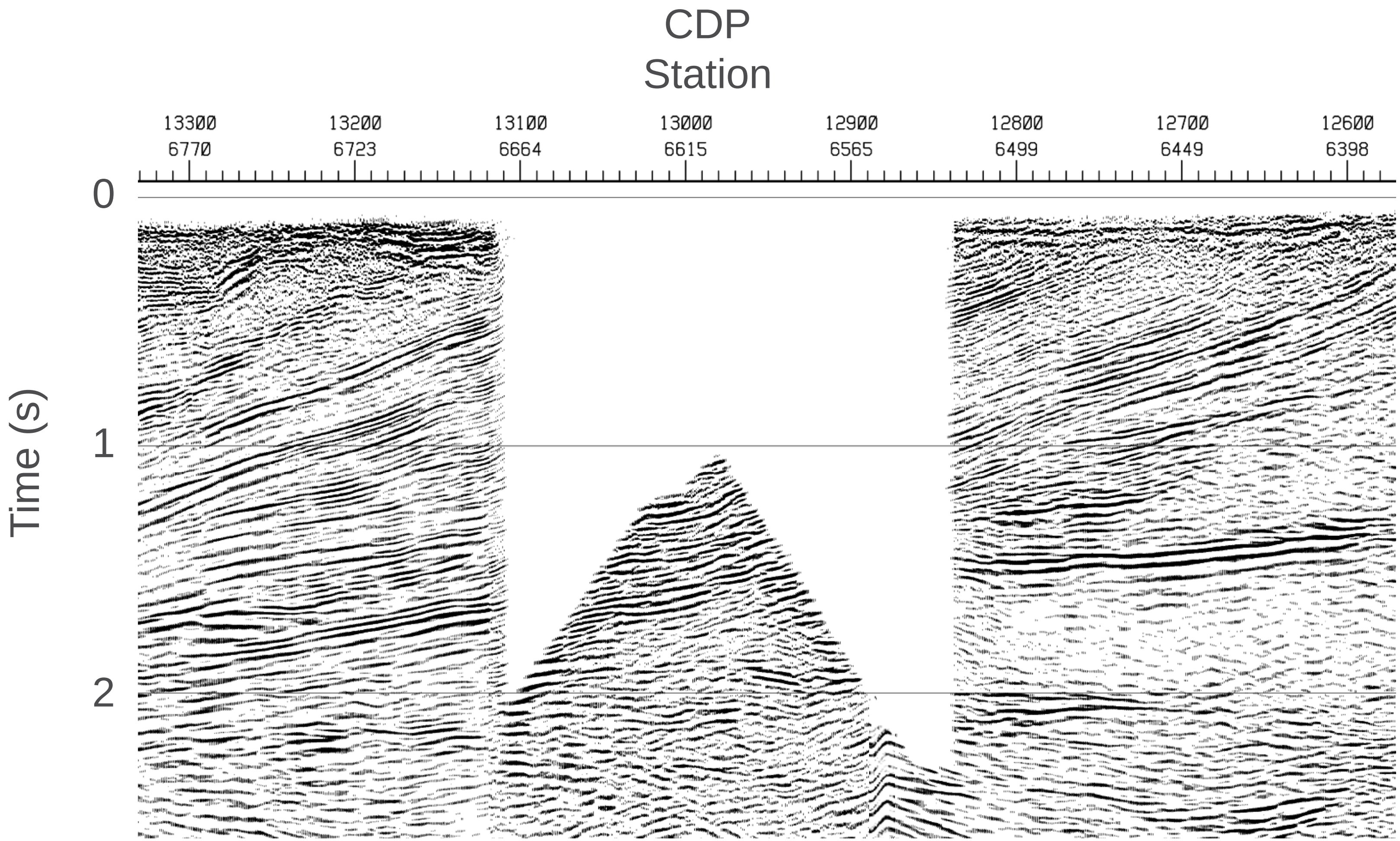
Warburton Data Gap

Migration



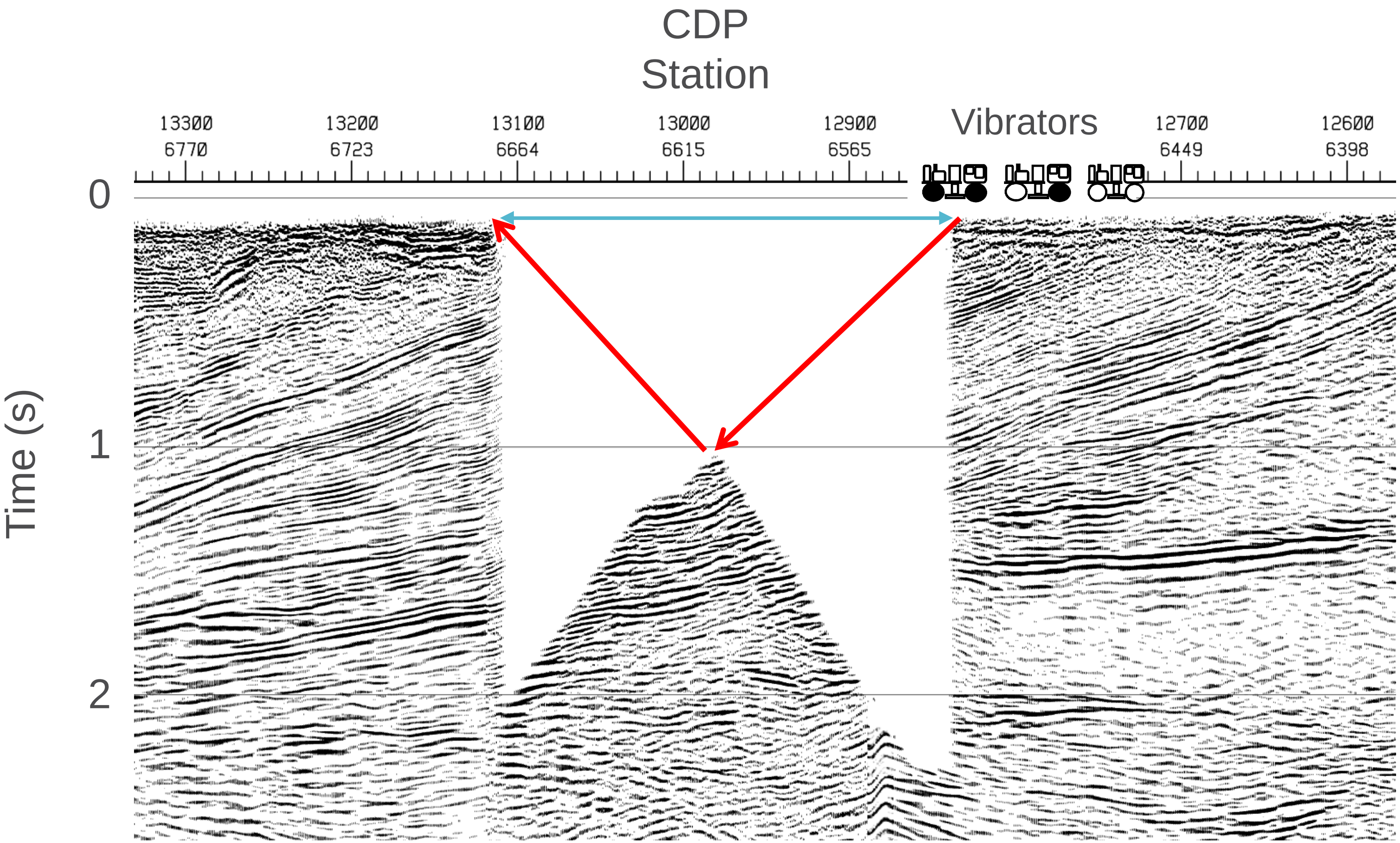
Warburton Data Gap

Migration



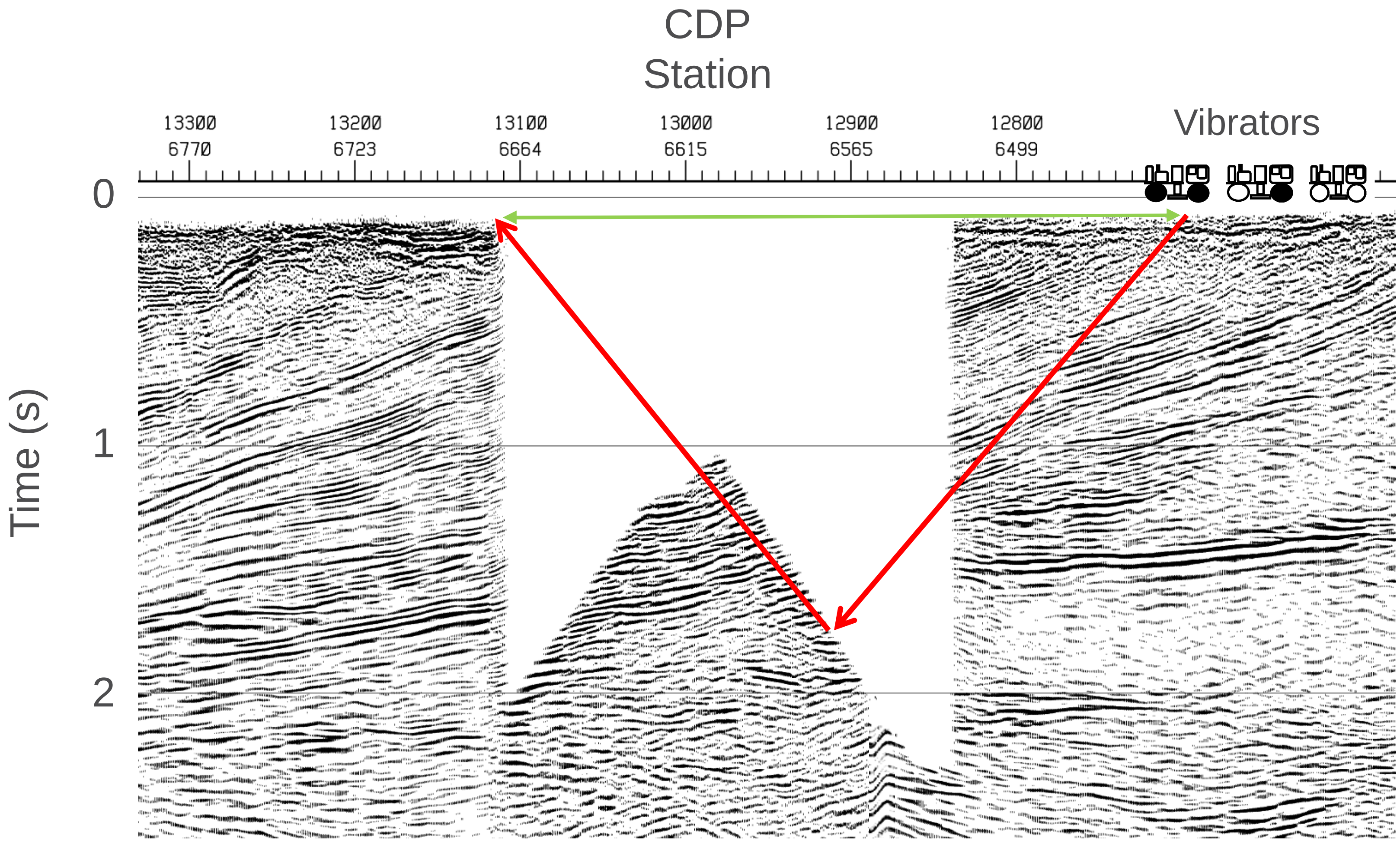
Warburton Data Gap

Minimum data offset – most shallow data in centre of gap



Warburton Data Gap

Further offset data – less shallow data in gap



Data Acquisition – Front Crew

Cable truck

Placing geophones

Data Acquisition – Back Crew

Picking up geophones

Pulling in cable

Geophones and cables

Seismic data acquisition parameters

Recording system Sercel SN388

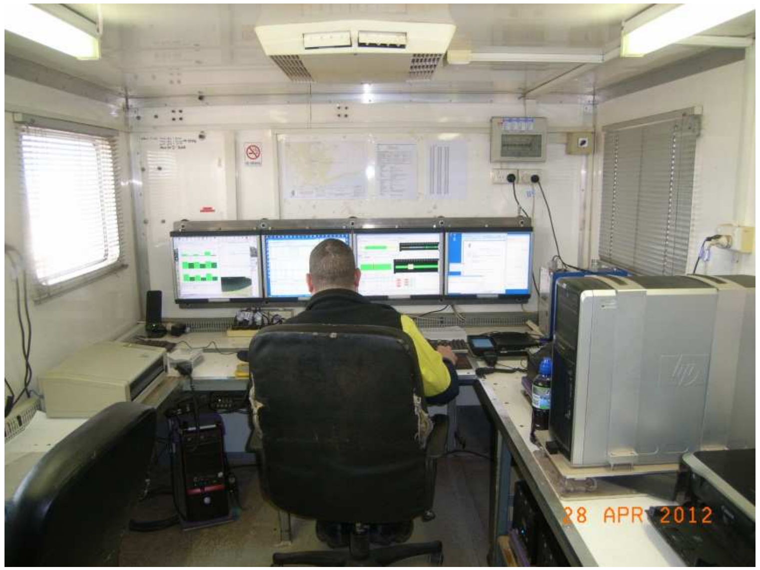
Data - SEG-D demultiplexed

LTO-2 tapes

Avg. production

216 VPs/day

17.3 km/day

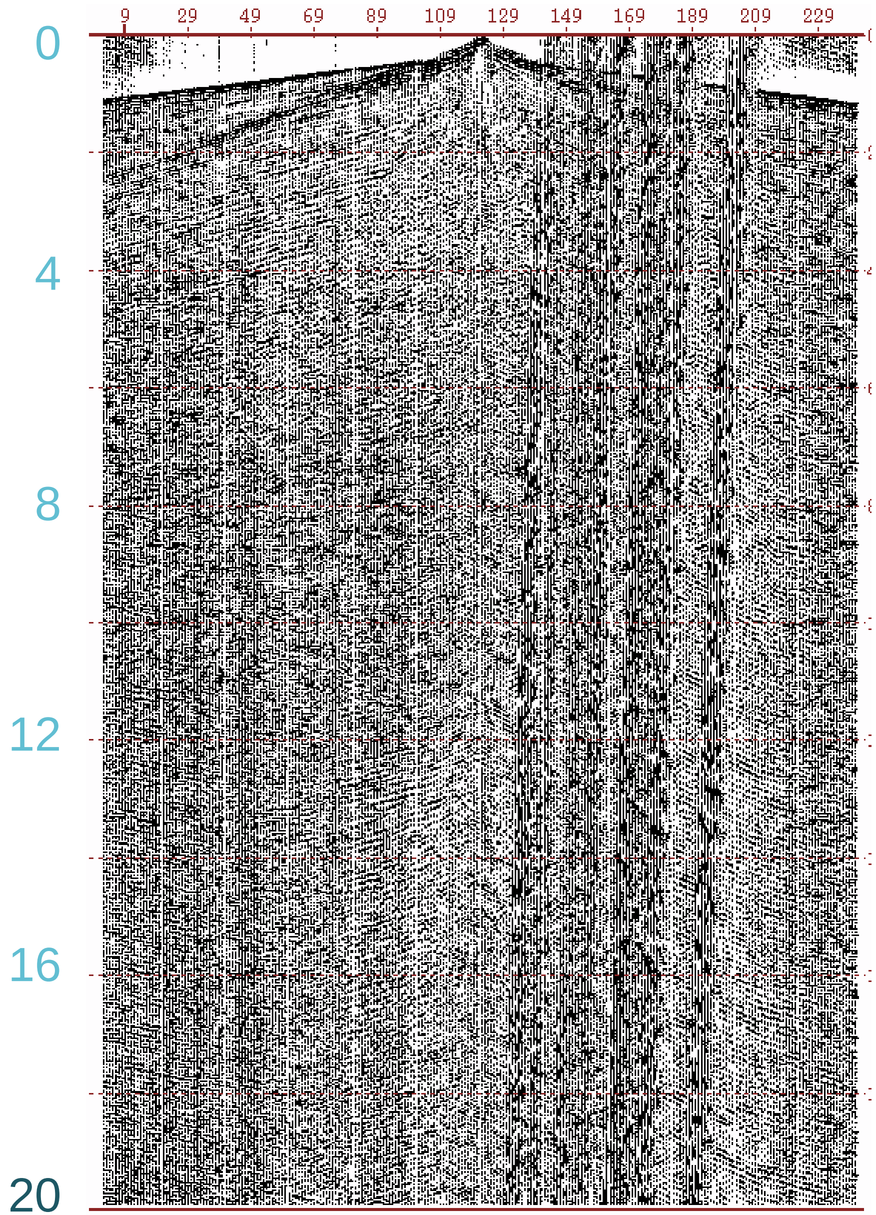


Seismic data acquisition

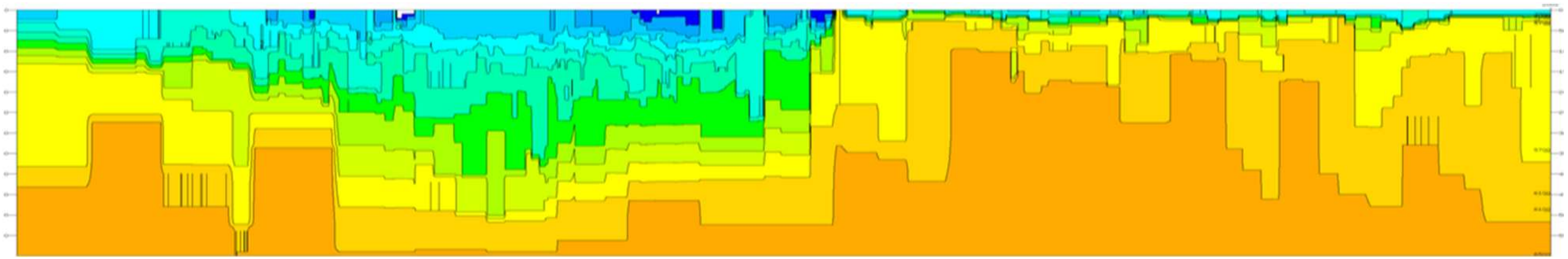
20 s and 22 s record length

2 ms sampling rate

Low/high-cut filters 3/205 Hz



Seismic Processing



Seismic Processing

Overall goal:

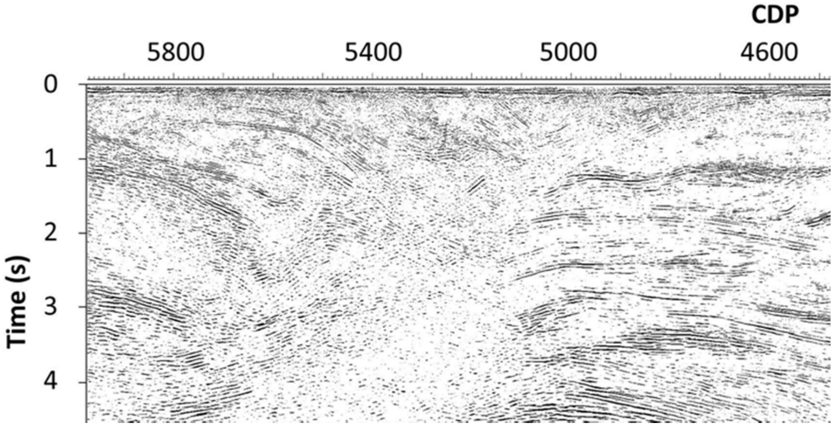
To produce an image of the subsurface

by

Enhancing and correctly positioning reflections

and

Reducing undesired energy (noise)



Seismic Data Reflection Processing

Setup Geometry — Crooked line smoothing

↓

Refraction Statics — Weathering and elevations

↓

Spectral Equalisation

↓

NMO Velocity Analysis

↓

Auto-statics

↓

DMO — Correct dipping reflections velocities

↓

Stack

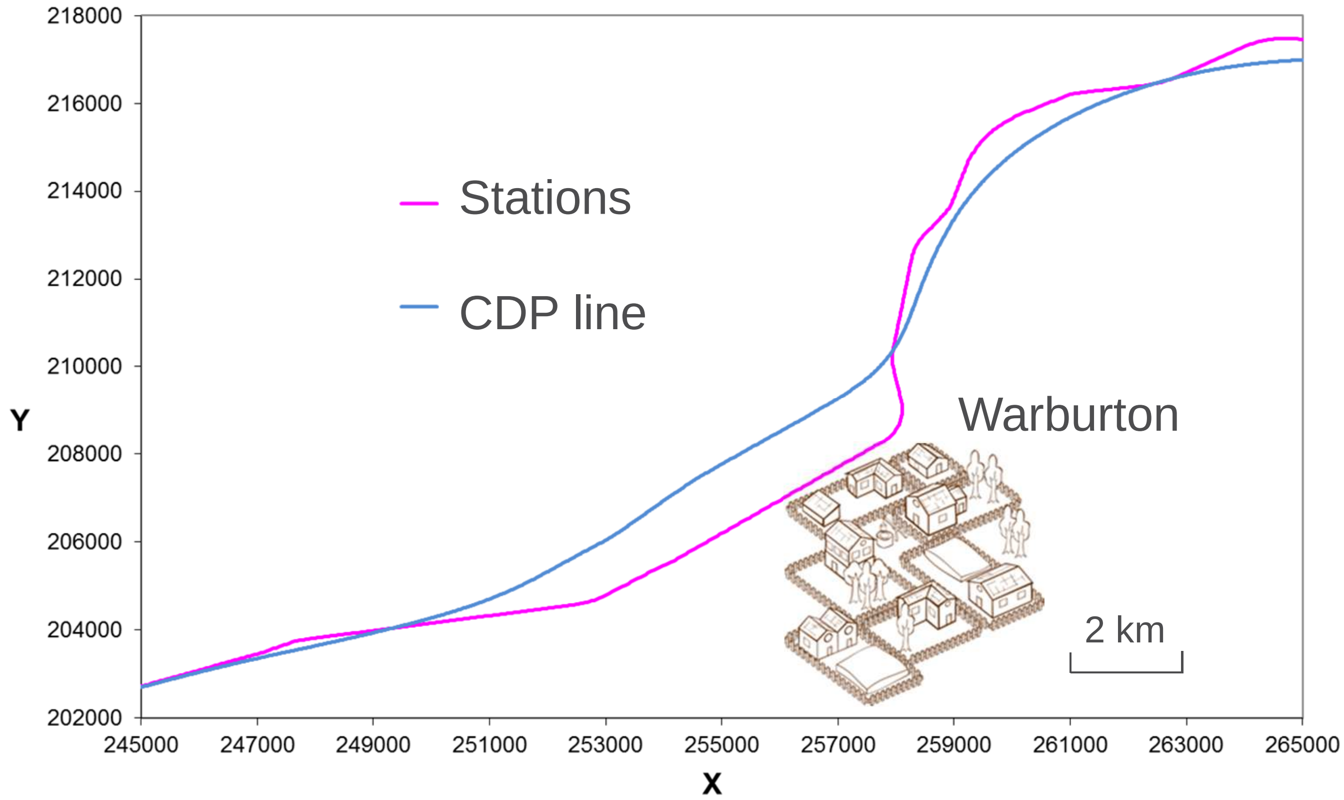
↓

Post Stack Migration

Processing and interpretation

Key Processing Steps

Crooked line geometry definition - Common Depth Point (CDP) line

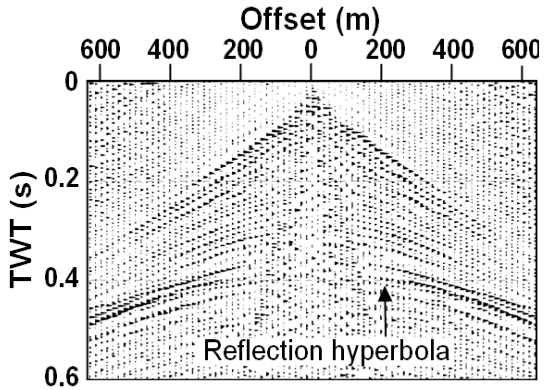


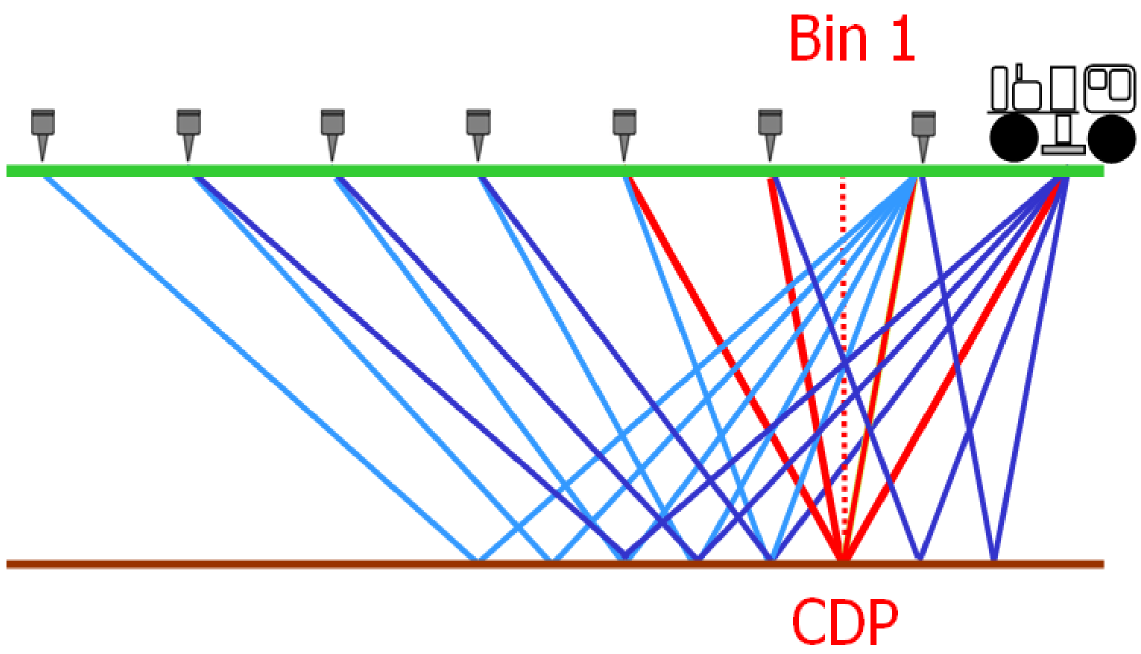
Processing and interpretation

Key Processing Steps

Crooked line geometry definition

CDP sort - collects traces within CDP bins





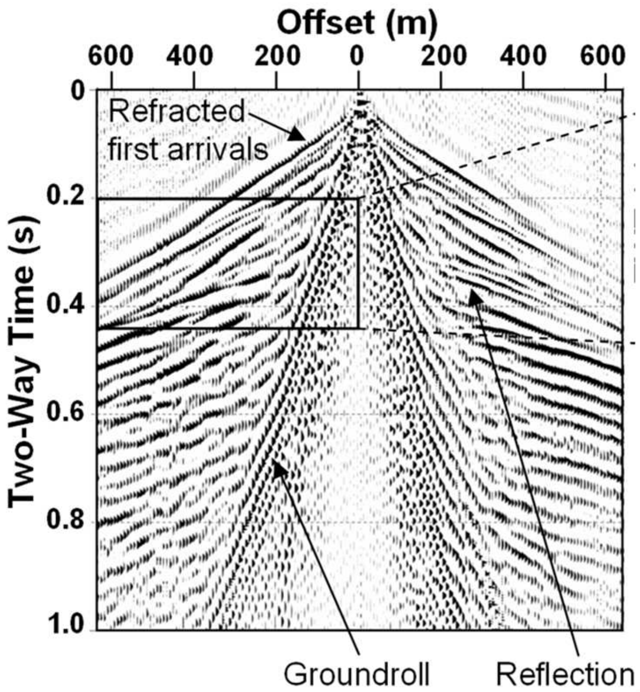
Processing and interpretation

Key Processing Steps

Crooked line geometry definition

CDP sort

Spectral equalisation - suppress low frequencies



10GA-PA1 NT, 2010, groundwater survey

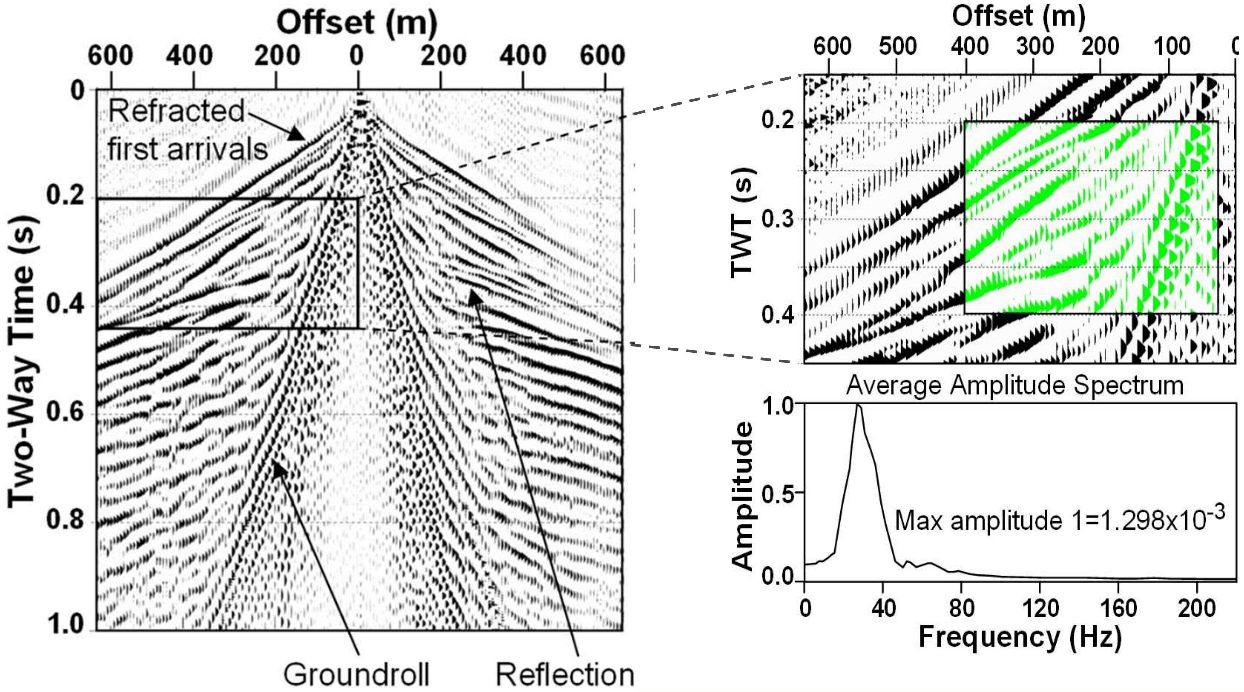
Processing and interpretation

Key Processing Steps

Crooked line geometry definition

CDP sort

Spectral equalisation - suppress low frequencies



10GA-PA1 NT, 2010, groundwater survey

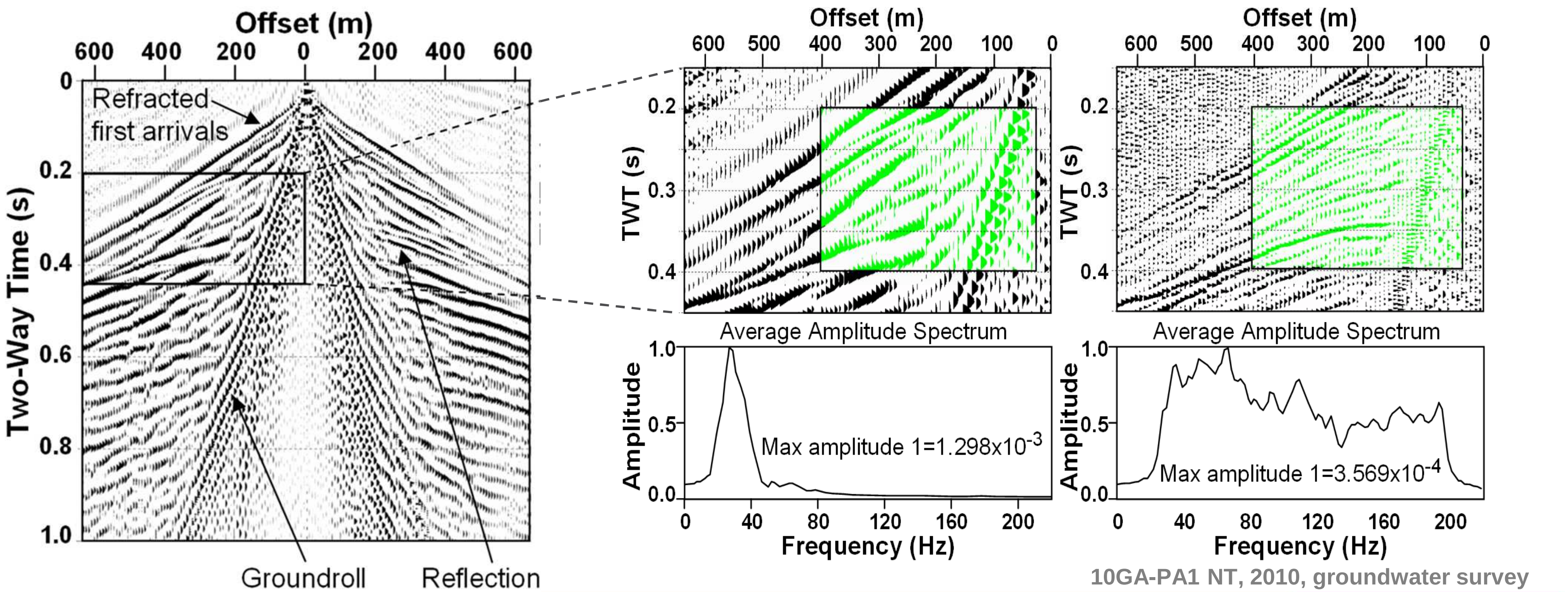
Processing and interpretation

Key Processing Steps

Crooked line geometry definition

CDP sort

Spectral equalisation - **suppress low frequencies**



10GA-PA1 NT, 2010, groundwater survey

Processing and interpretation

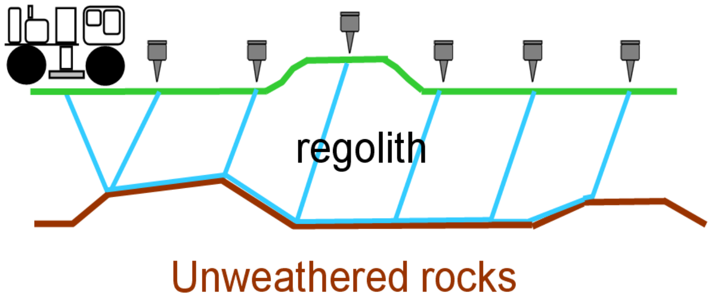
Key Processing Steps

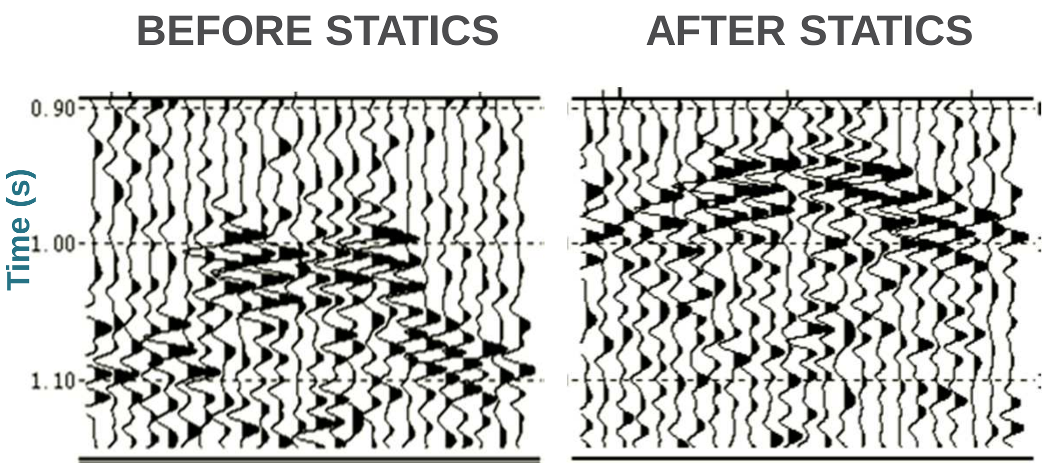
Crooked line geometry definition

CDP sort

Spectral equalisation

Refraction statics – corrects for time delays in regolith





Processing and interpretation

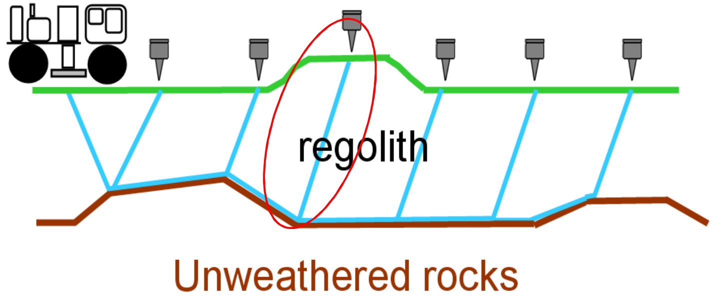
Key Processing Steps

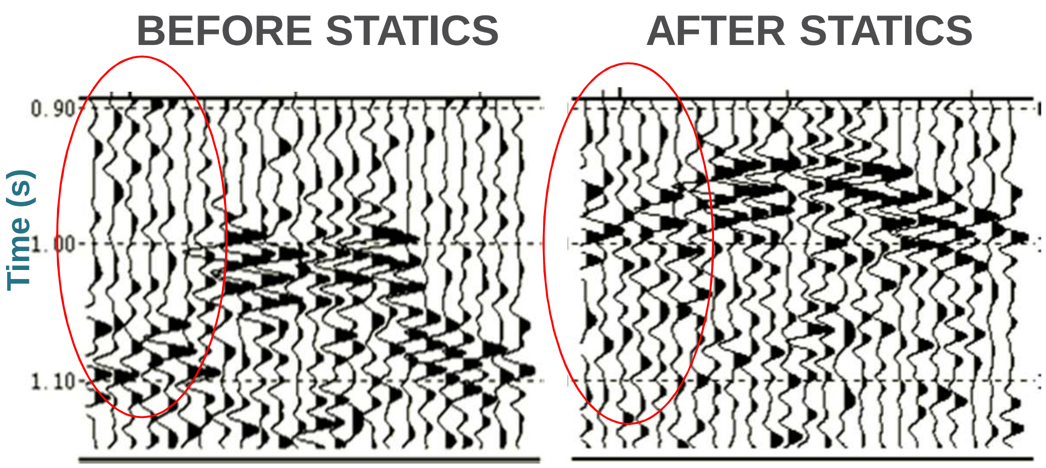
Crooked line geometry definition

CDP sort

Spectral equalisation

Refraction statics – **corrects for time delays in regolith**





Processing and interpretation

Key Processing Steps

Crooked line geometry definition

CDP sort

Spectral equalisation

Refraction statics

Automatic statics - fine tune statics corrections

Processing and interpretation

Key Processing Steps

Crooked line geometry definition

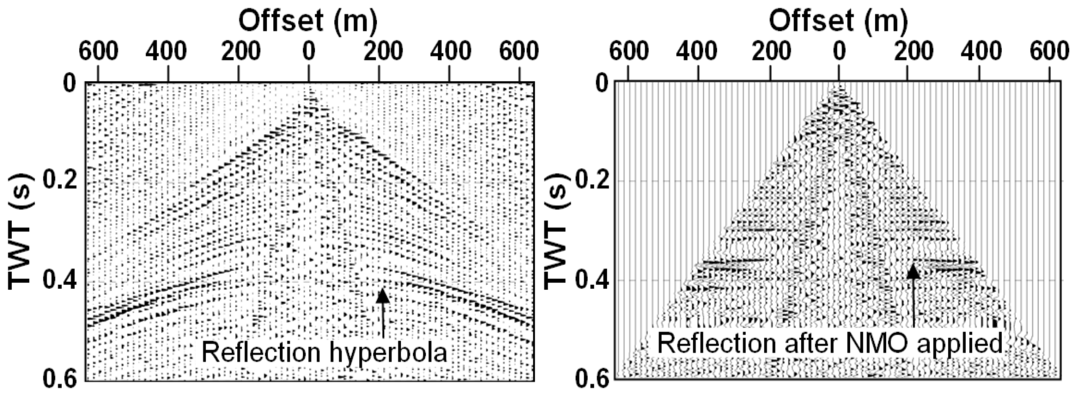
CDP sort

Spectral equalisation

Refraction statics

Automatic statics

Normal Moveout (NMO) - corrects for source-receiver offset



10GA-PA1 NT, 2010, groundwater survey

Processing and interpretation

Key Processing Steps

Crooked line geometry definition

CDP sort

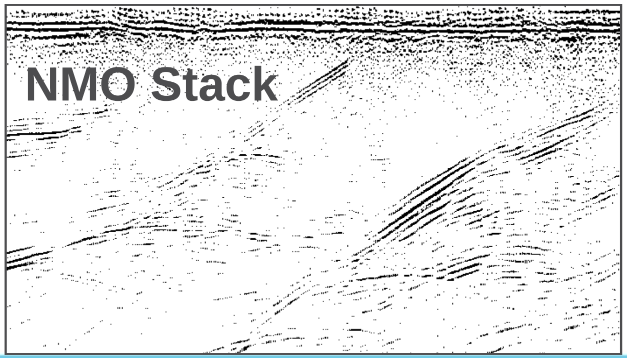
Spectral equalisation

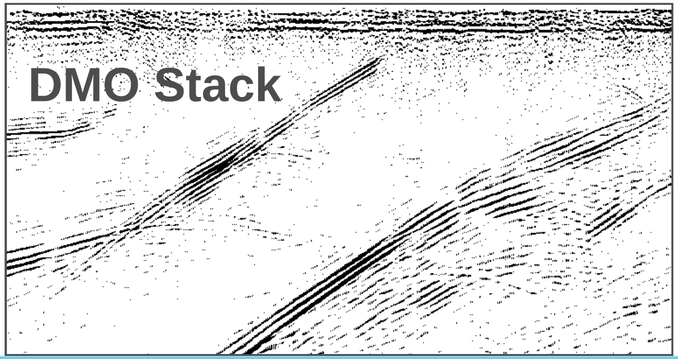
Refraction statics

Automatic statics

Normal Moveout (NMO)

Dip Moveout (DMO) - allows imaging of dipping reflectors





Processing and interpretation

Key Processing Steps

Crooked line geometry definition

CDP sort

Spectral equalisation

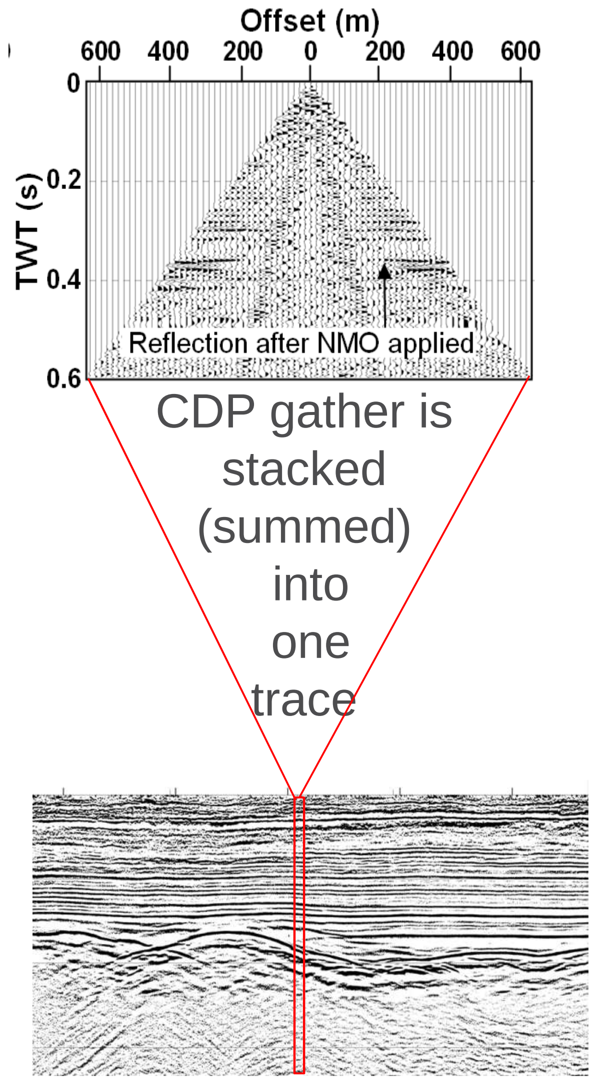
Refraction statics

Automatic statics

Normal Moveout (NMO)

Dip Moveout (DMO)

Common mid-point stack - improves signal to noise



Processing and interpretation

Key Processing Steps

Crooked line geometry definition

CDP sort

Spectral equalisation

Refraction statics

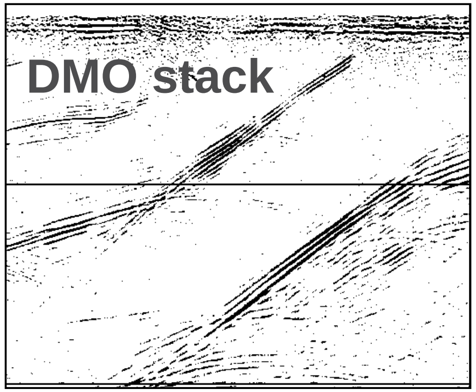
Automatic statics

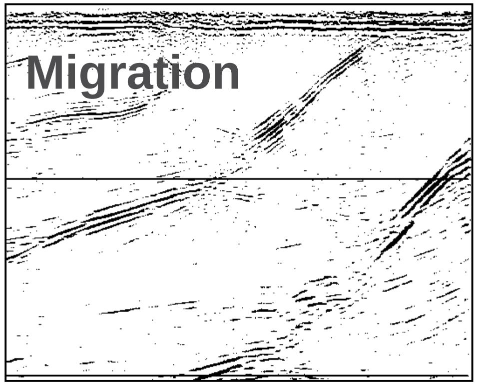
NMO correction

DMO correction

Common mid-point stack

Post Stack Migration - moves reflectors to correct positions





Processing and interpretation

Key Processing Steps

Crooked line geometry definition

CDP sort

Spectral equalisation

Refraction statics

Automatic statics

NMO correction

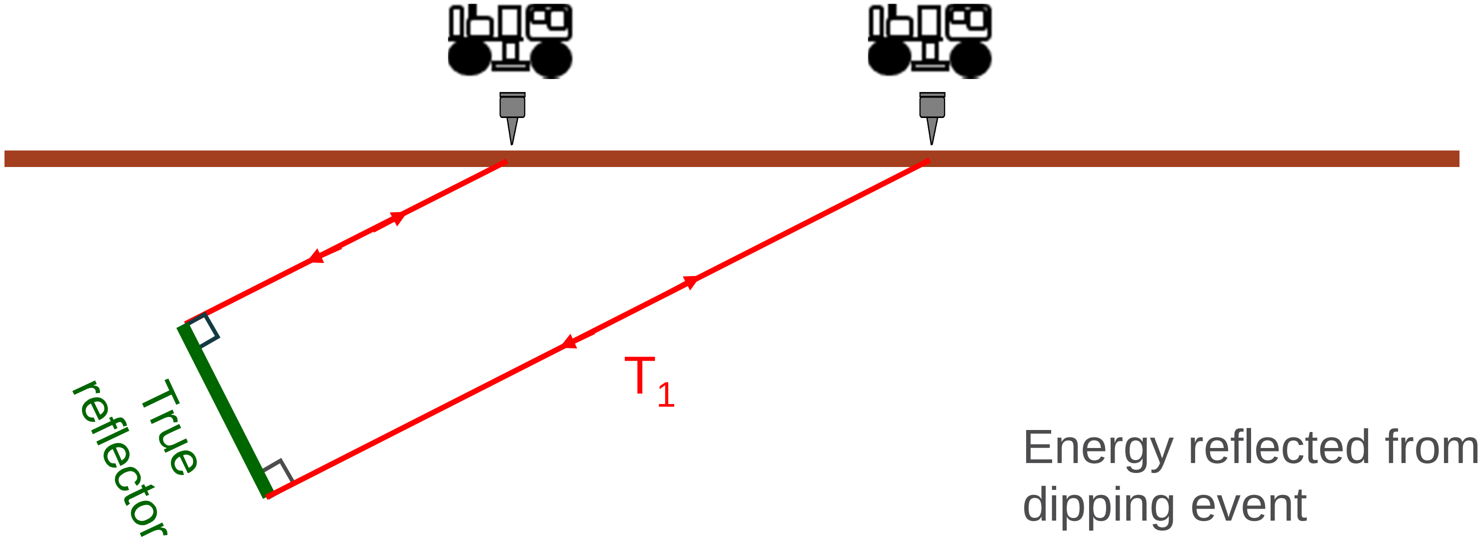
DMO correction

Common mid-point stack

Post Stack Migration

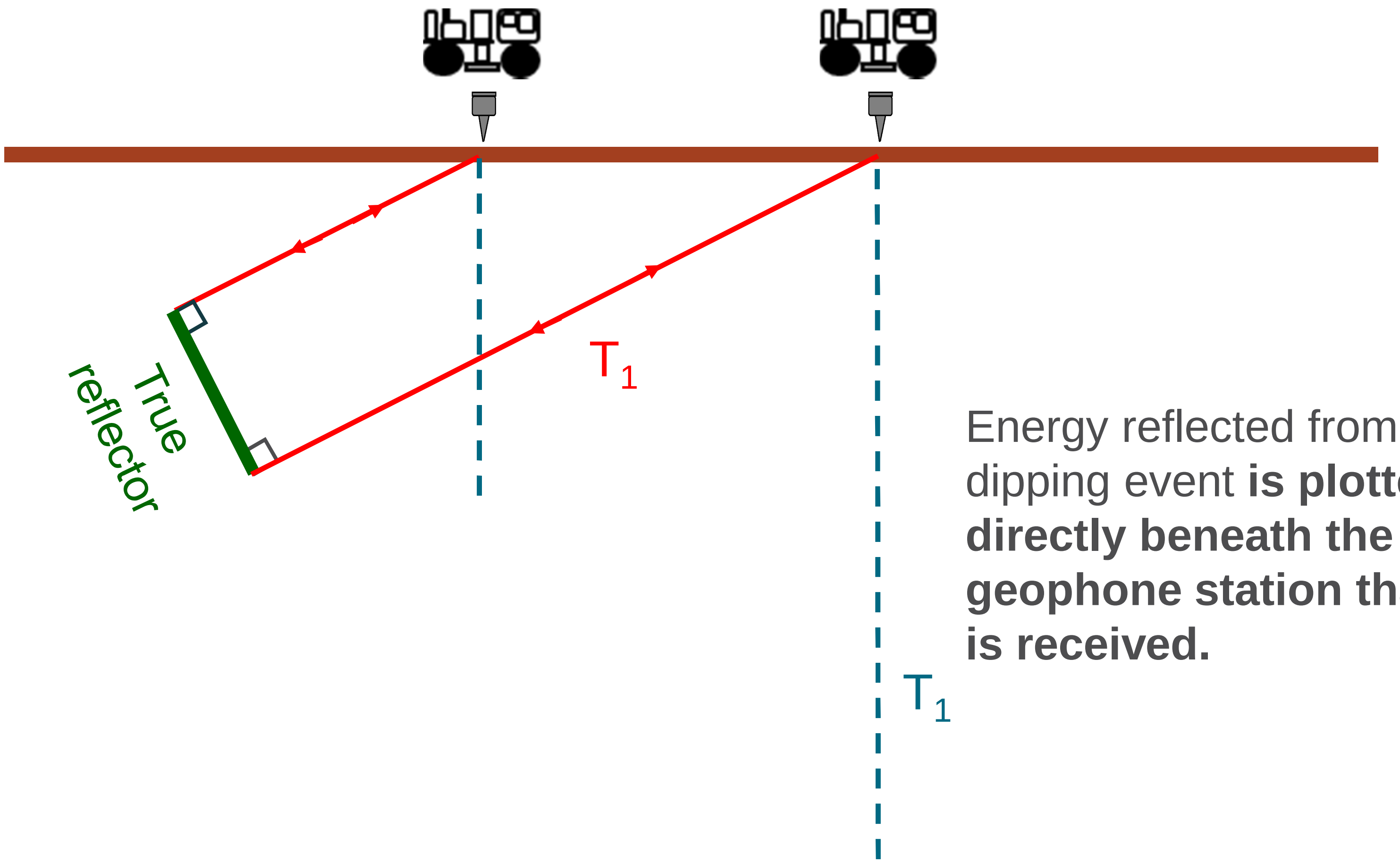
Coherency enhancement - amplifies coherent events

Migration of a dipping reflection



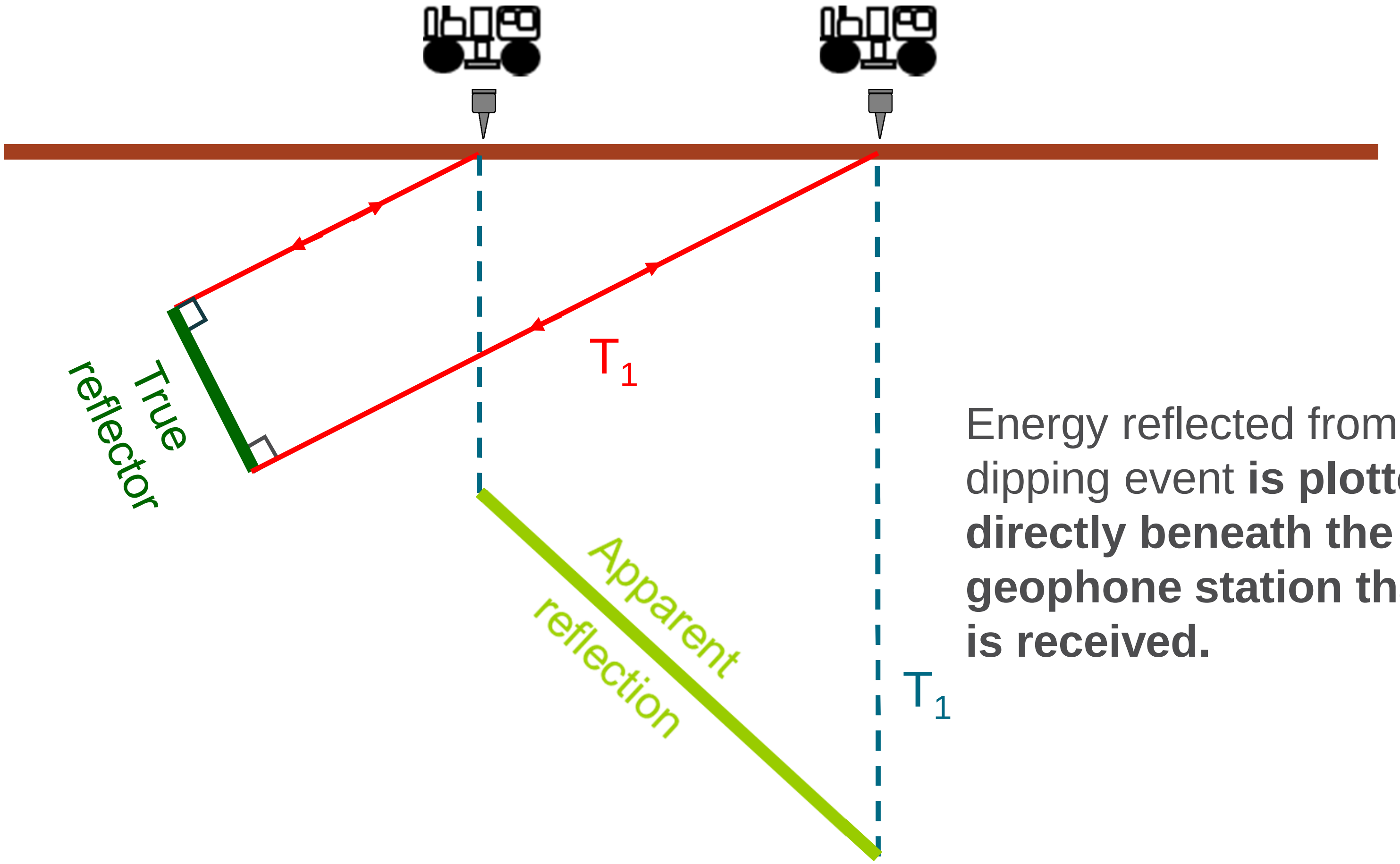
Energy reflected from a dipping event

Migration of a dipping reflection



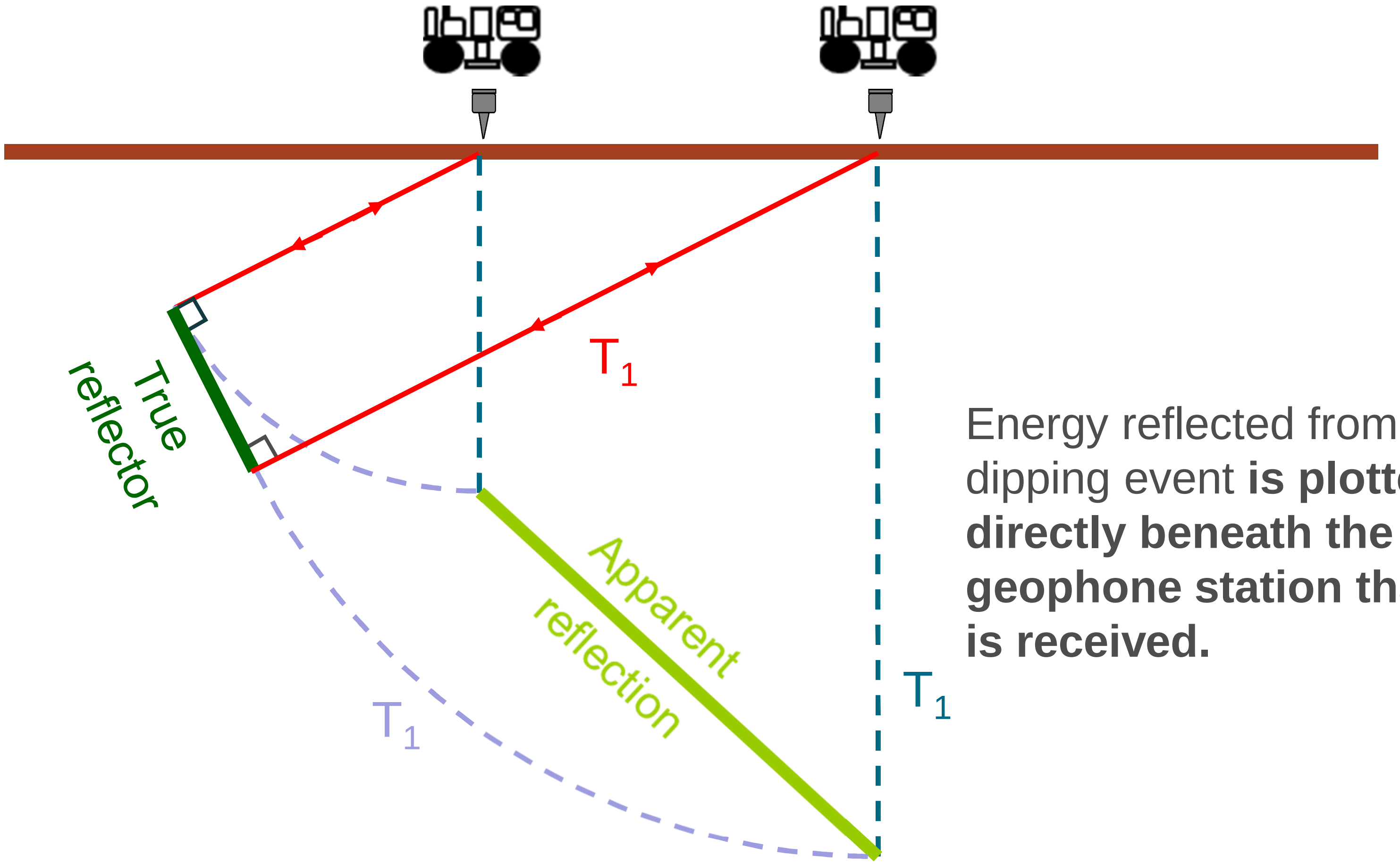
Energy reflected from a dipping event **is plotted directly beneath the geophone station that it is received.**

Migration of a dipping reflection



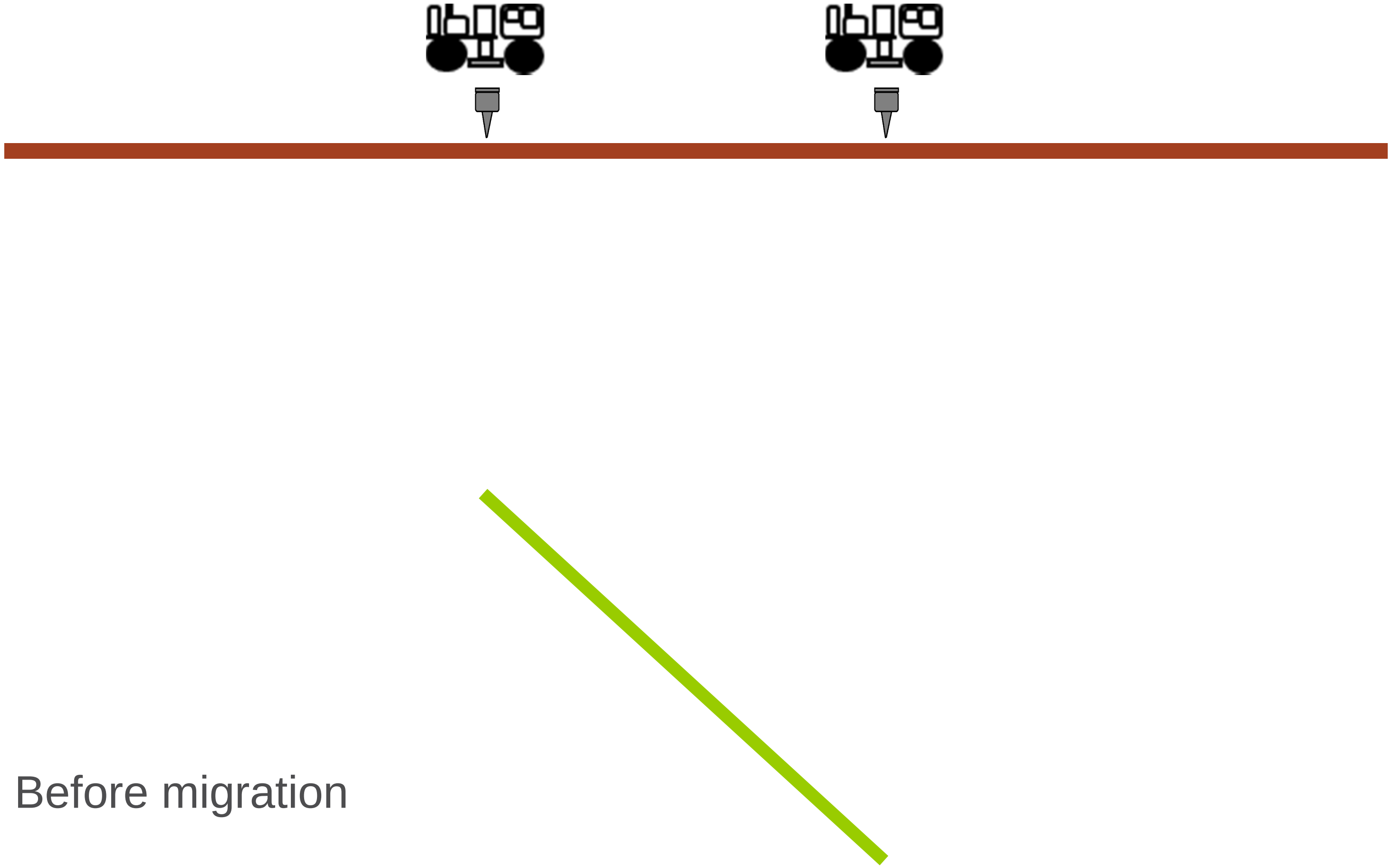
Energy reflected from a dipping event **is plotted directly beneath the geophone station that it is received.**

Migration of a dipping reflection



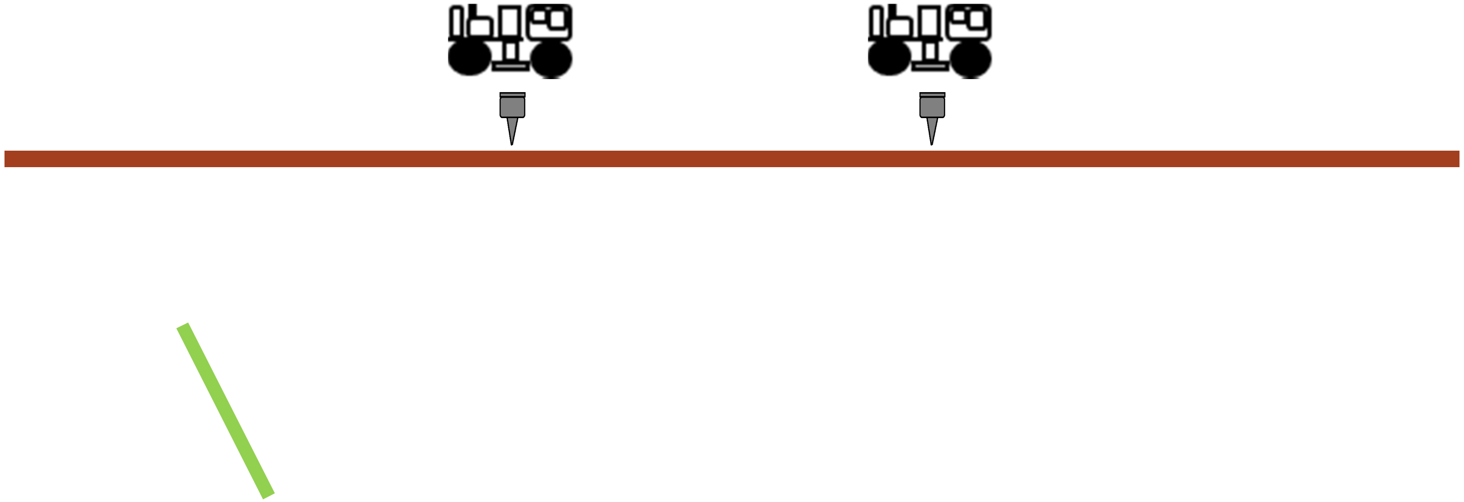
Energy reflected from a dipping event **is plotted directly beneath the geophone station that it is received.**

Migration of a dipping reflection



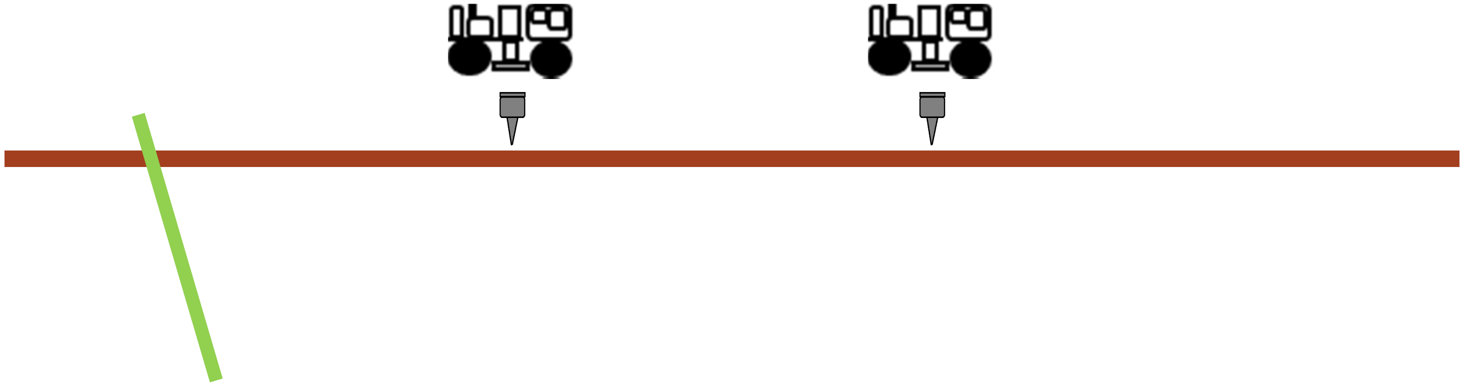
Before migration

Migration of a dipping reflection



Correct migration

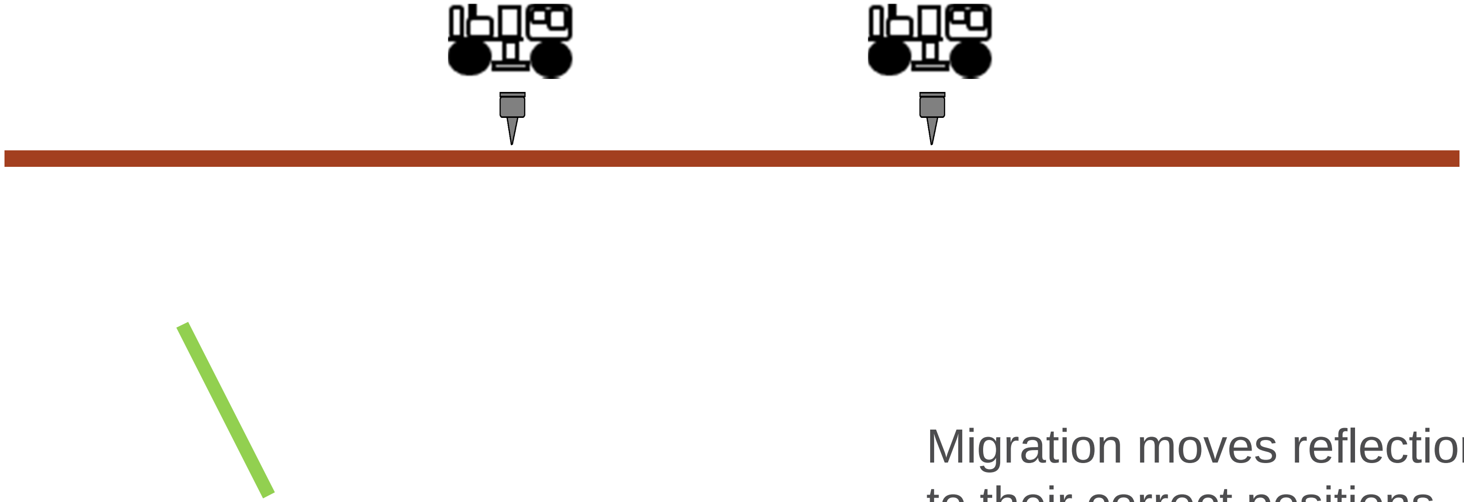
Migration of a dipping reflection



Over migration stretches
and smears reflections

Over migration

Migration of a dipping reflection

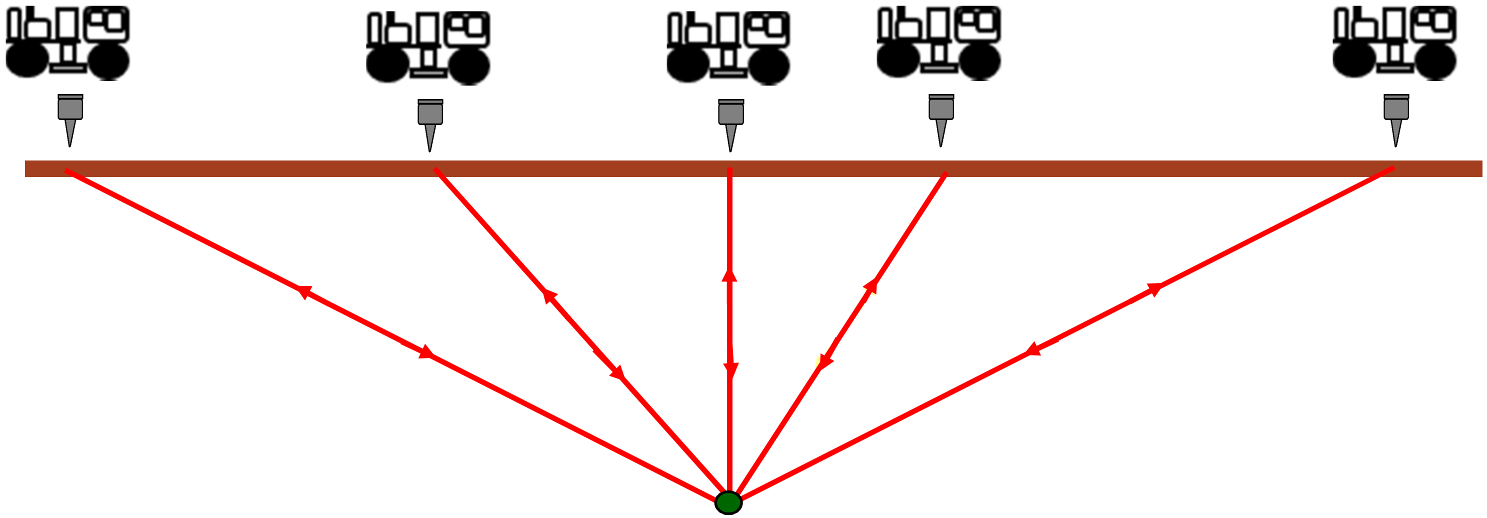


Migration moves reflections to their correct positions

- up dip
- more dip (steeper)
- shorter length

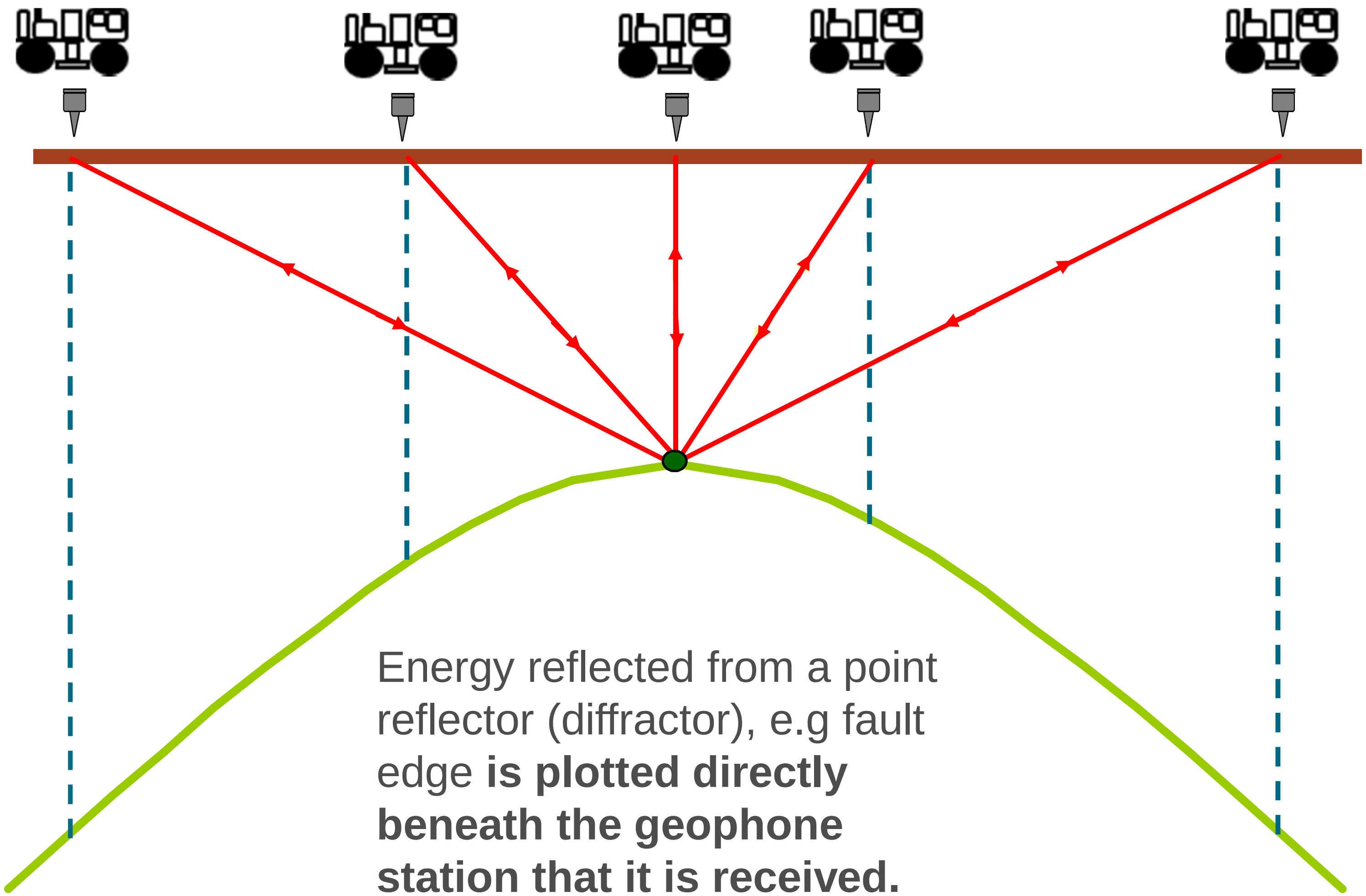
Correct migration

Migration – collapse diffractions



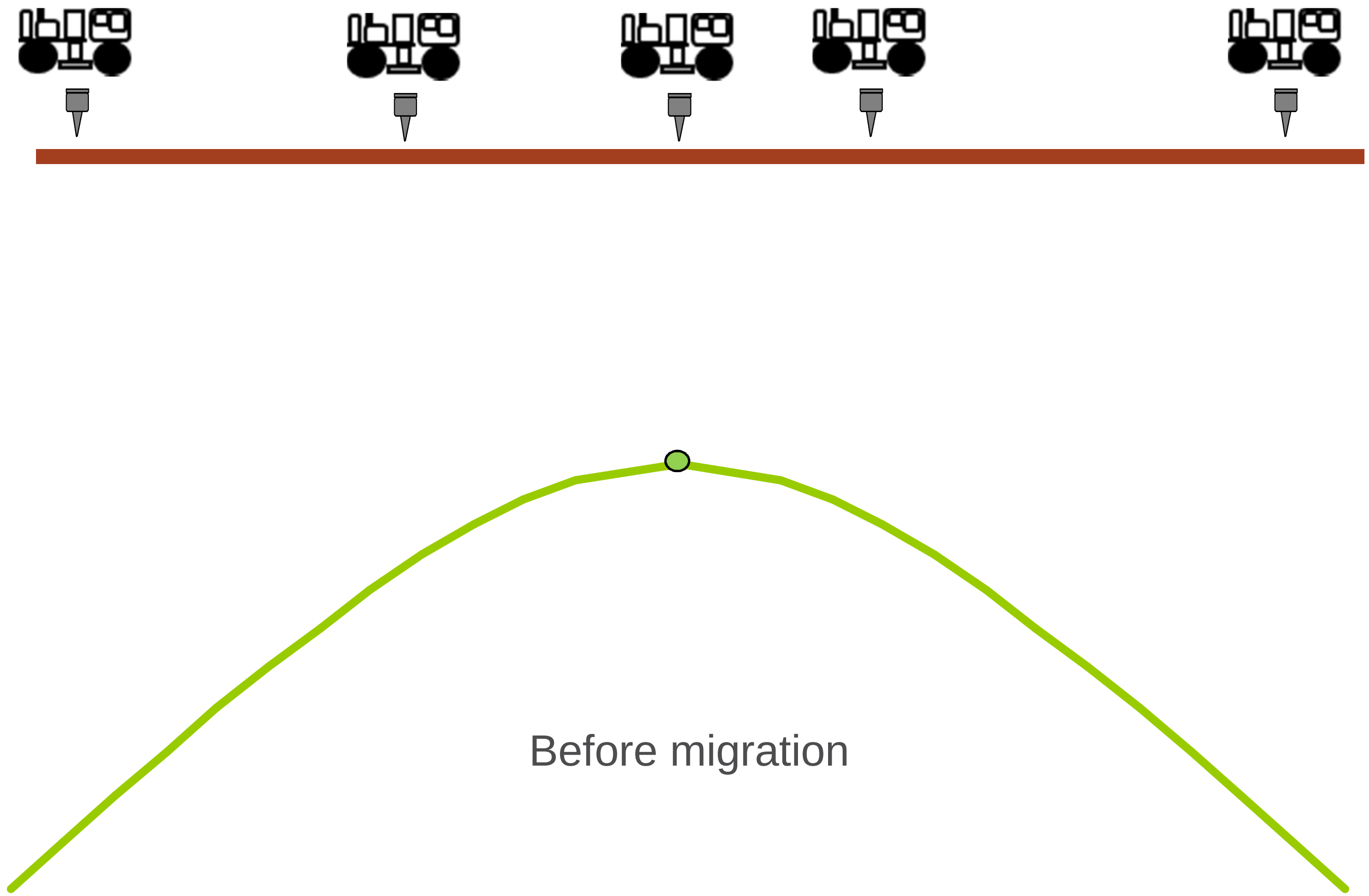
Energy reflected from a point reflector (diffractor), e.g fault edge

Migration – collapse diffractions

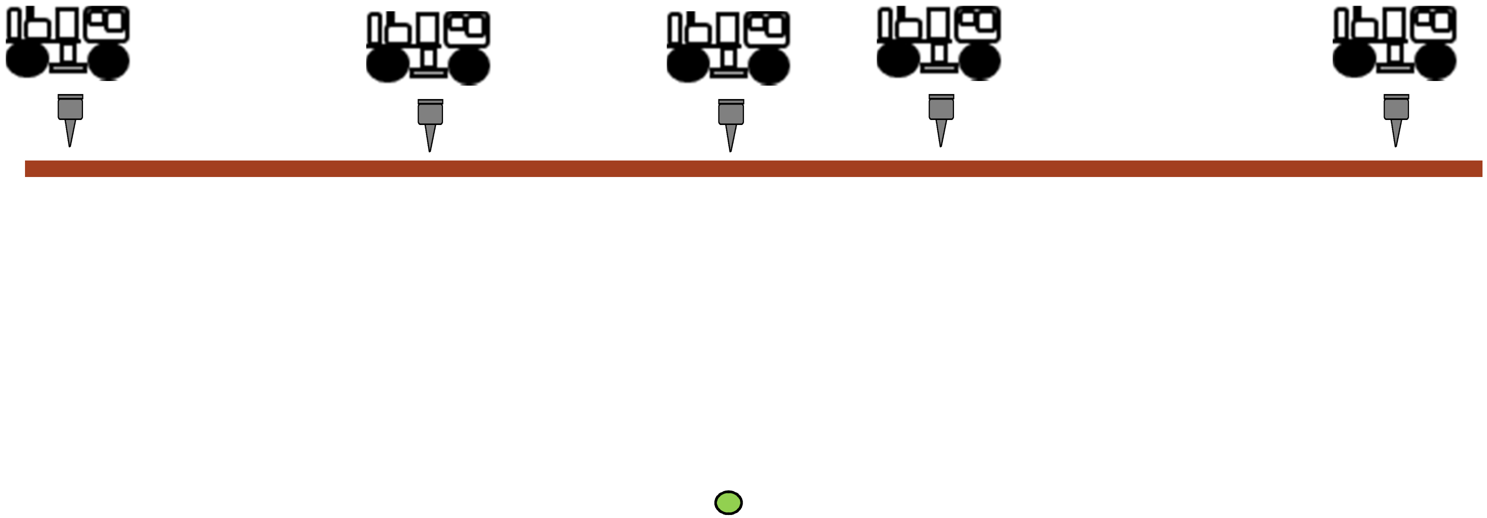


Energy reflected from a point reflector (diffractor), e.g fault edge **is plotted directly beneath the geophone station that it is received.**

Migration – collapse diffractions

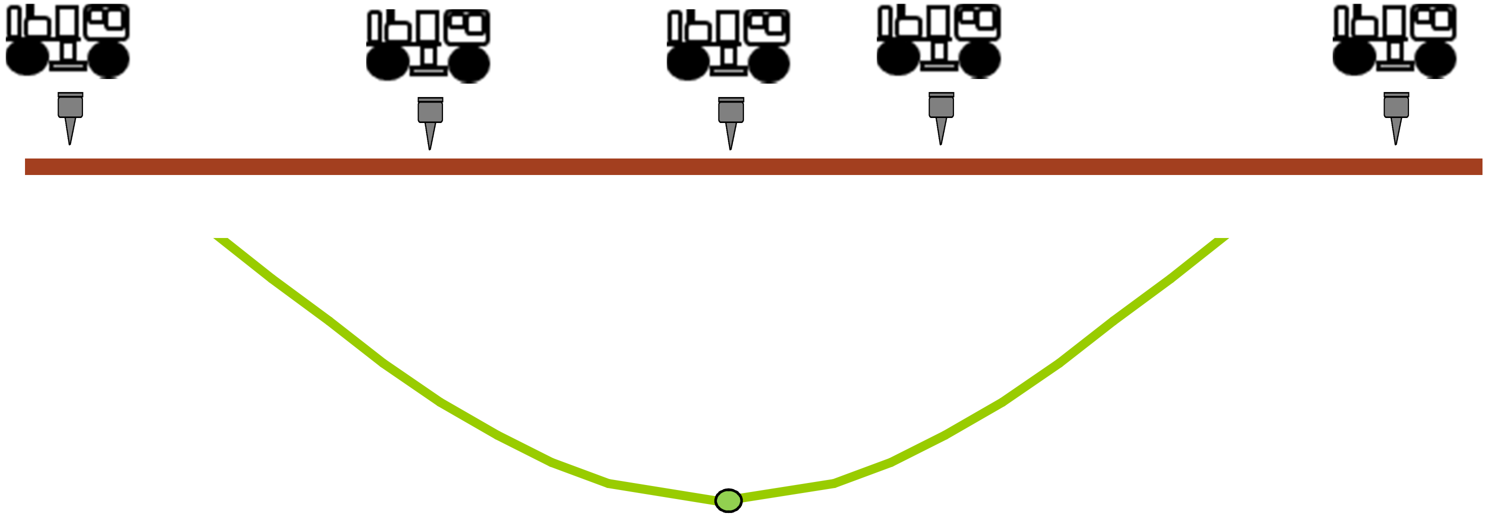


Migration – collapse diffractions



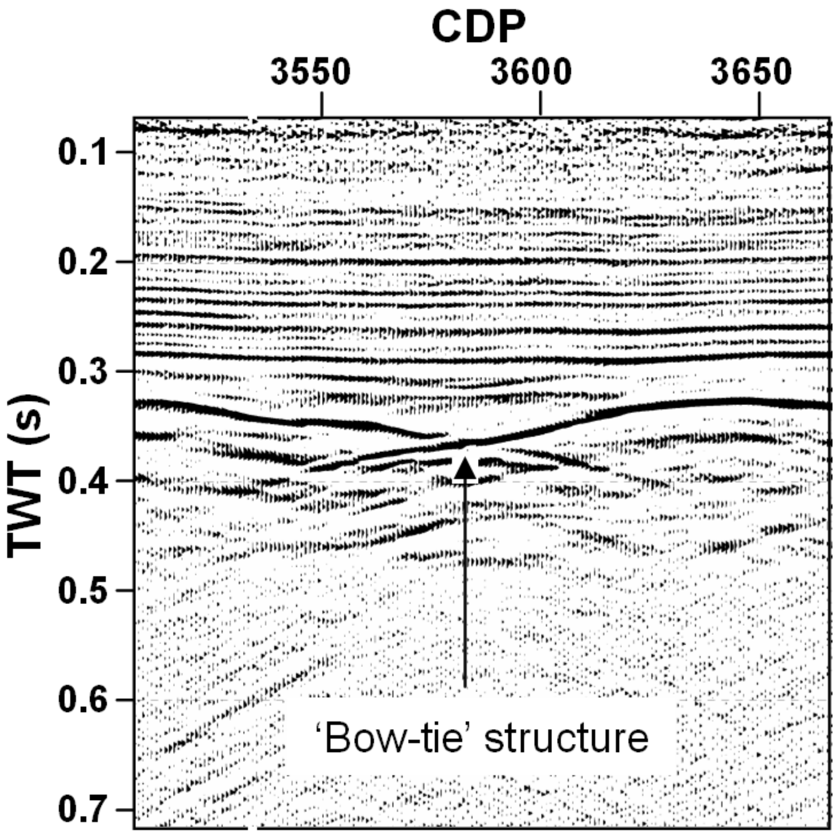
Correct migration

Migration – over migration



Over migration

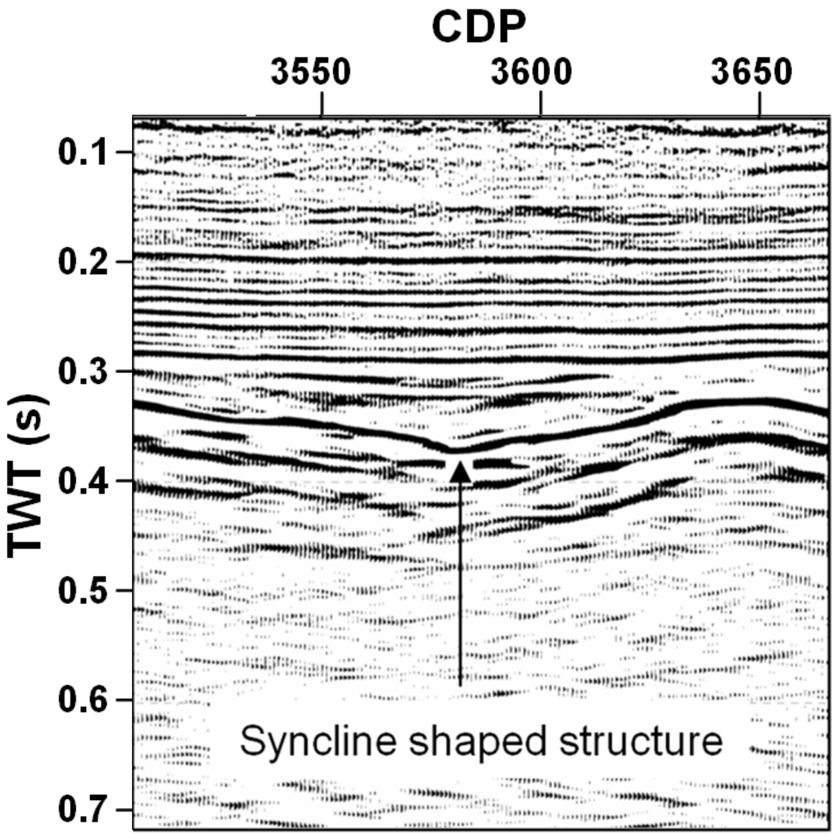
Migration – improve lateral resolution



10GA-PA1 NT, 2010, groundwater survey

DMO stack shows a 'bow-tie' structure.

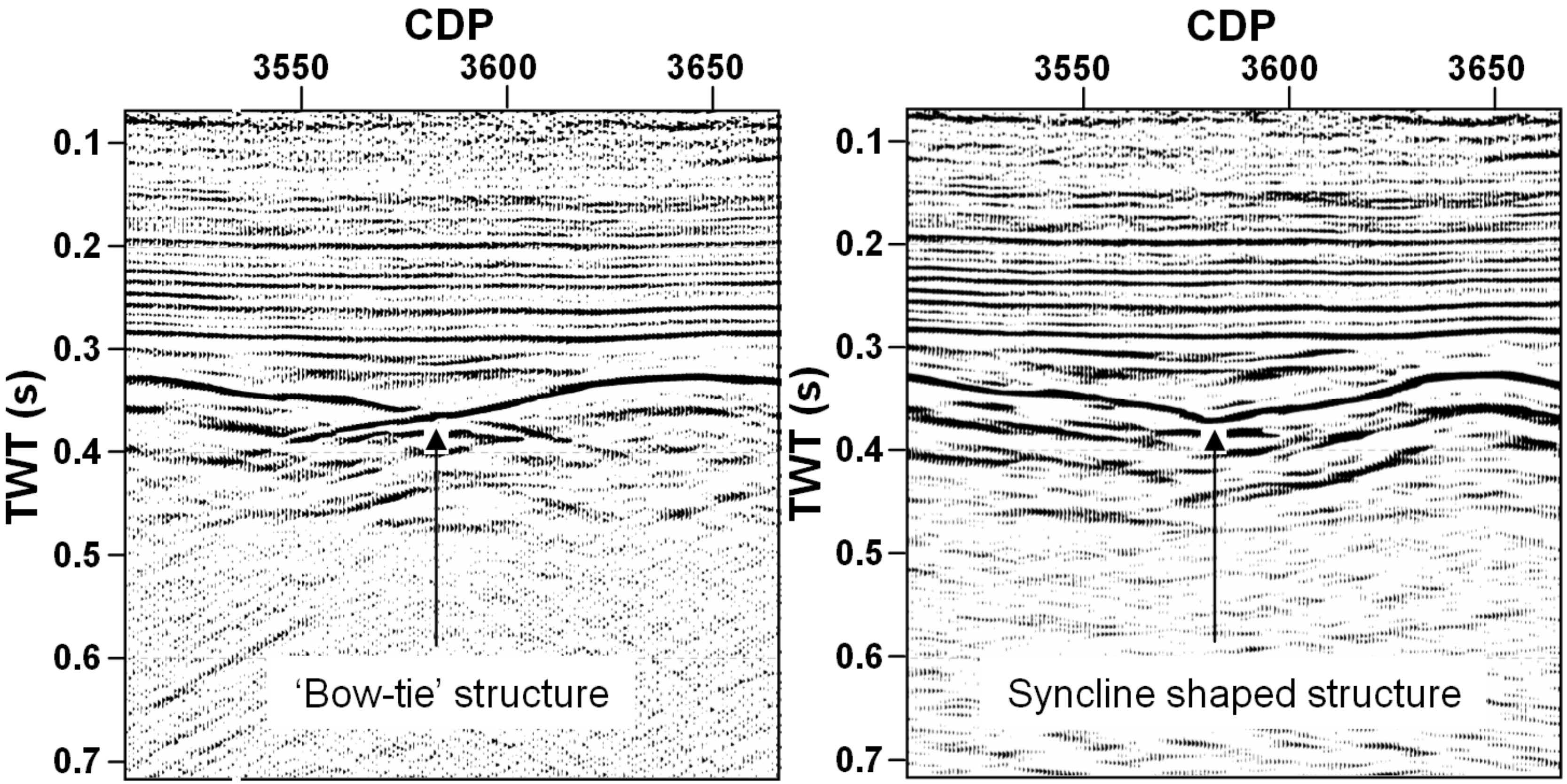
Migration – improve lateral resolution



10GA-PA1 NT, 2010, groundwater survey

Migration has improved lateral resolution reconstructing a syncline shaped structure

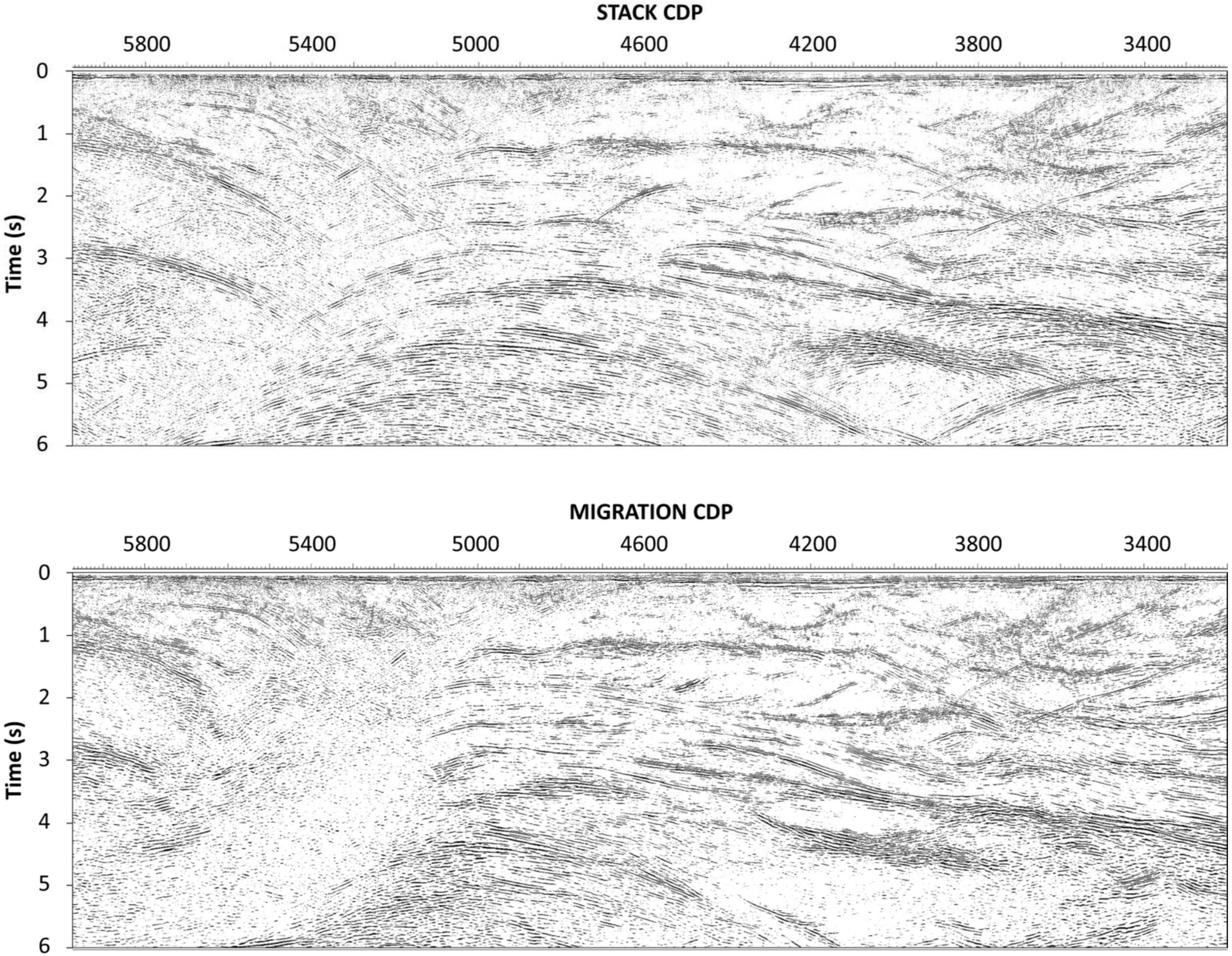
Migration – improve lateral resolution



10GA-PA1 NT, 2010, groundwater survey

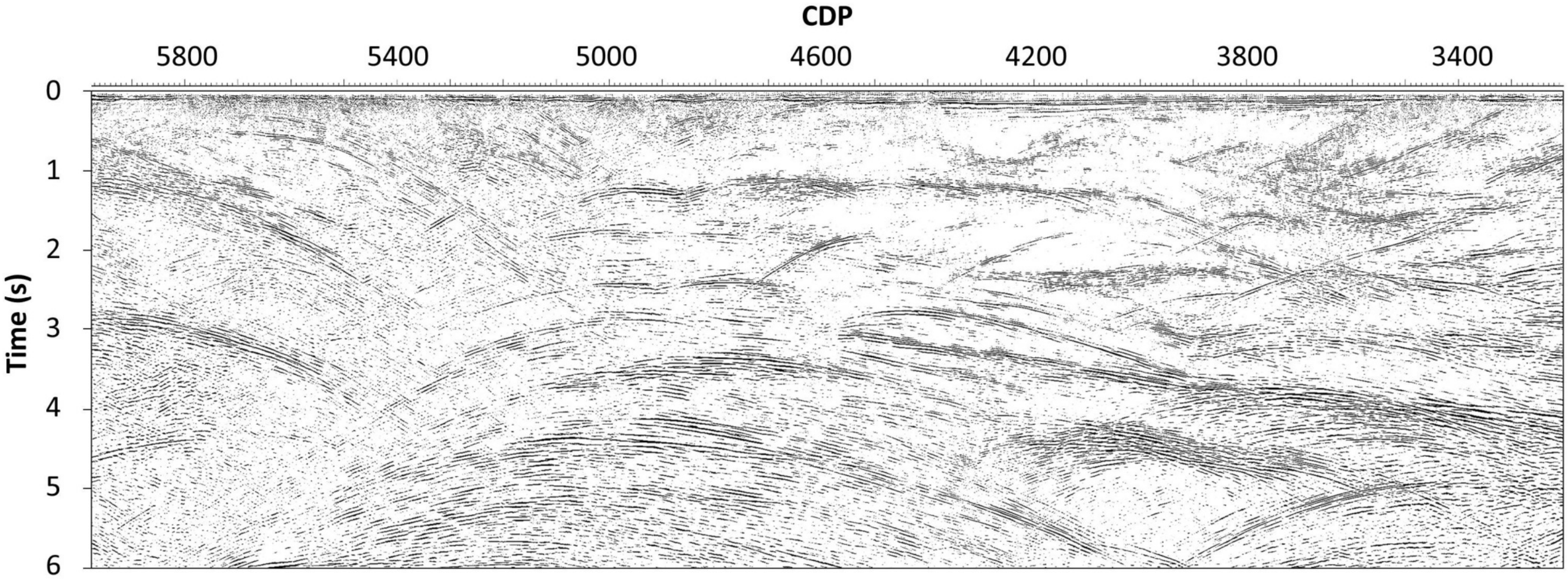
DMO stack on the left shows a 'bow-tie' structure. On the right migration has improved lateral resolution reconstructing a syncline shaped structure.

Migration – 11GA-YO1



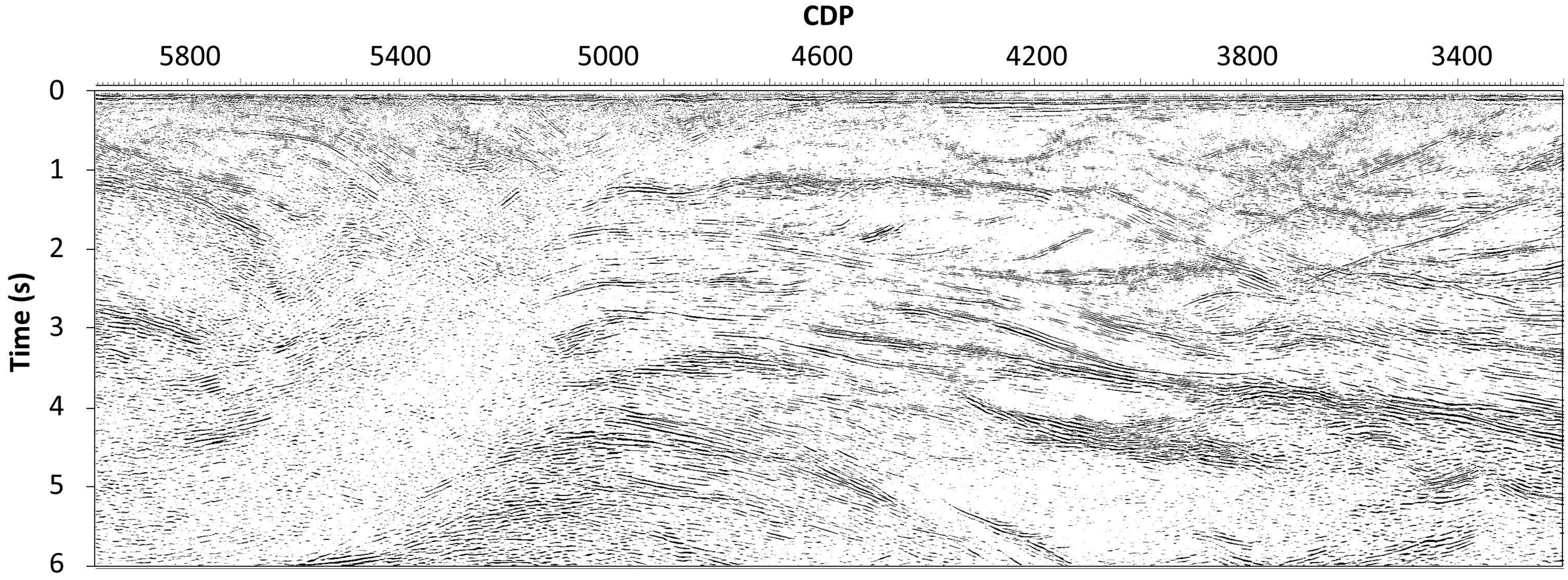
Migration

Stack



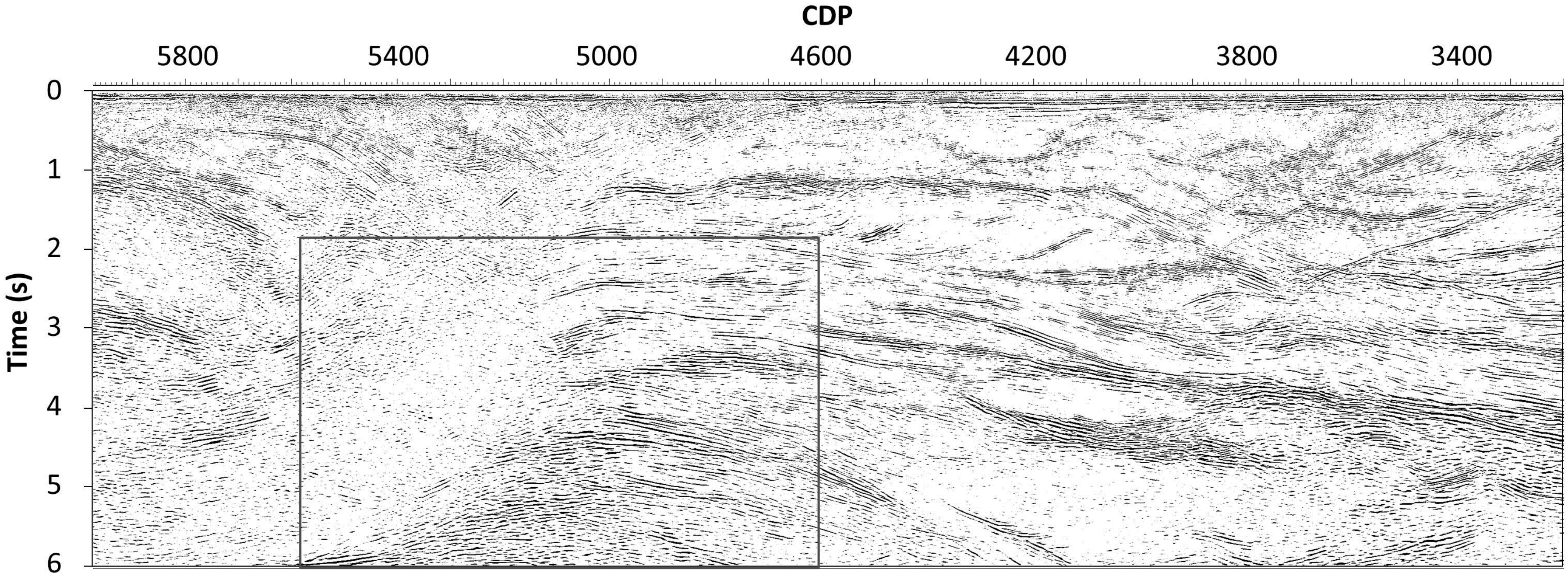
Migration

Migration



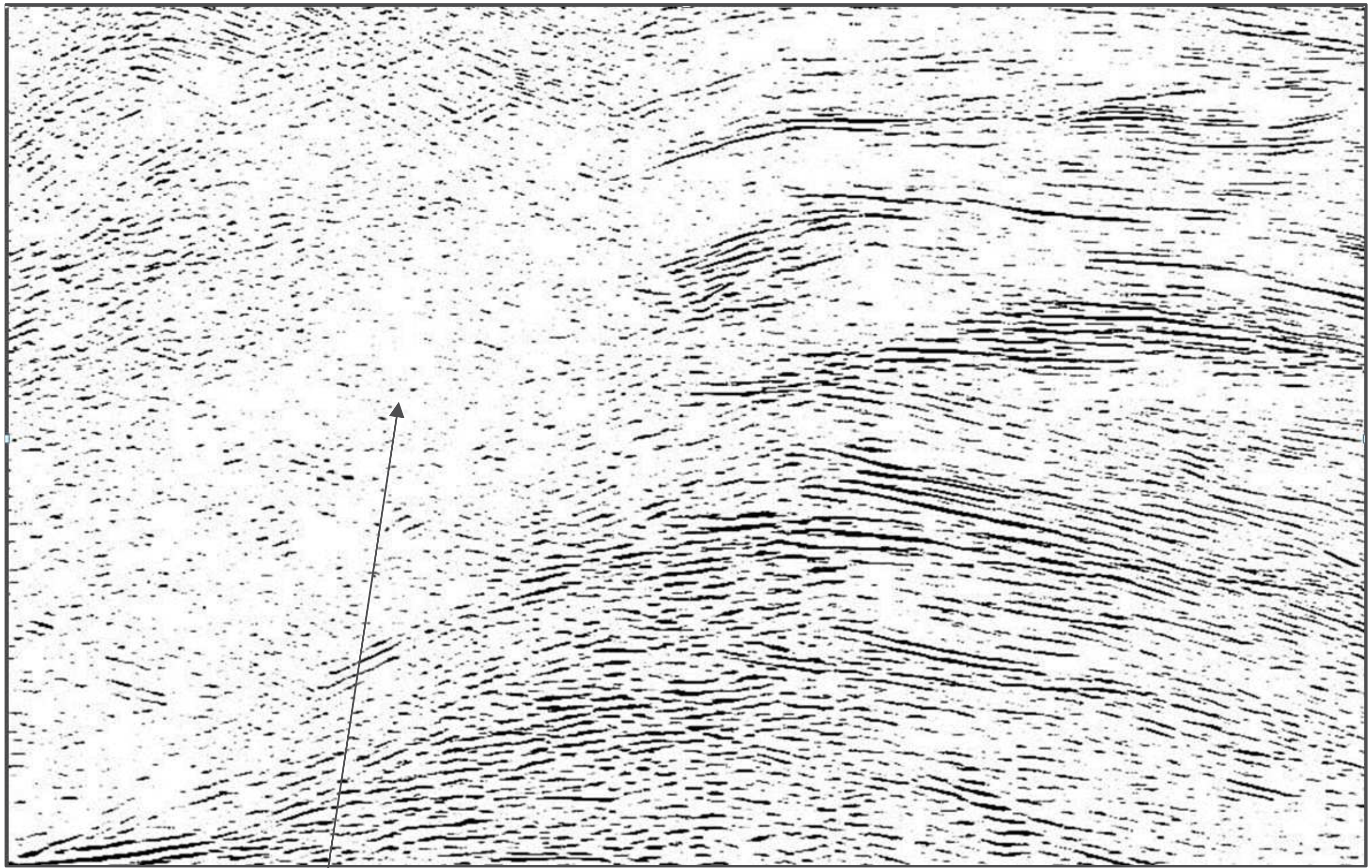
Migration

Migration



DMO Stack

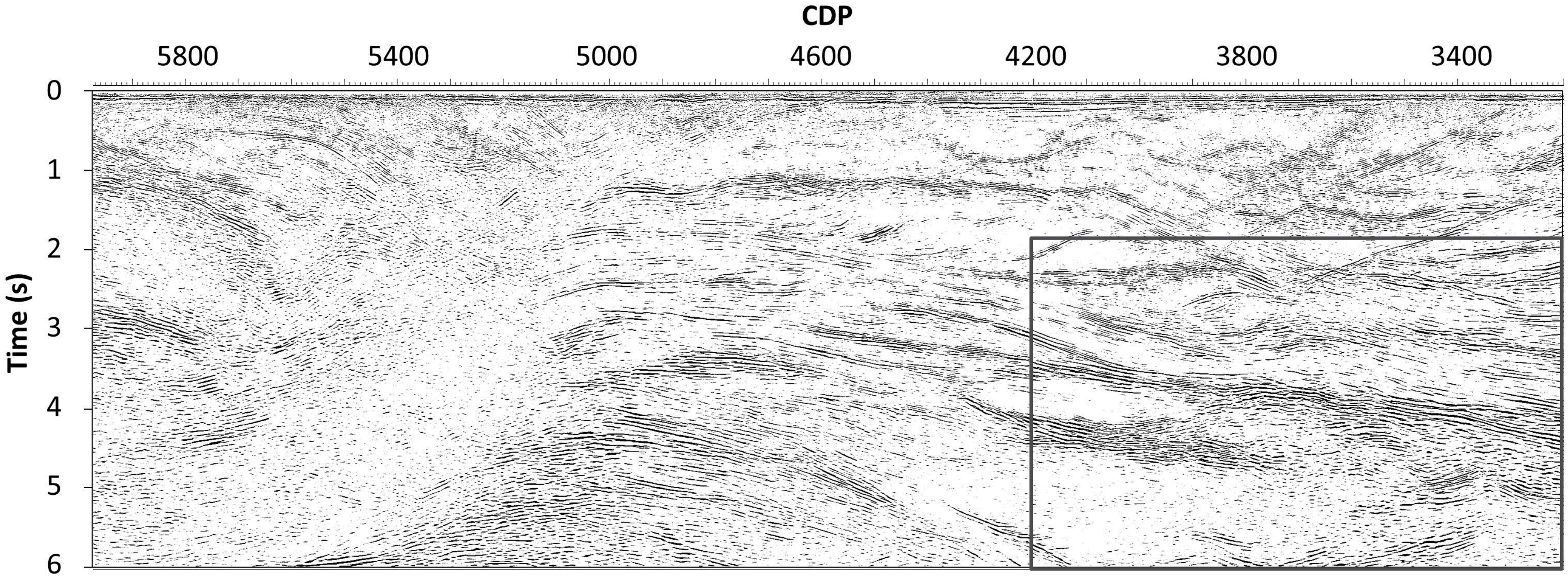
Migration



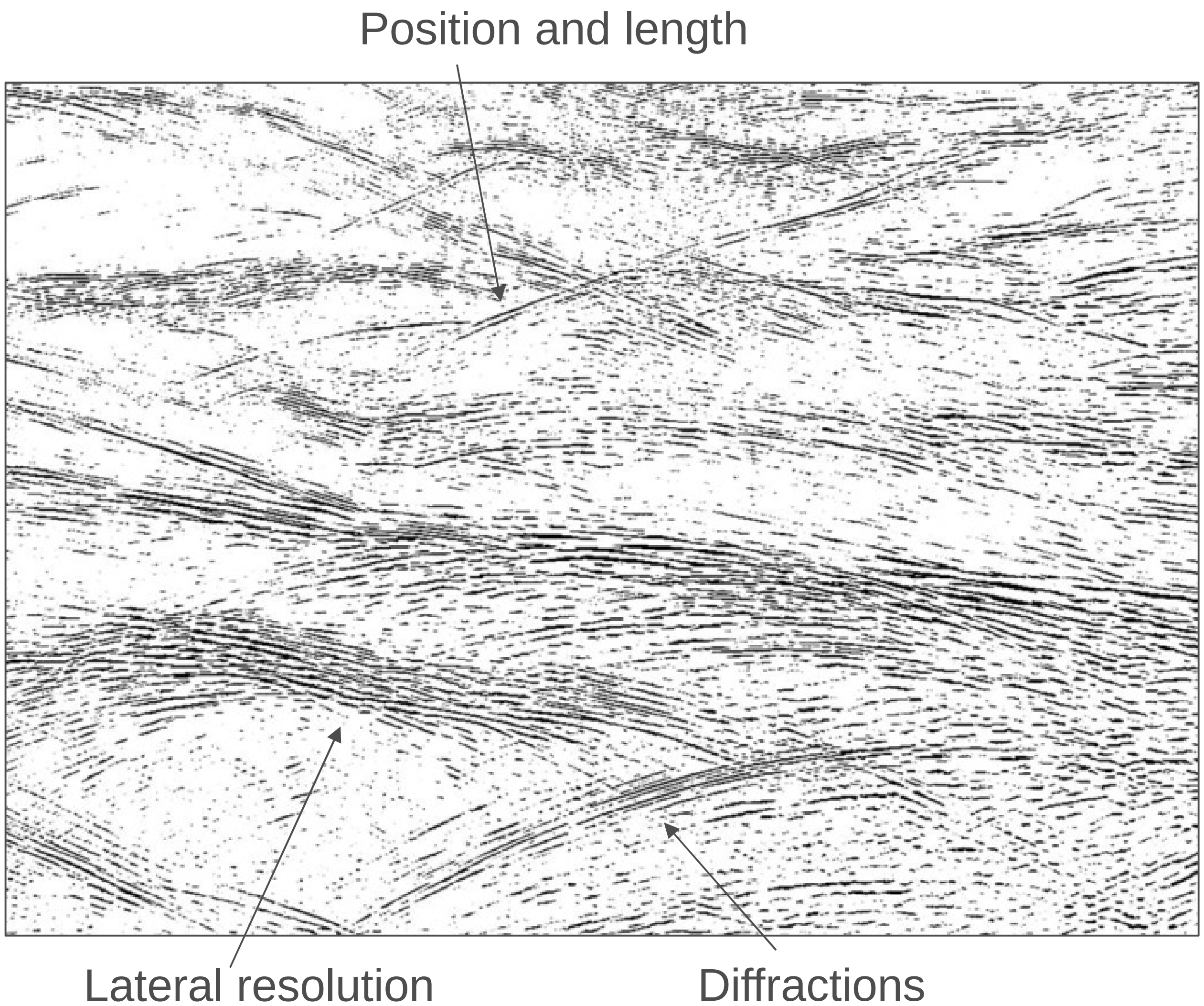
Diffractions

Migration

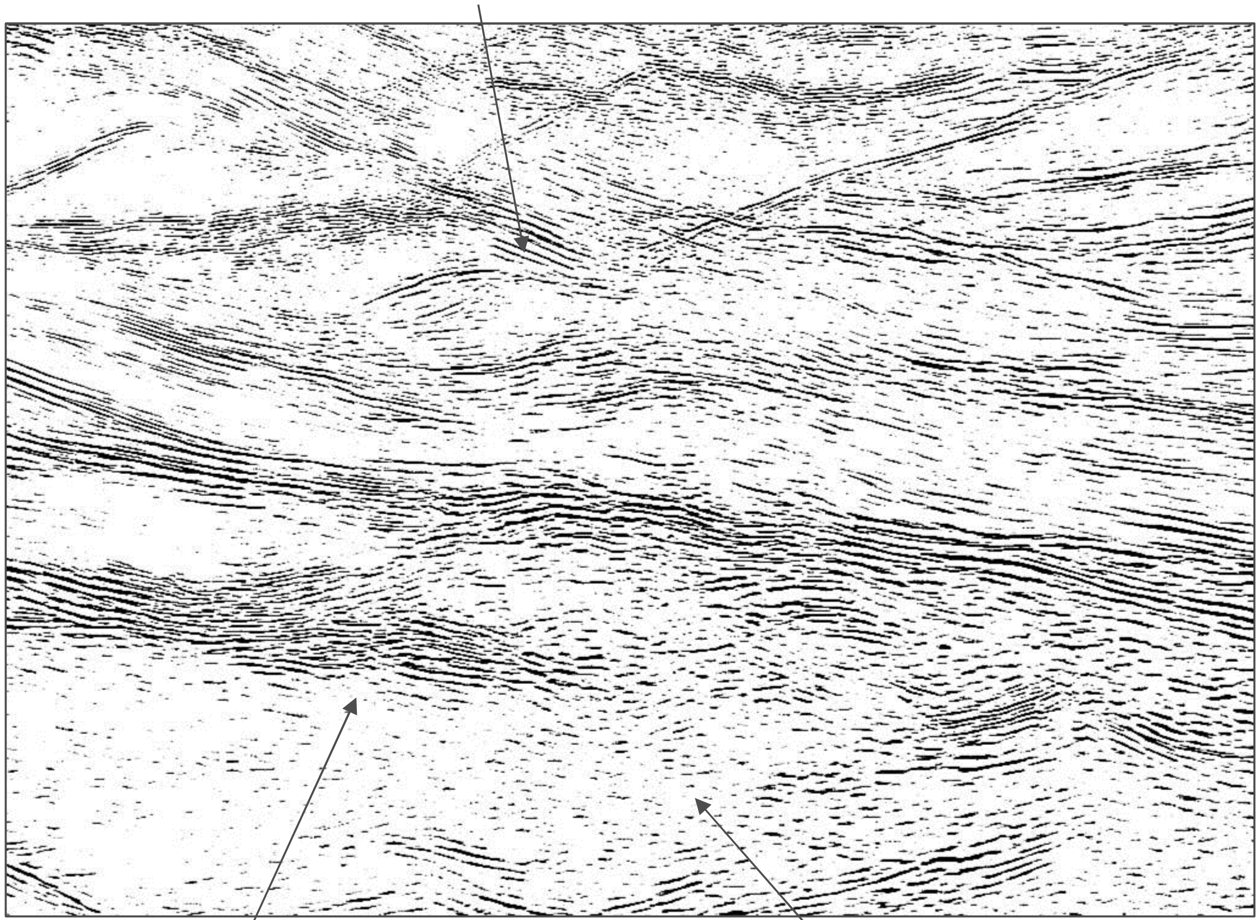
Migration



DMO Stack

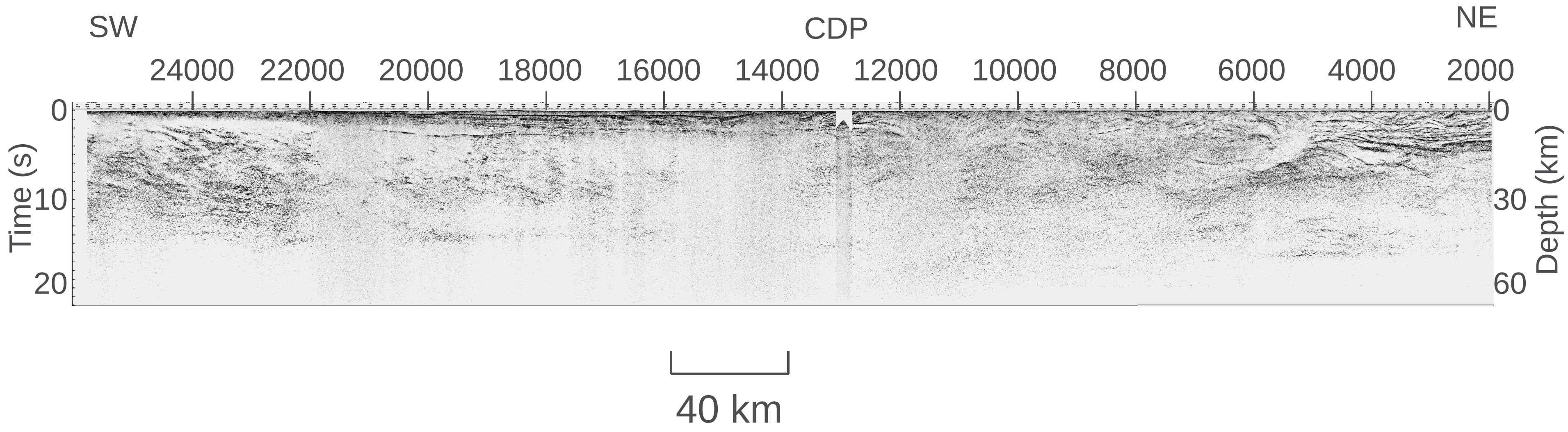


Migration



Migrated line - 11GA-YO1

Seismic line V/H = 1

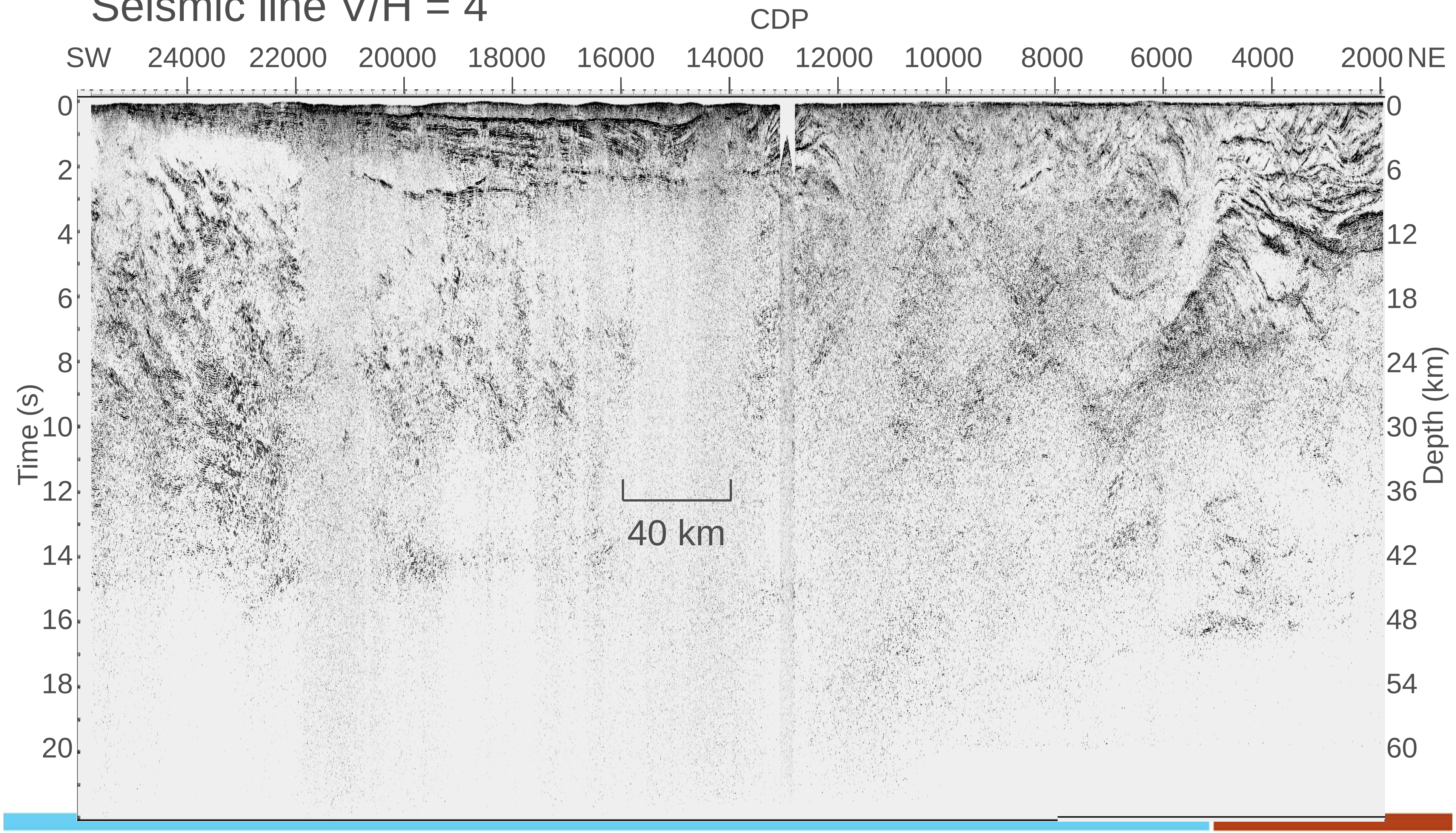


Display shows vertical scale equal to the horizontal scale, assuming an average crustal velocity of 6000 m/s.

Officer Basin sediments will be shallower than shown (lower stacking velocities).

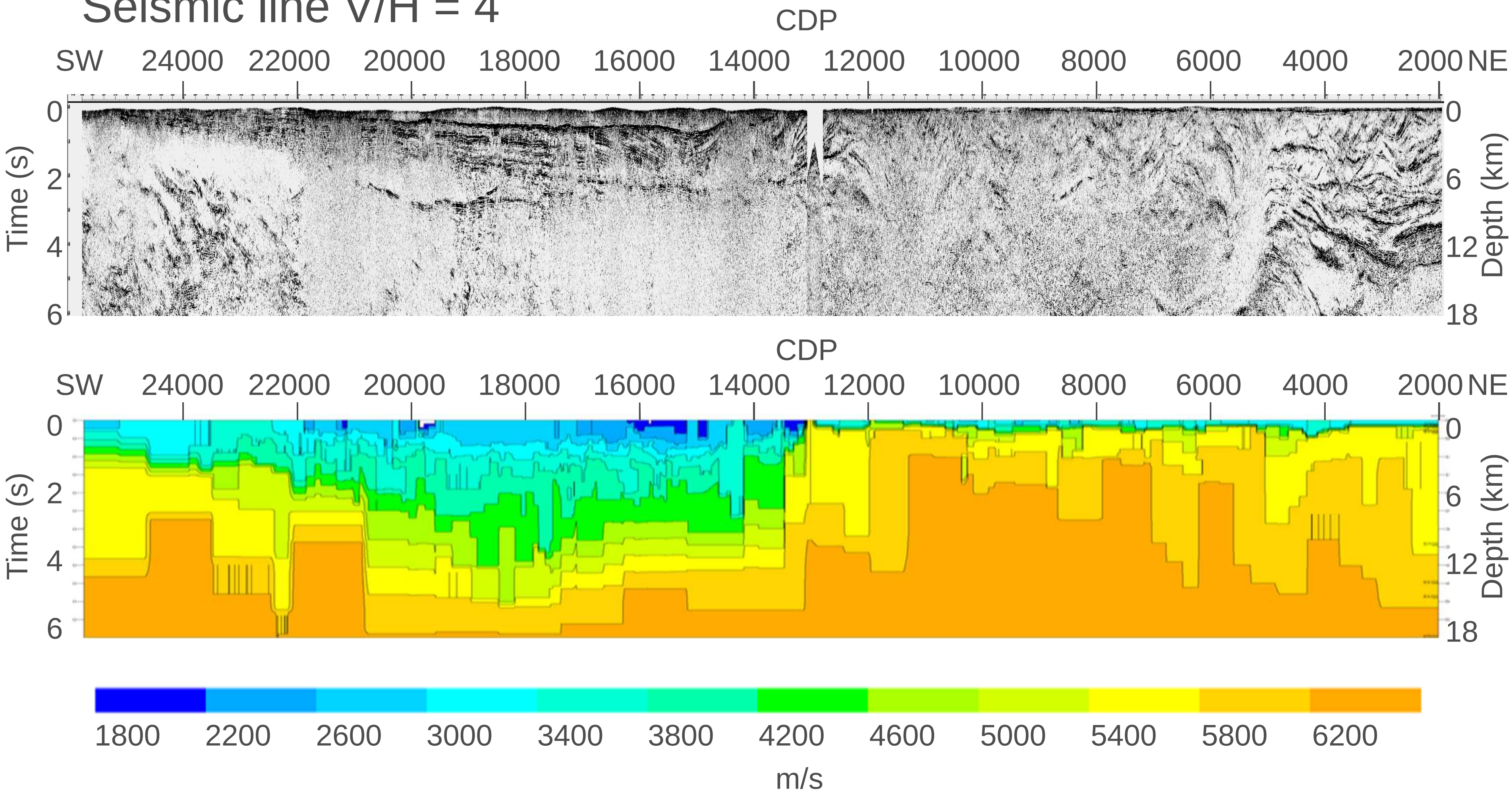
Migrated line - 11GA-YO1

Seismic line V/H = 4



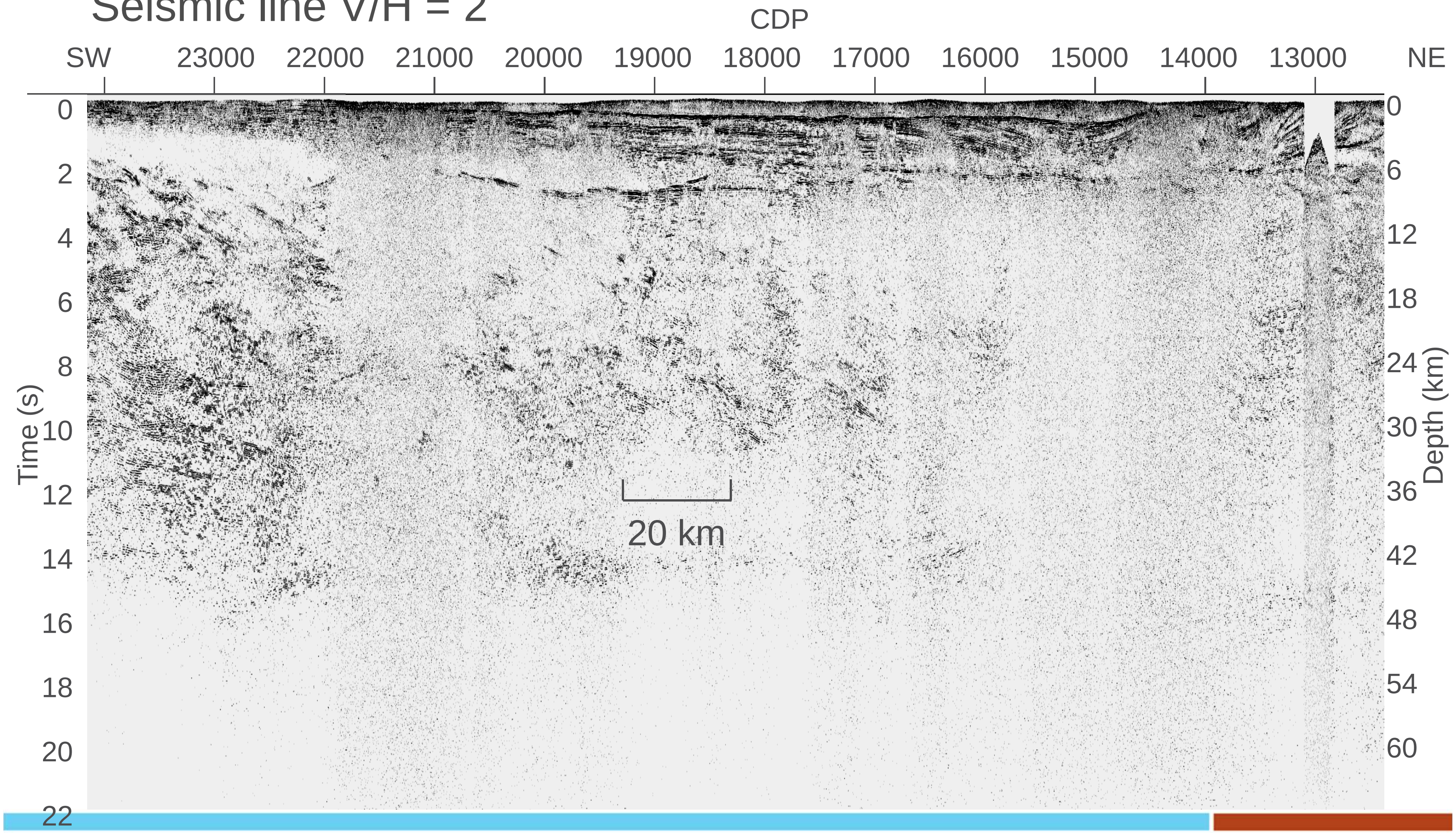
Migrated line - 11GA-YO1 Stacking Velocities

Seismic line V/H = 4



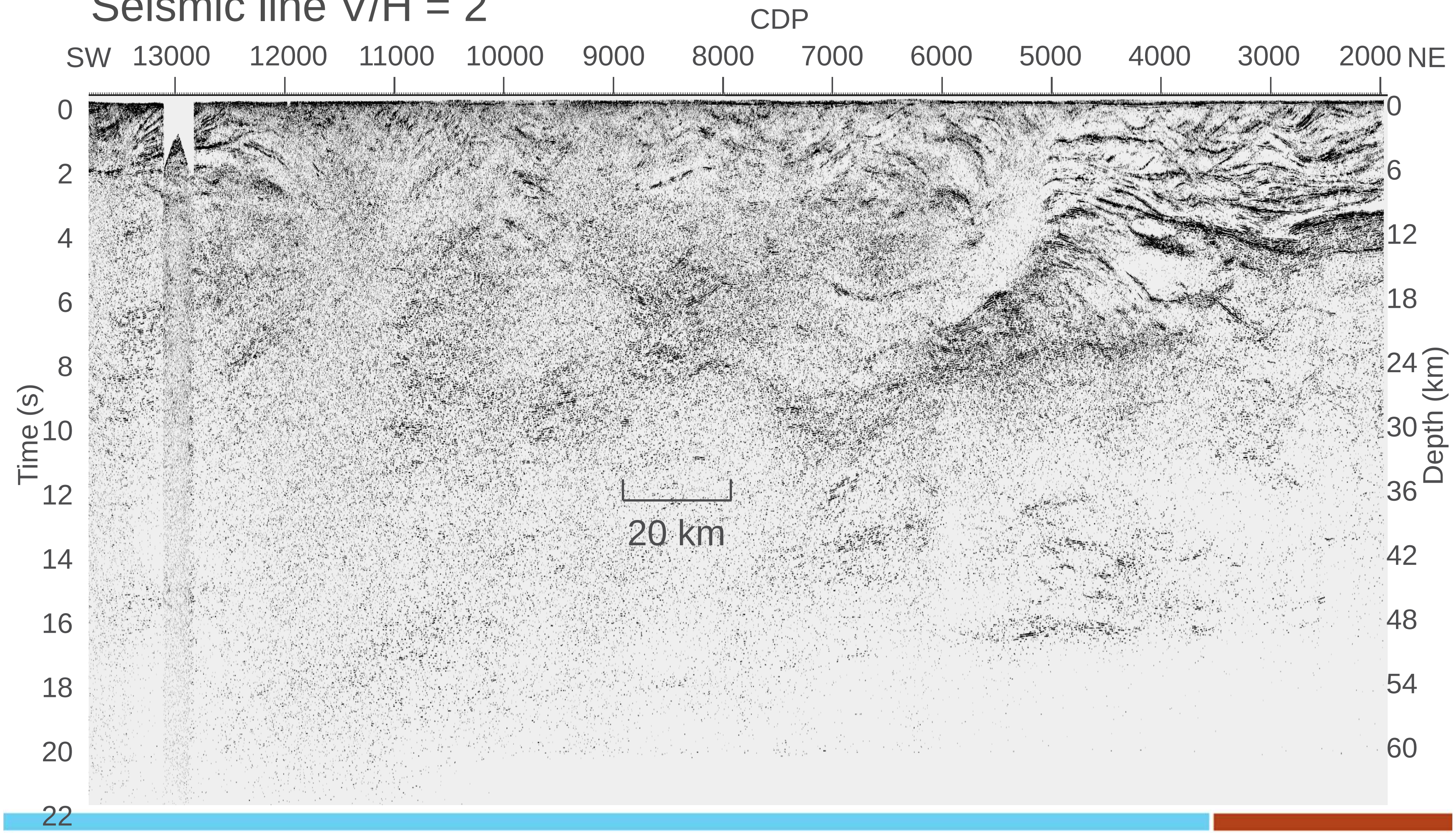
Migrated line – Officer Basin

Seismic line V/H = 2



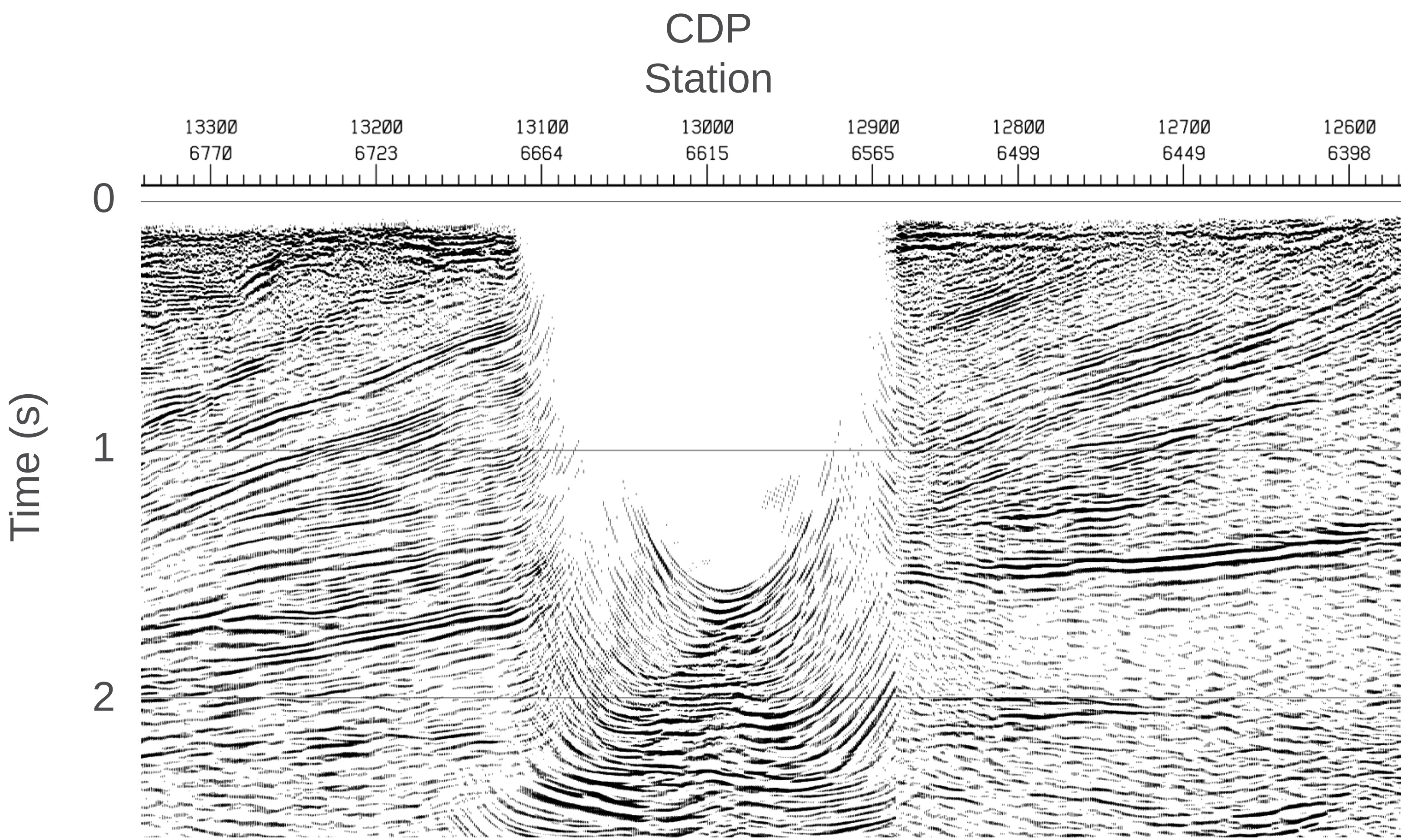
Migrated line – Musgrave

Seismic line V/H = 2



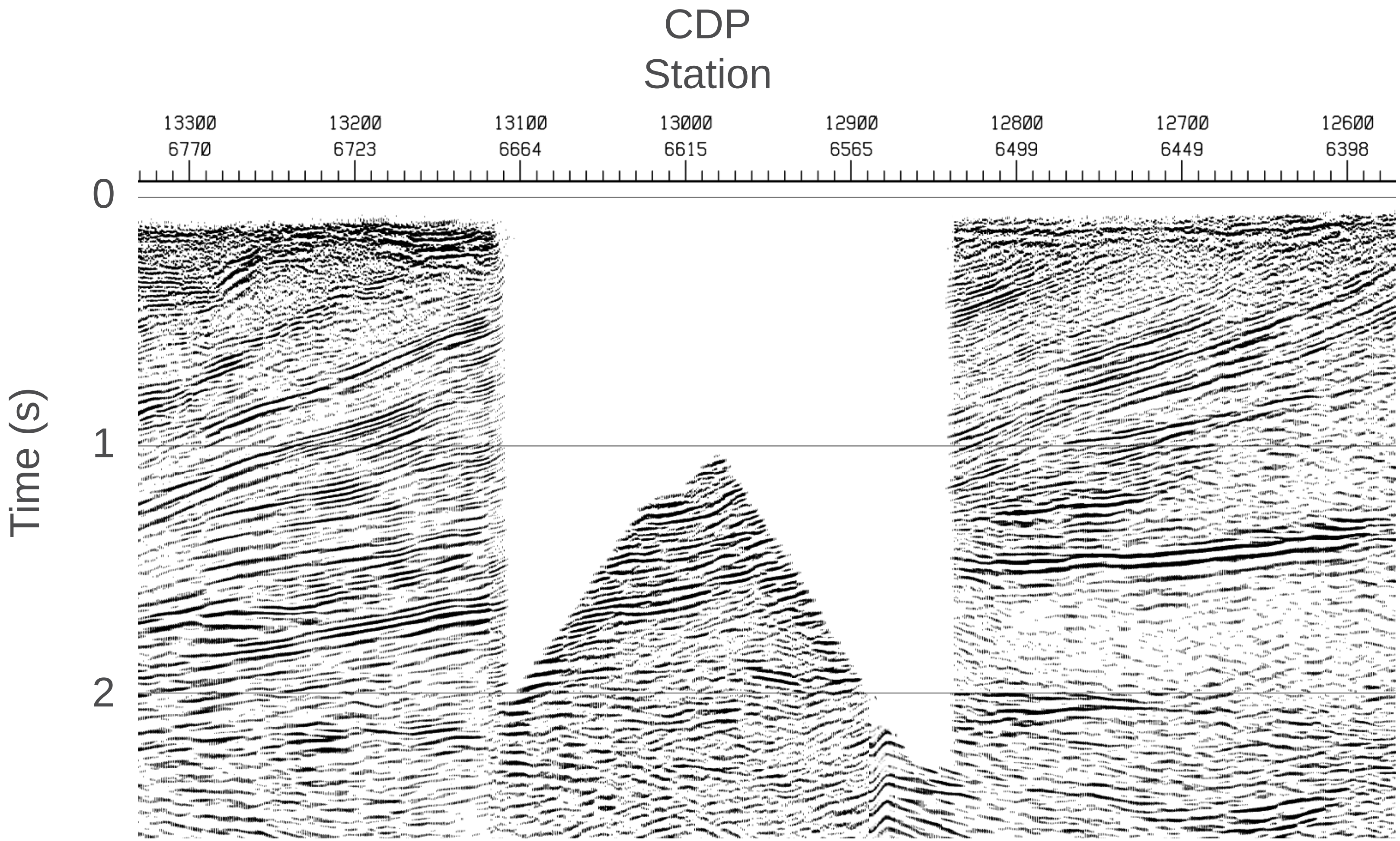
Gap edge effects

Migration smearing, far offsets lost

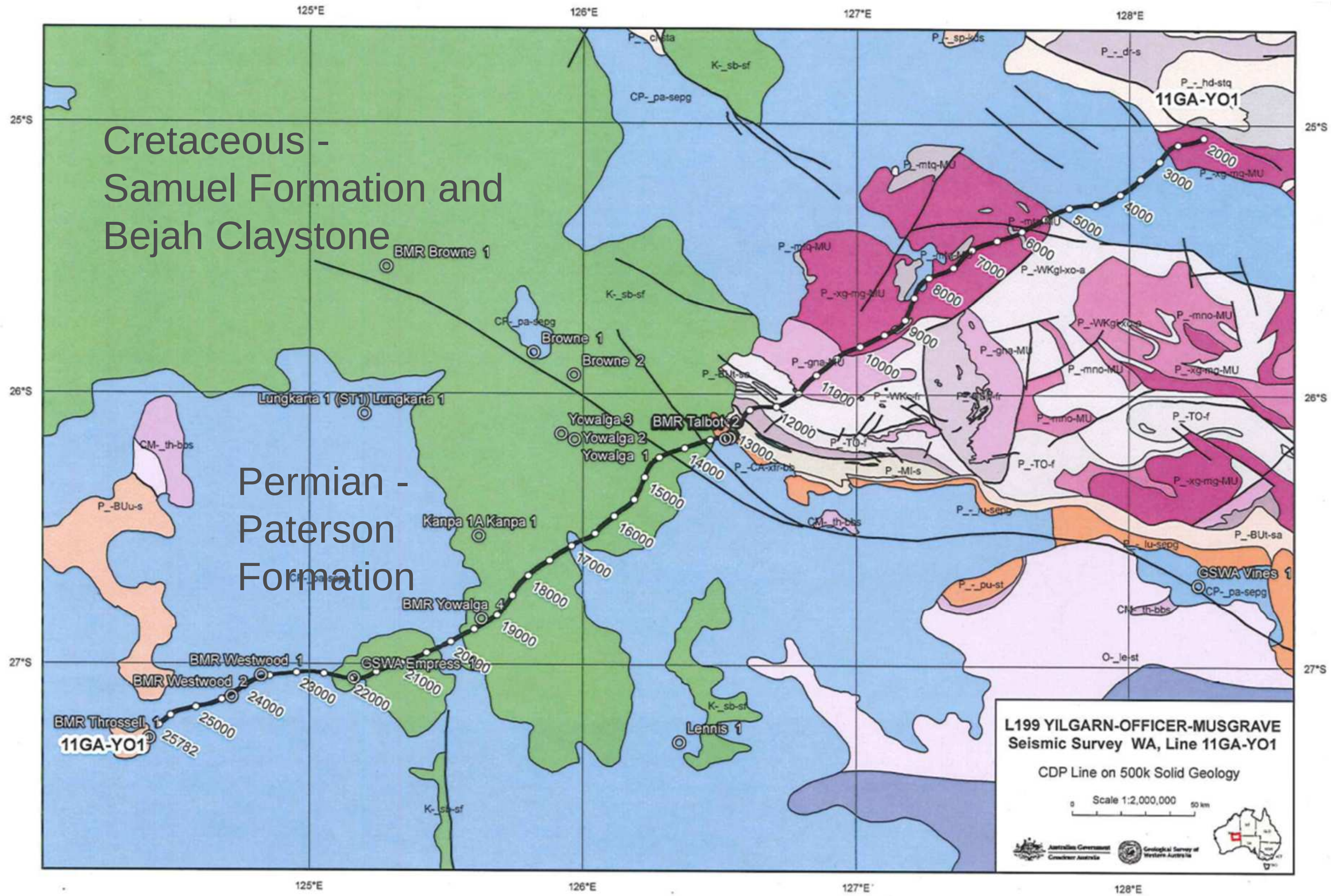


Warburton Data Gap

Migration

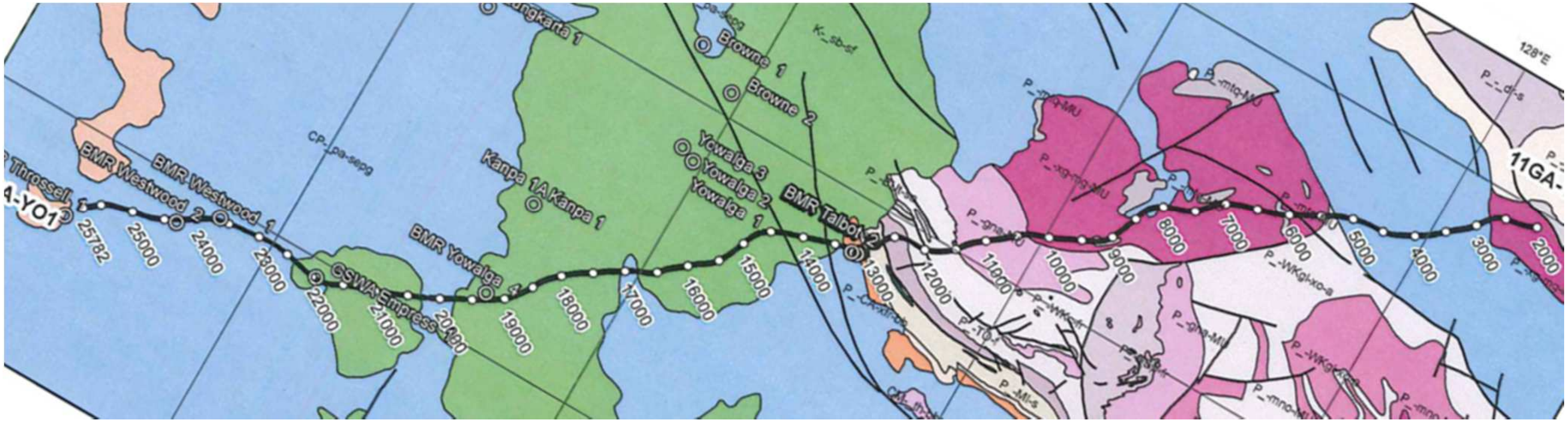


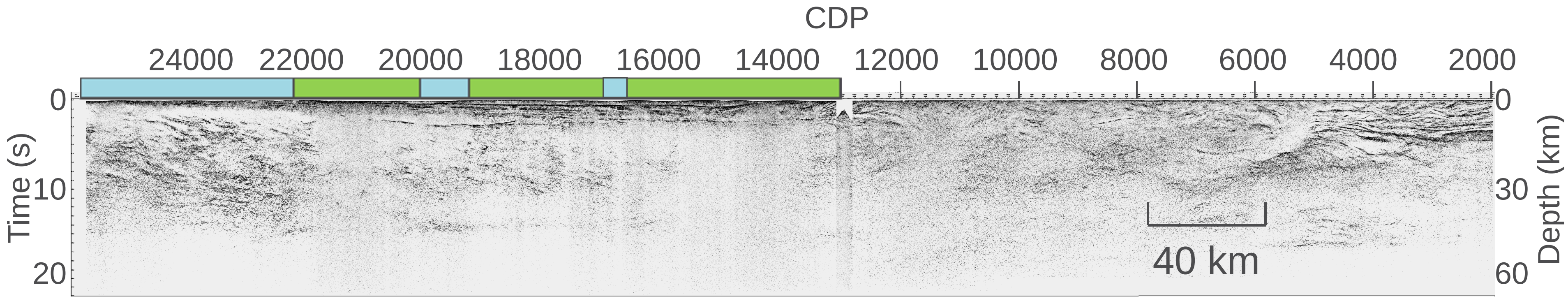
Weak reflections – green regions



Weak reflections – green regions

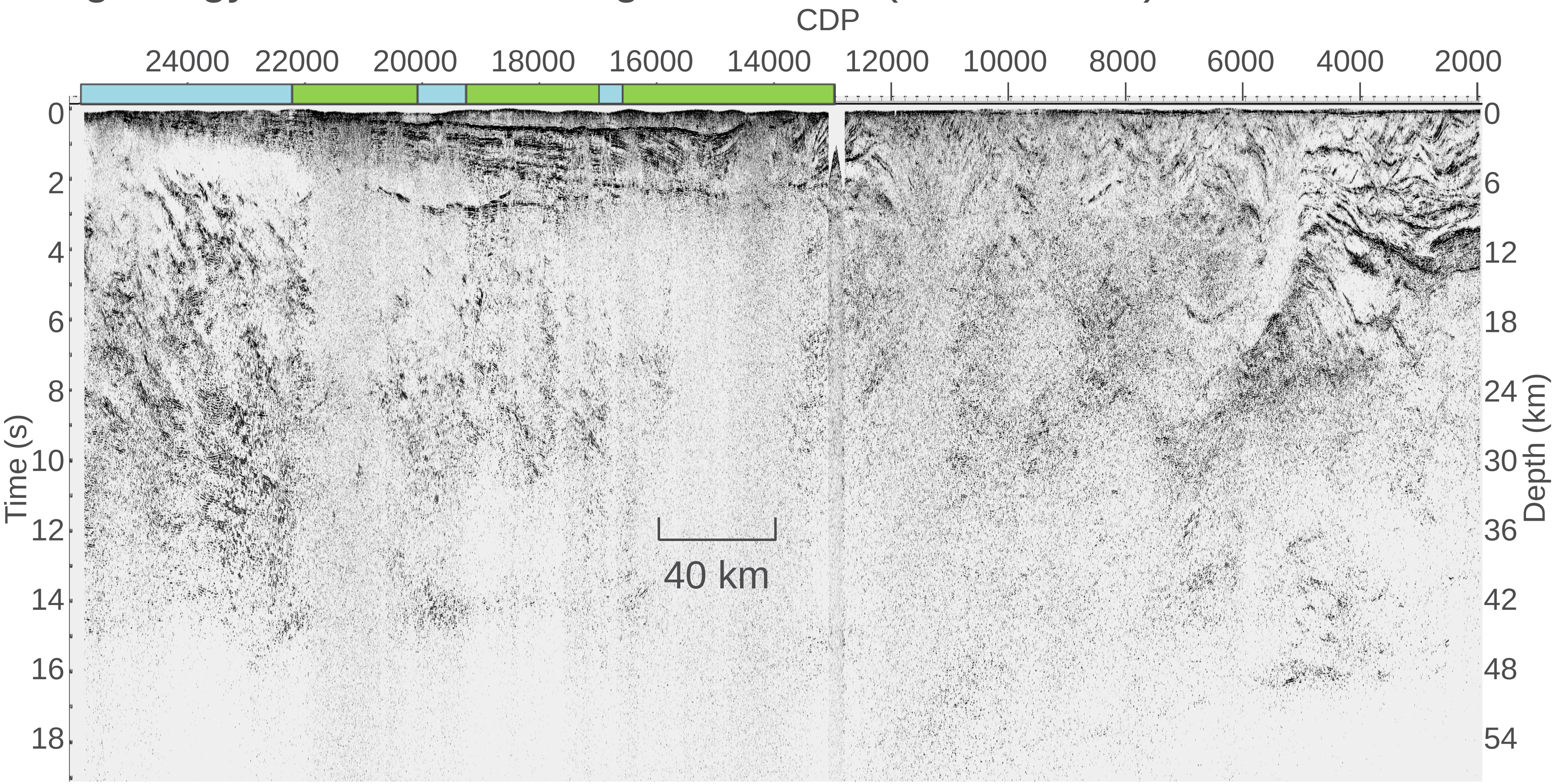
Weak reflections could be due to energy loss through surface geology identified as the green areas.





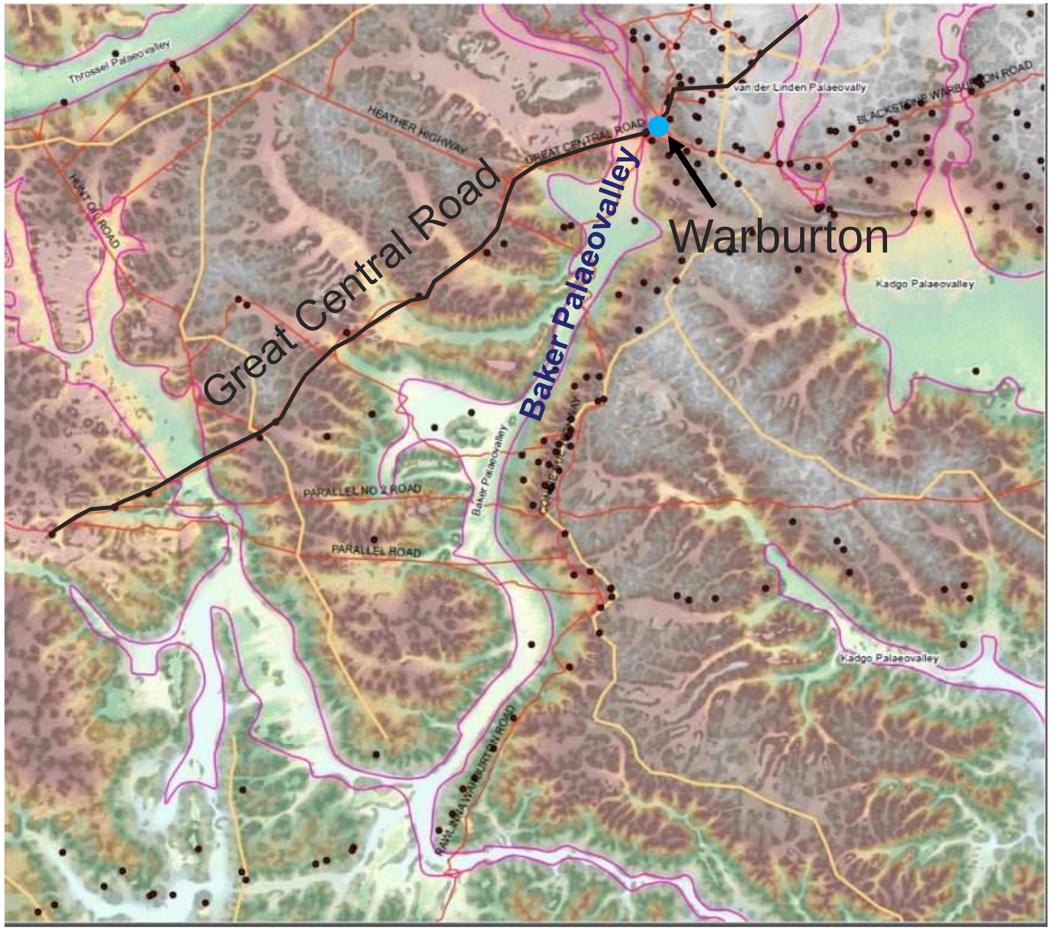
Weak reflections – green regions

Weak reflections could be due to energy loss through surface geology identified as the green areas (Cretaceous).



Imaging limits

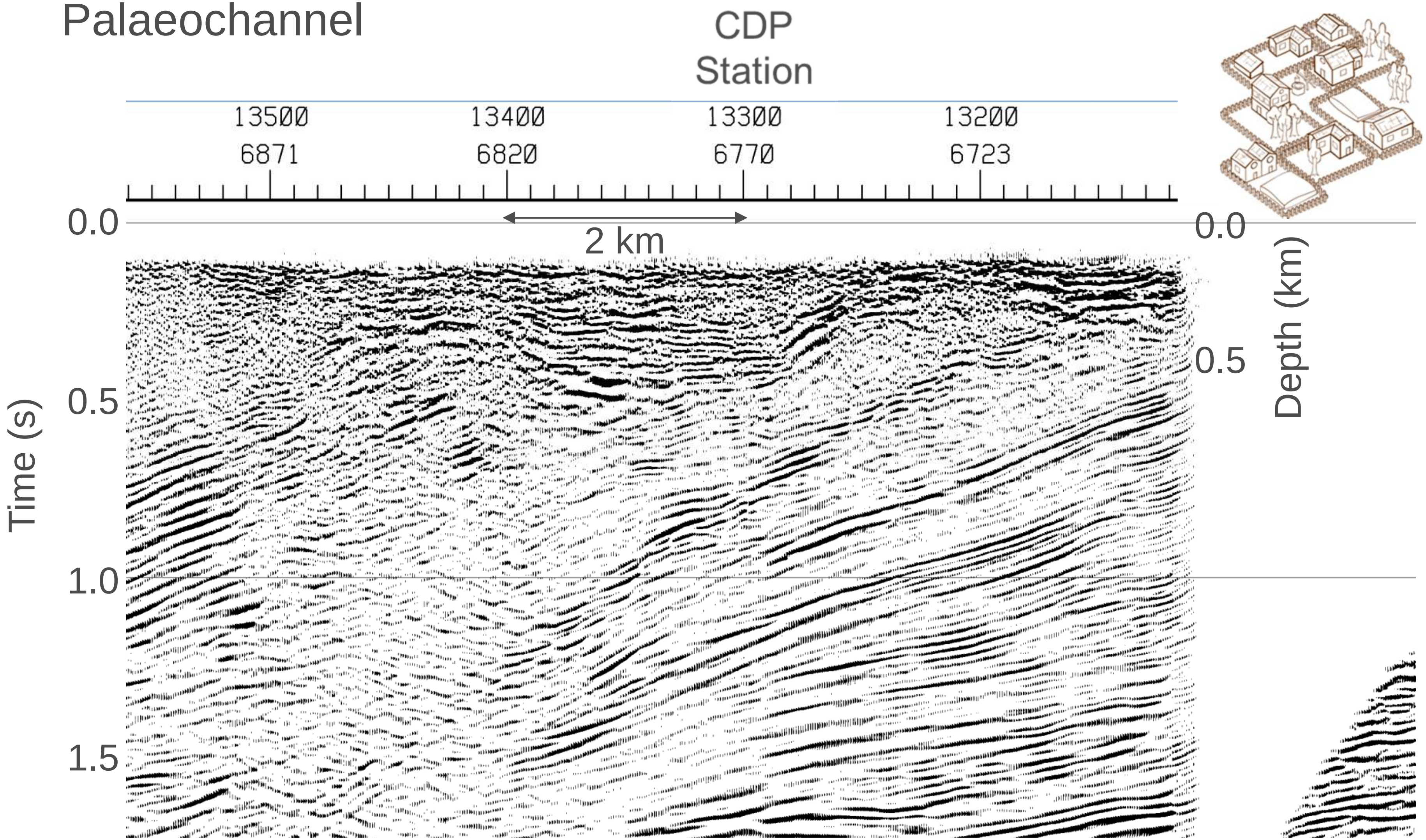
WASANT Palaeovalley map – Geoscience Australia



Imaging limits

Palaeochannel

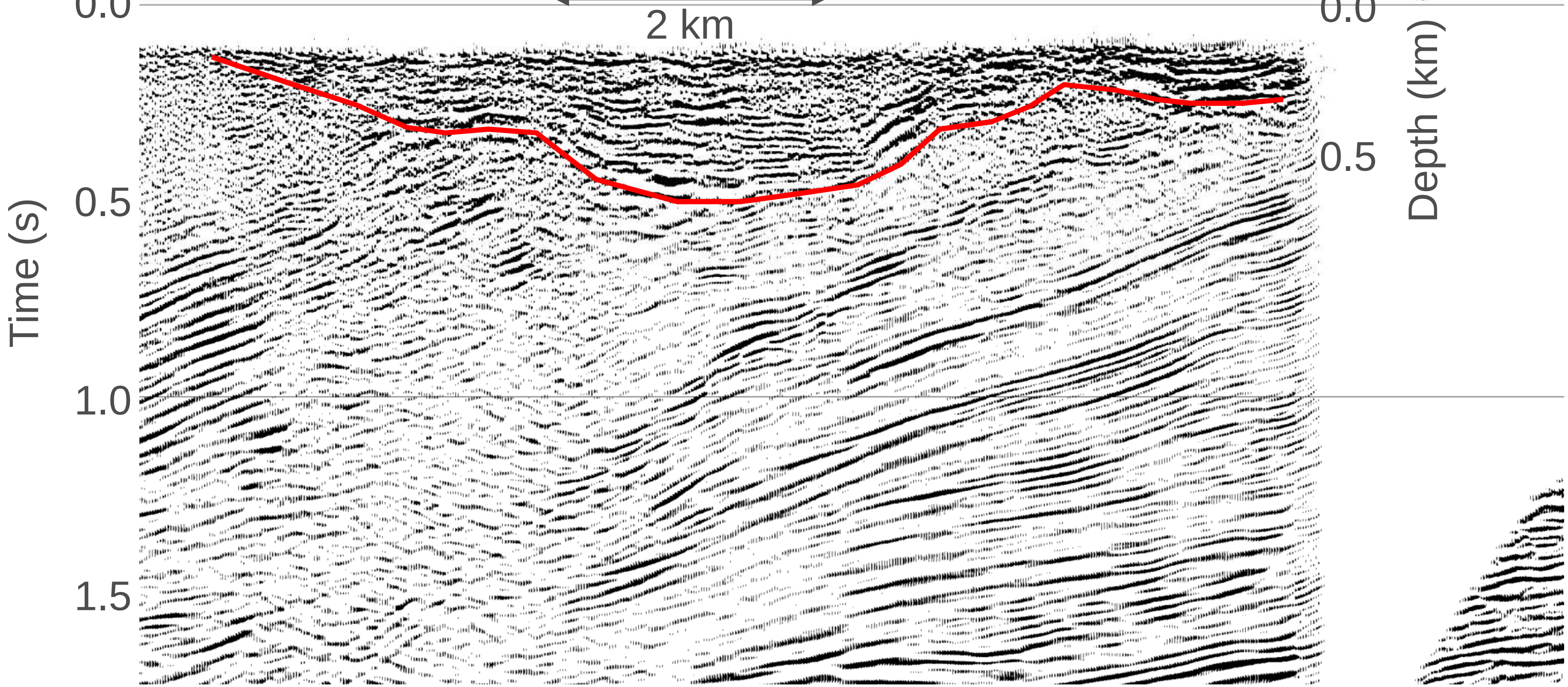
Warburton



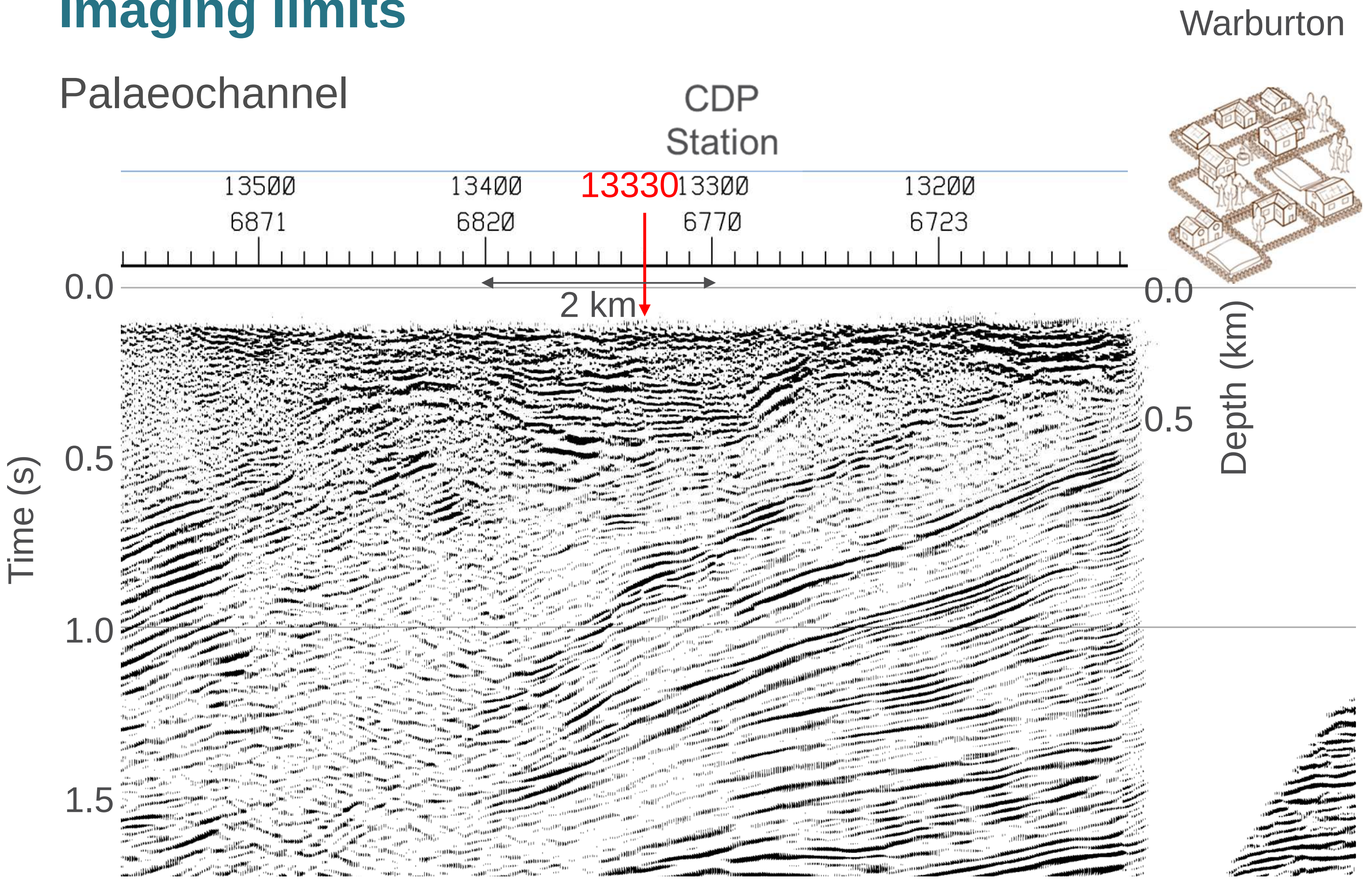
Imaging limits

Palaeochannel

Warburton

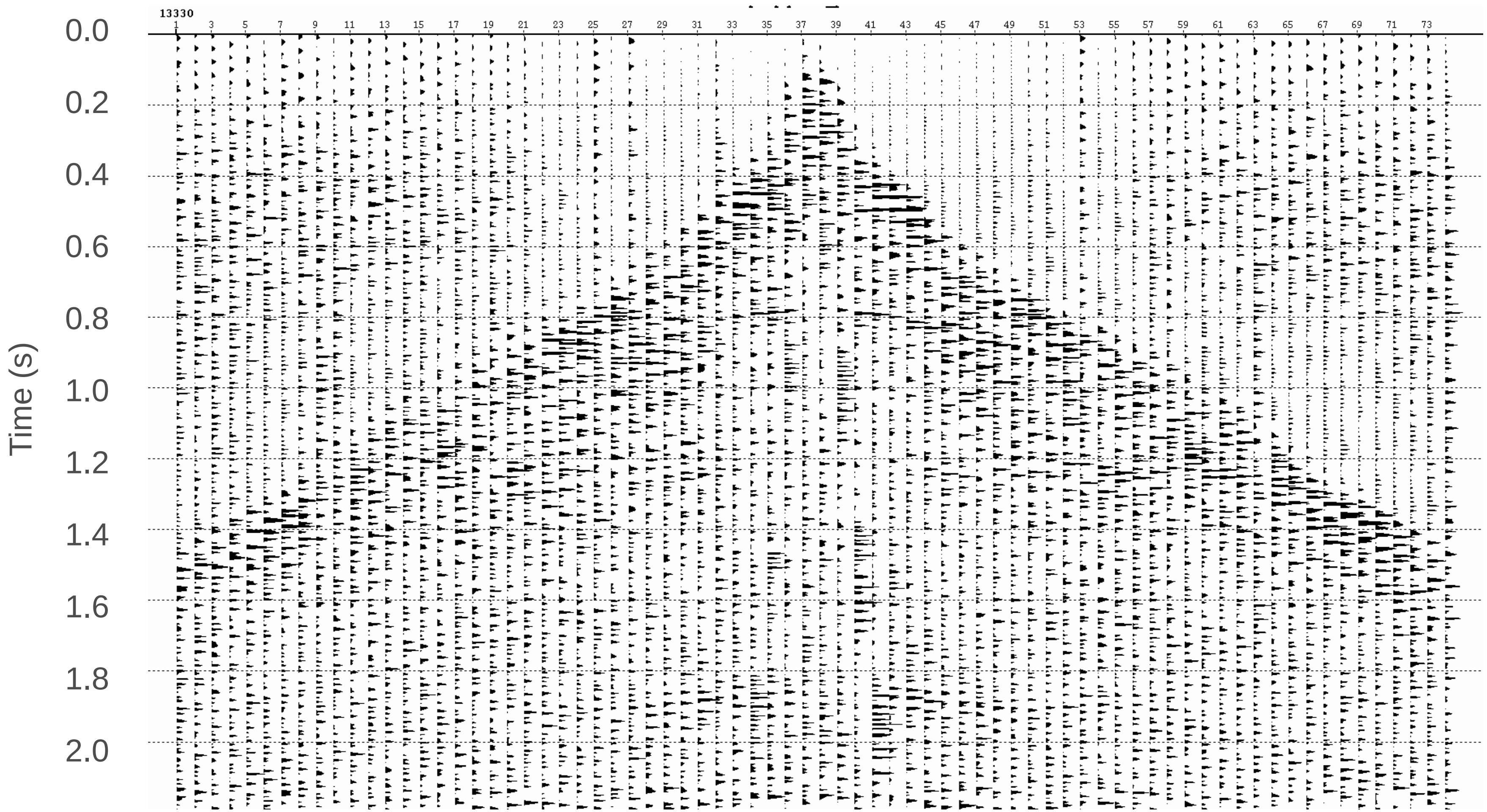


Imaging limits



Imaging limits

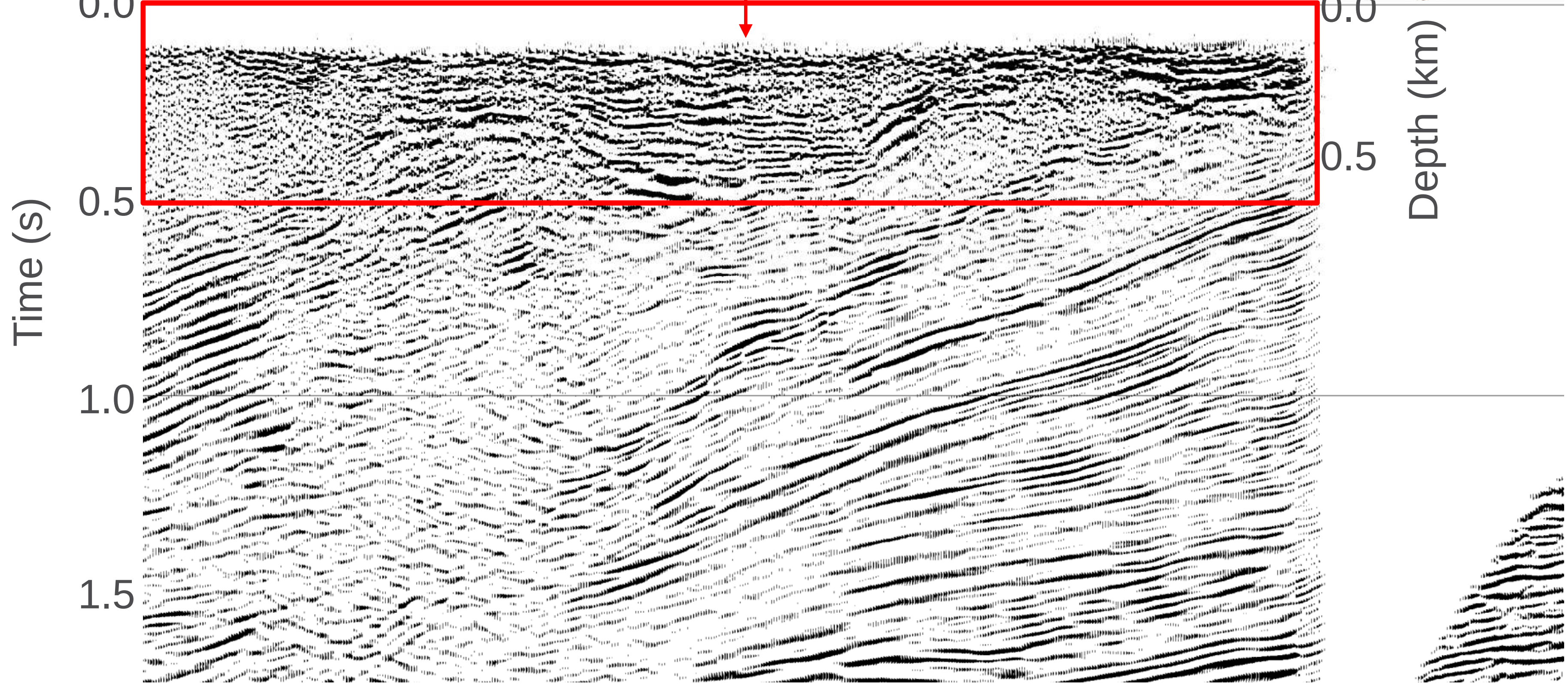
CMP 13330 gather



Imaging limits

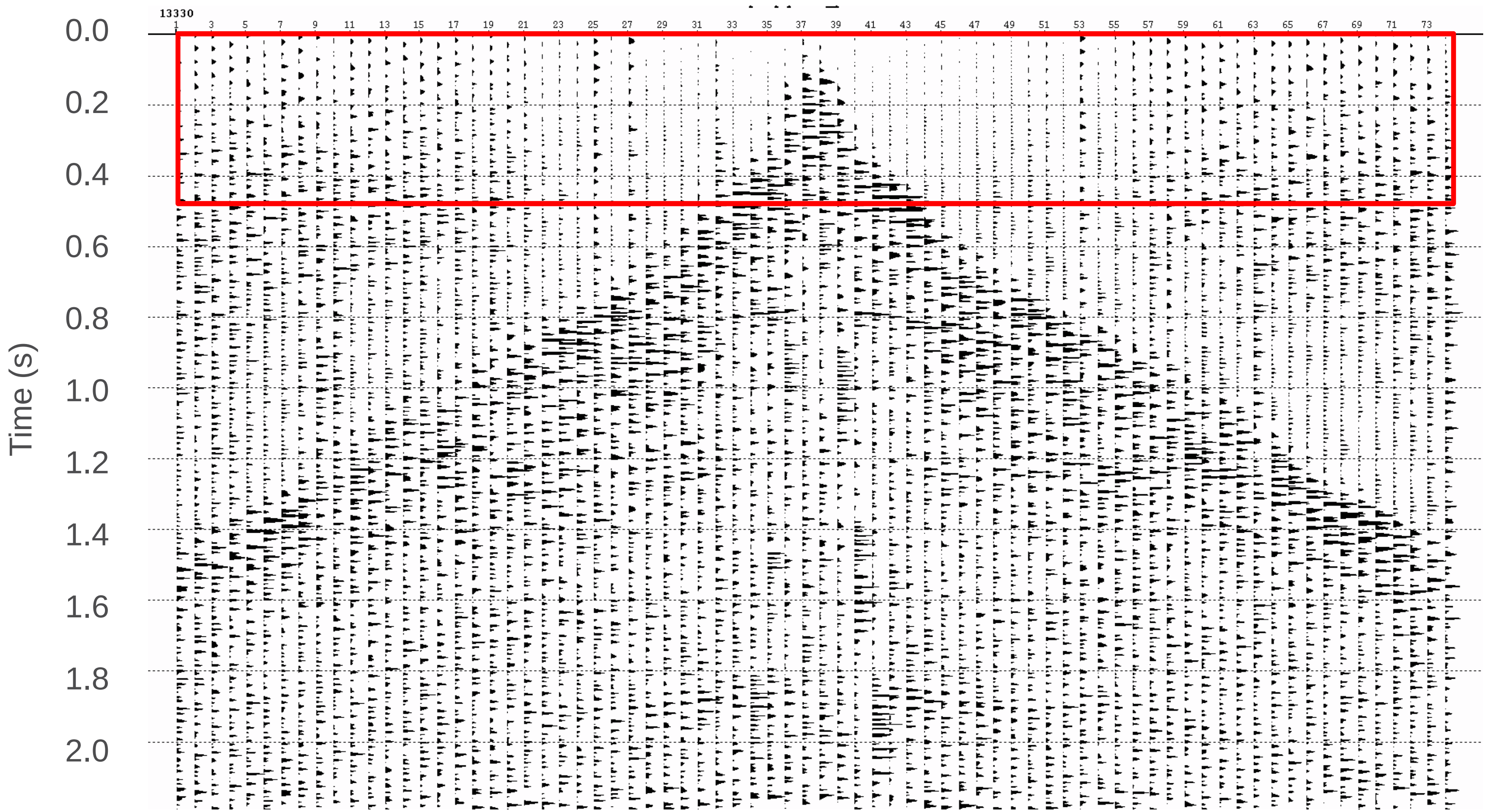
Palaeochannel

Warburton



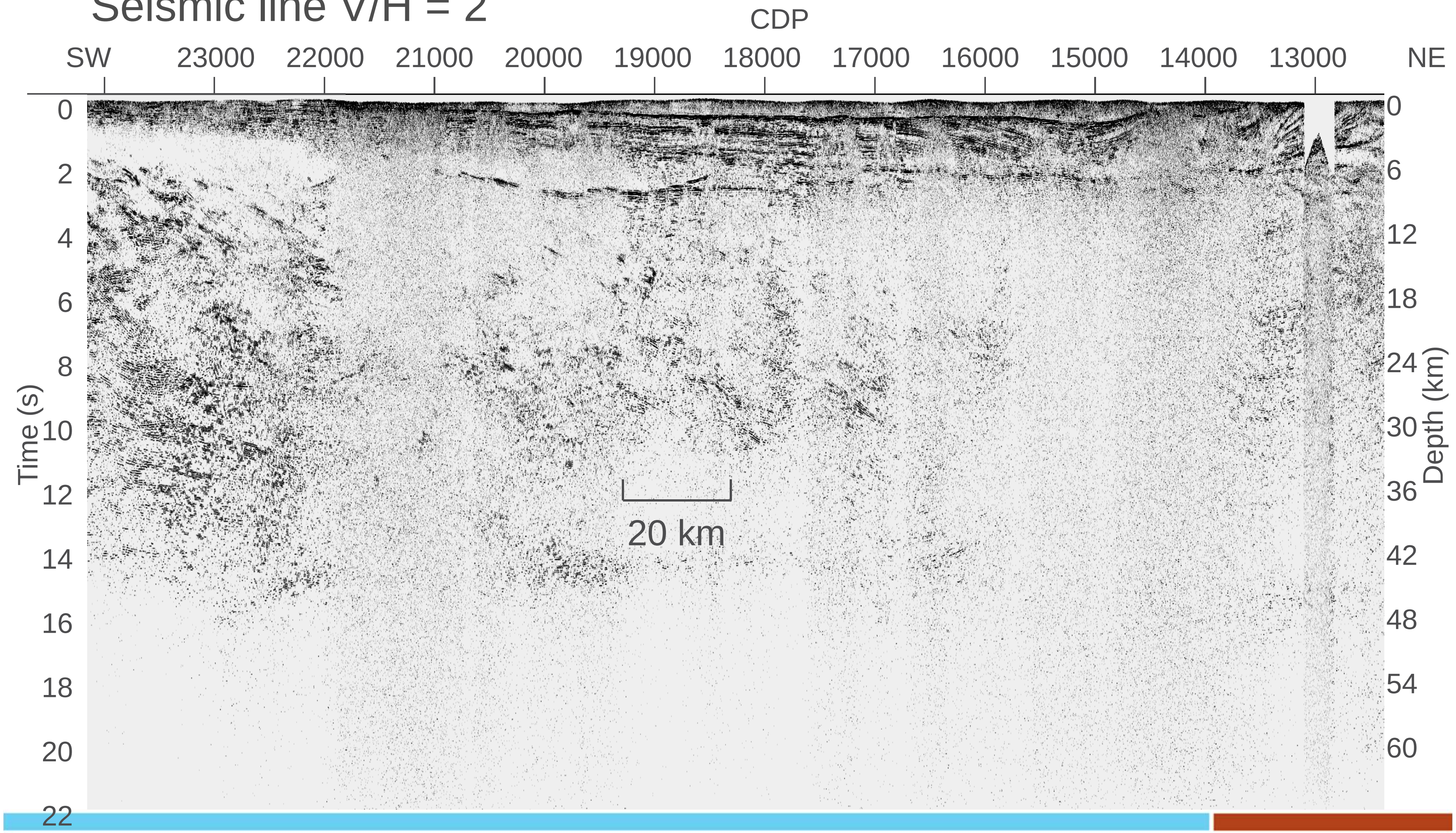
Imaging limits

CMP 13330 gather – 12 fold at 0.5 s, Full 75 fold at 1.5 s



Migrated line – Officer Basin

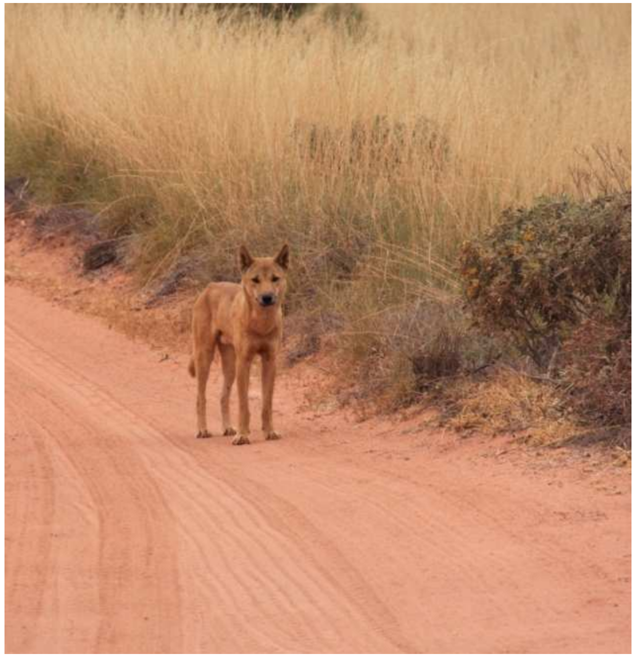
Seismic line V/H = 2



Conclusion

For most of the seismic line the seismic data provides images of the full depth of the crust through this region.

The processed data provides valuable information on the nature of the major crustal structures and detailed sedimentary layering in this area



Other Data Sets Available –Wide Angle

Wide Angle (Refraction)

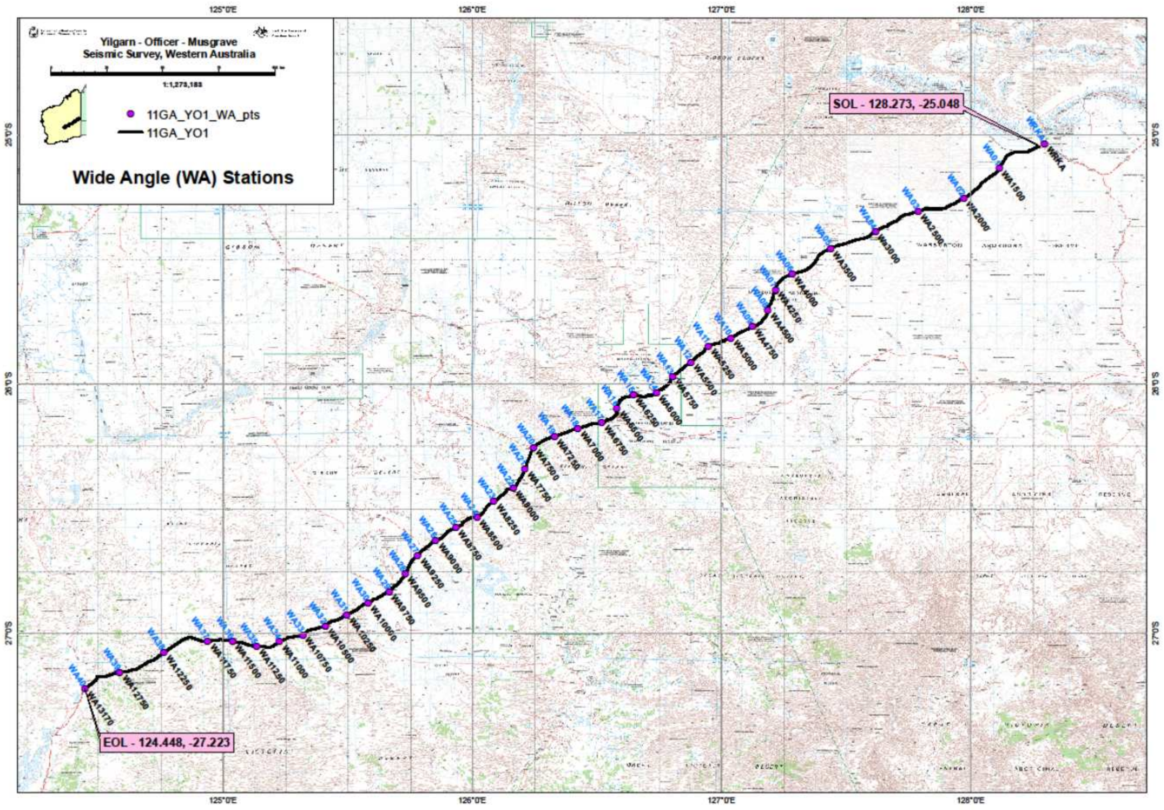
- Collect wide-angle data at large offsets (60+ km) using vibroseis sources

- Supplement seismic reflection data with velocity information for upper crust

- 11GA-YO1 wide angle data currently being processed, available later.

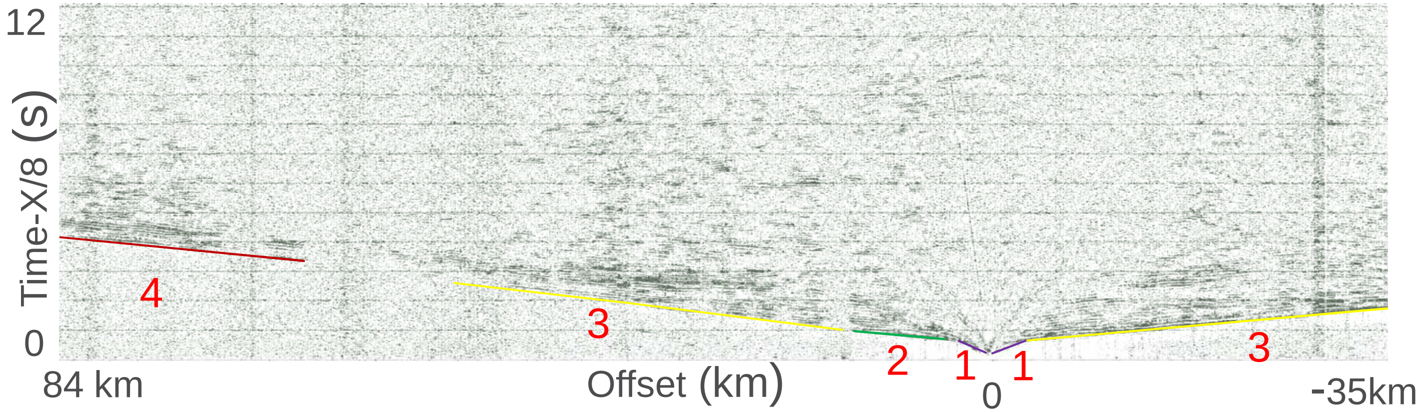
Wide Angle

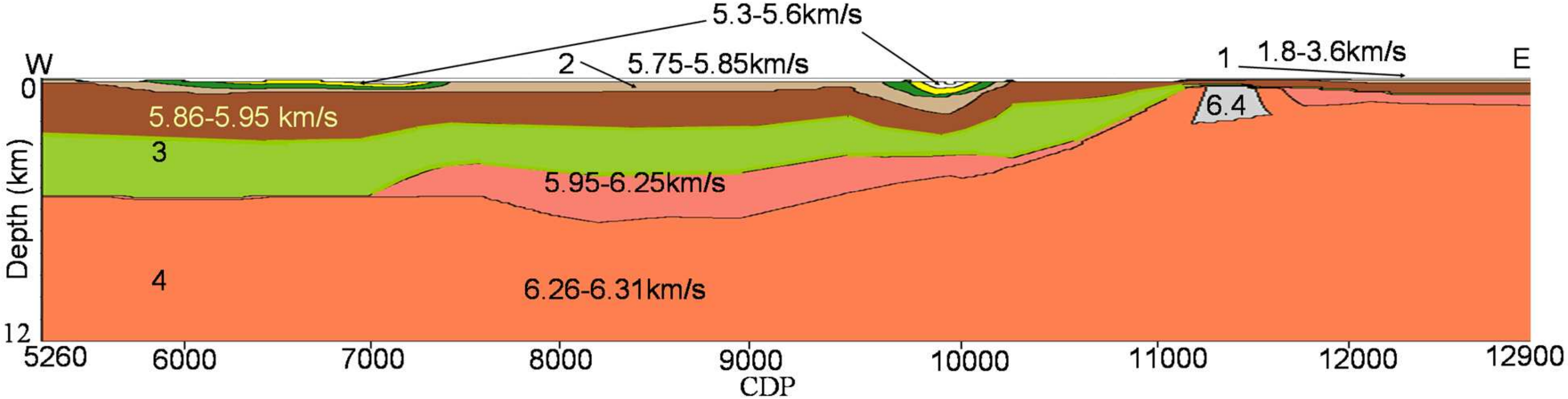
Wide-Angle/Refraction line coincident with the YOM seismic reflection transect; recording array – 40 stations (in blue)



Wide Angle

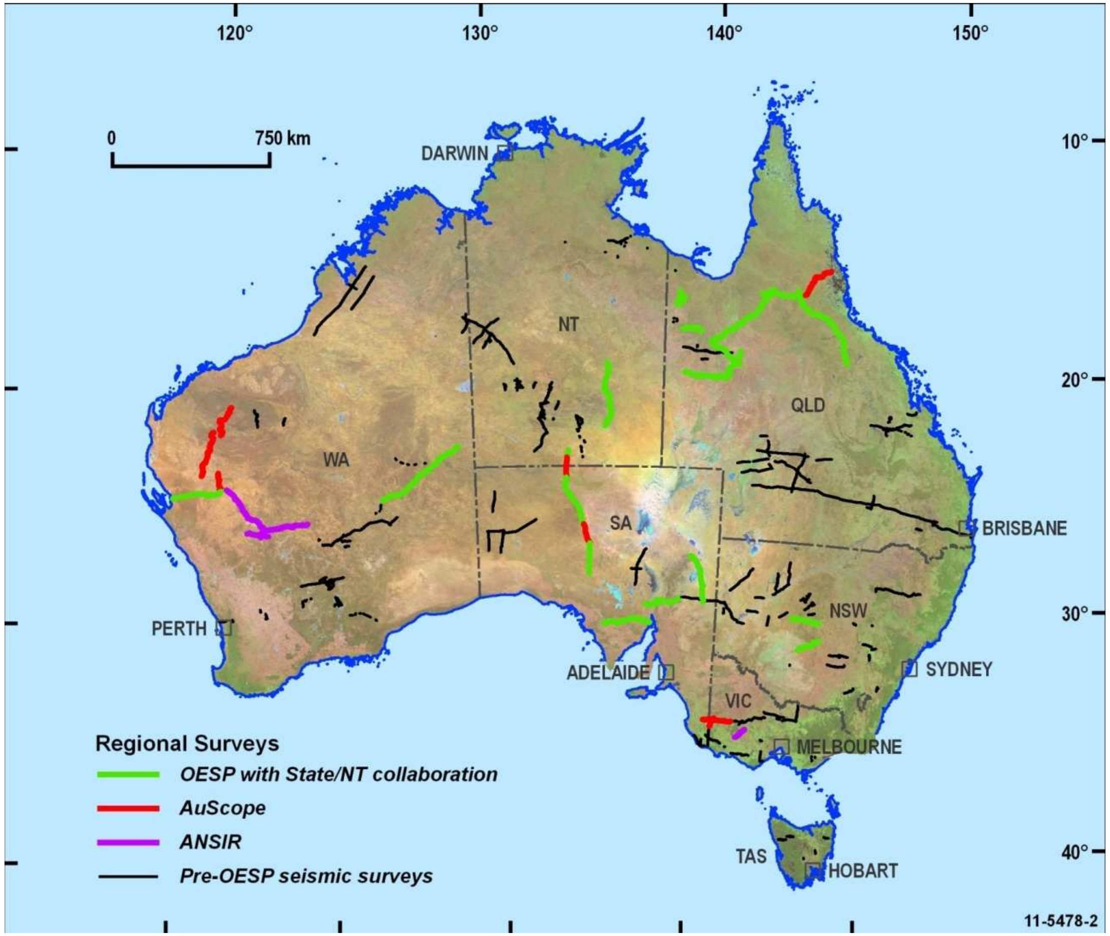
Gawler example of velocity model for the upper crust





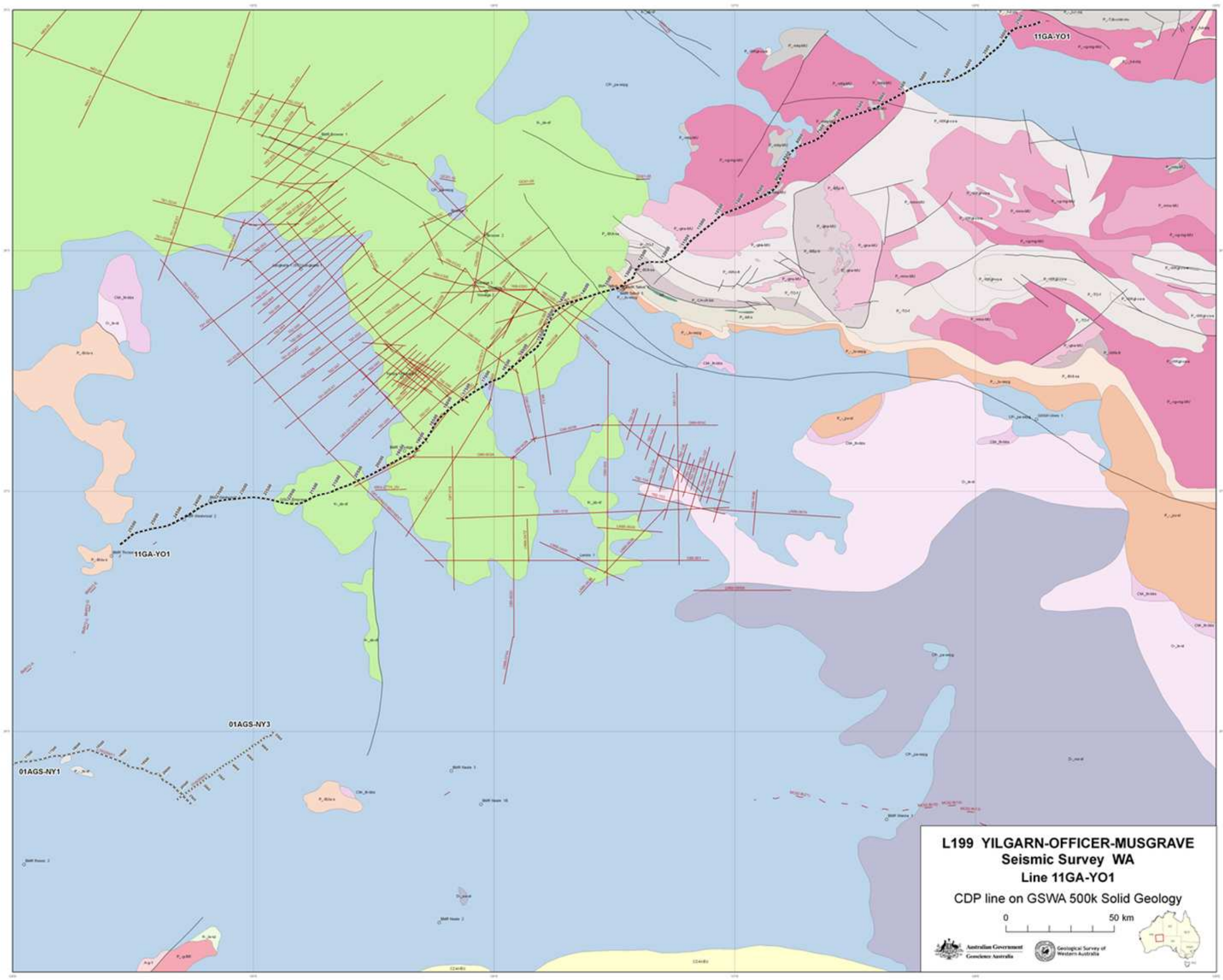
Other Data Sets Available – Seismic Data

http://www.ga.gov.au/minerals/projects/current-projects/seismic-acquisition-processing.html



Other Data Sets Available – Seismic Data

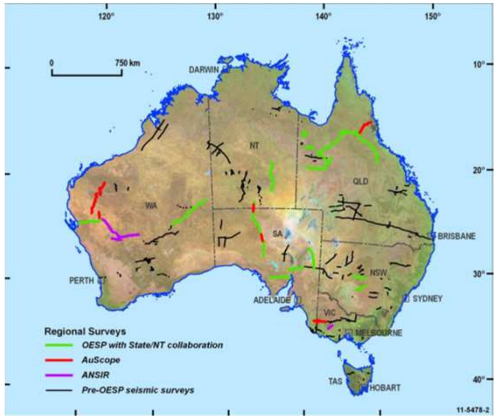
http://www.dmp.wa.gov.au/374.aspx

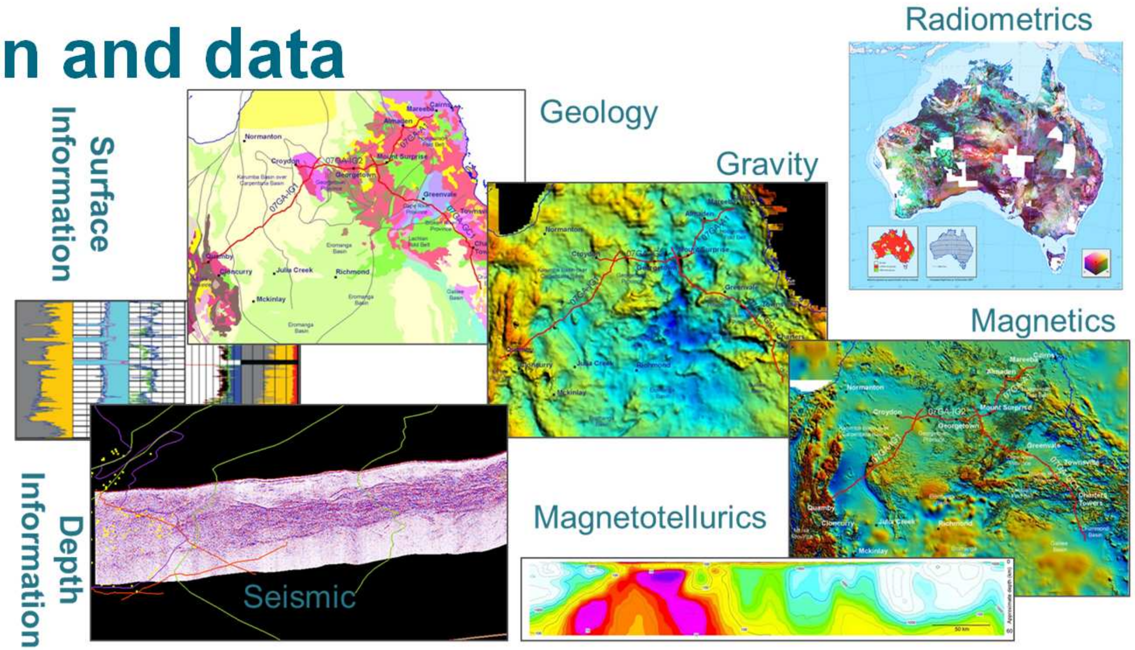


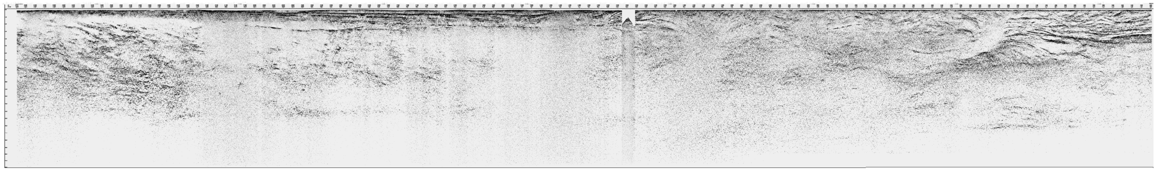
Australian Government
Geoscience Australia

Further information and data

http://www.ga.gov.au/







Phone: +61 2 6249 9153

Web: www.ga.gov.au

Email: Josef.Holzschuh@ga.gov.au

Address: Cnr Jerrabomberra Avenue and Hindmarsh Drive, Symonston ACT 2609

Postal Address: GPO Box 378, Canberra ACT 2601