

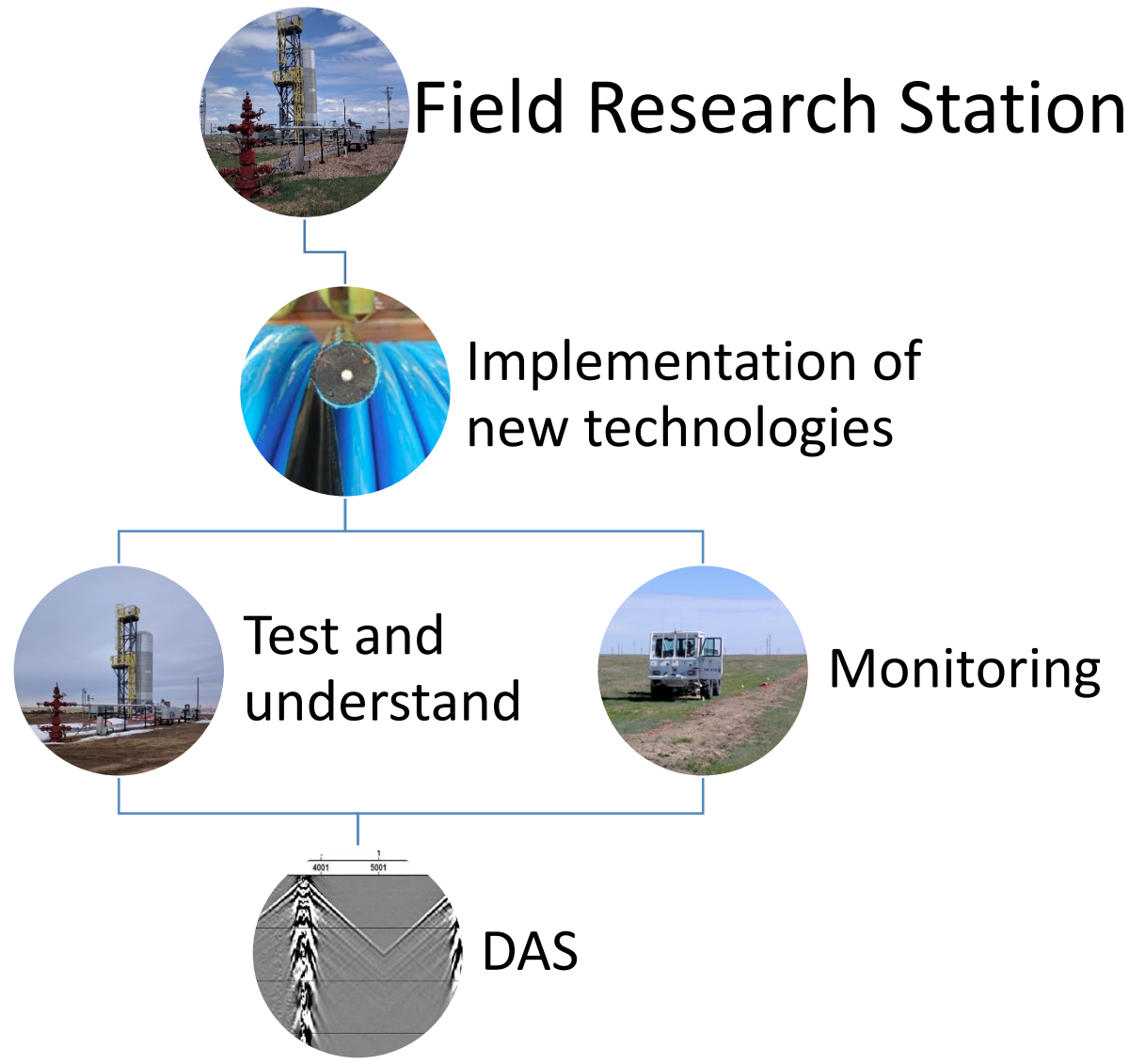
# Walk away VSP processing of DAS and geophone data at CaMI FRS

Adriana Gordon\* and Don C. Lawton

Sponsors meeting, November 29 2018



- Objectives
- Datasets and acquisition parameters
- Processing flow
- Results
- Conclusions
- Acknowledgements



## Processing walk away VSP

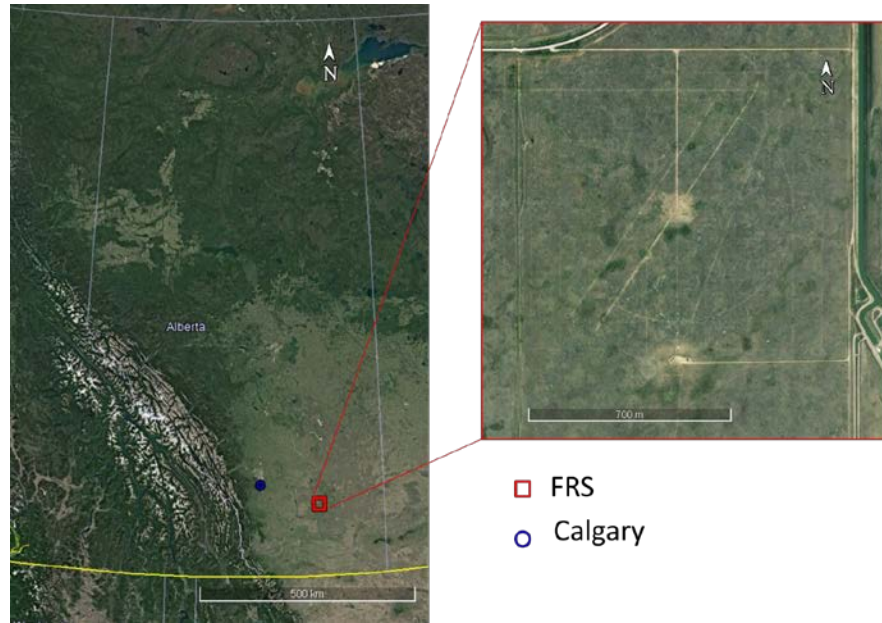
- ### Straight fibre
- Raw DAS
  - Integrated DAS

- ### Helical wound fibre
- Raw DAS
  - Integrated DAS

- ### 3C Geophones
- Vertical Component
  - Multicomponent



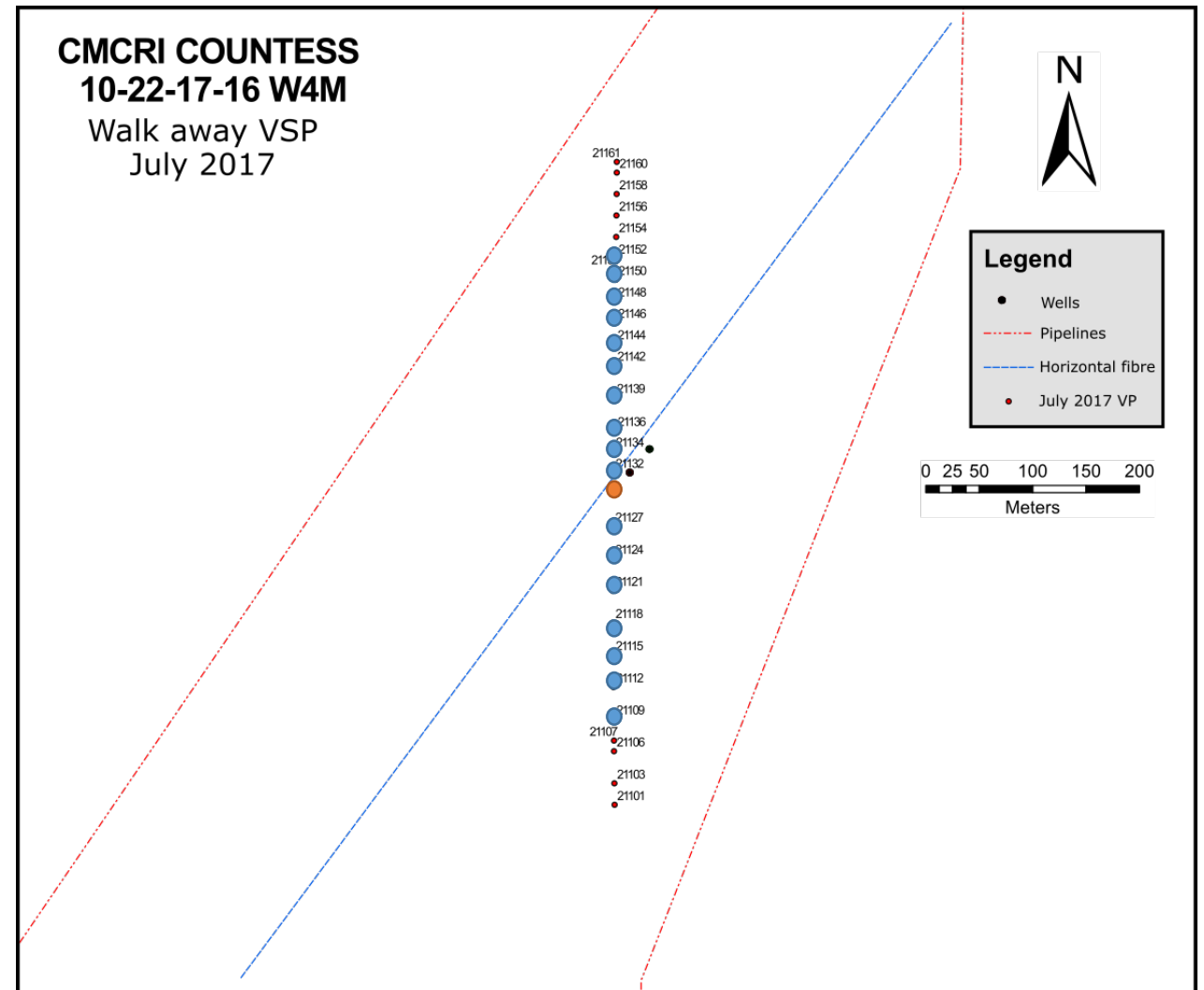
# Datasets and acquisition parameters



□ FRS  
○ Calgary

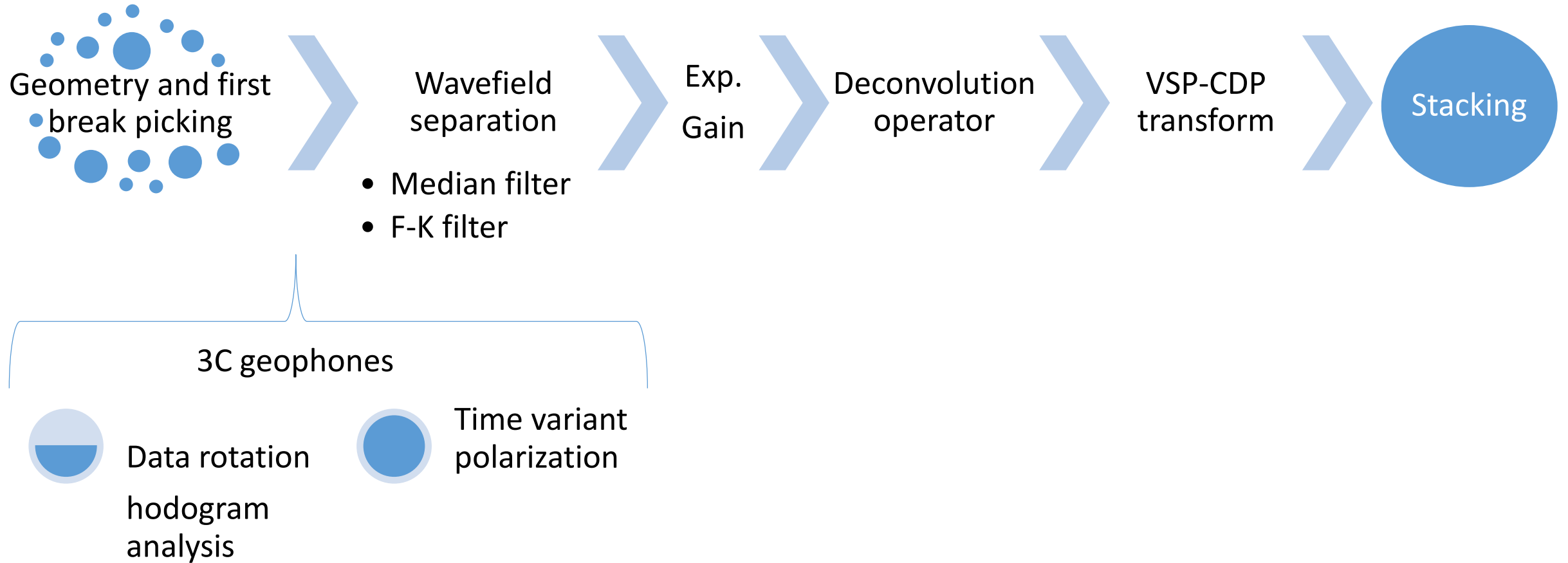
## Acquisition parameters

Source	IVI EnviroVibe
Sweep	10 – 150 Hz, 16 s + 3 s listening time
Source interval	20 – 30 m
DAS depth	320 m
Gauge length	10 m, channel spacing 0.25 m
Geophone array	191 – 306 m, 5 m spacing
Offset	9 – 220 m



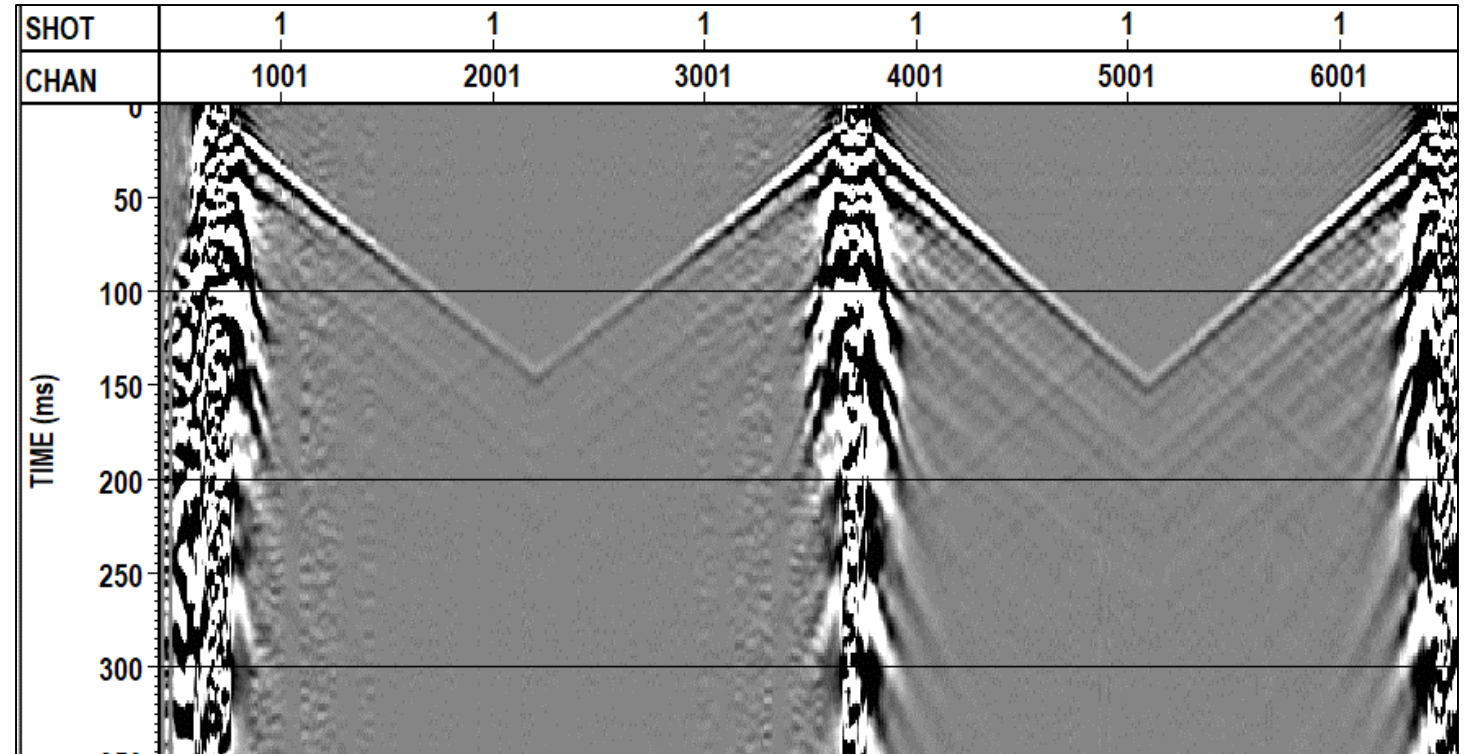


# Processing flow





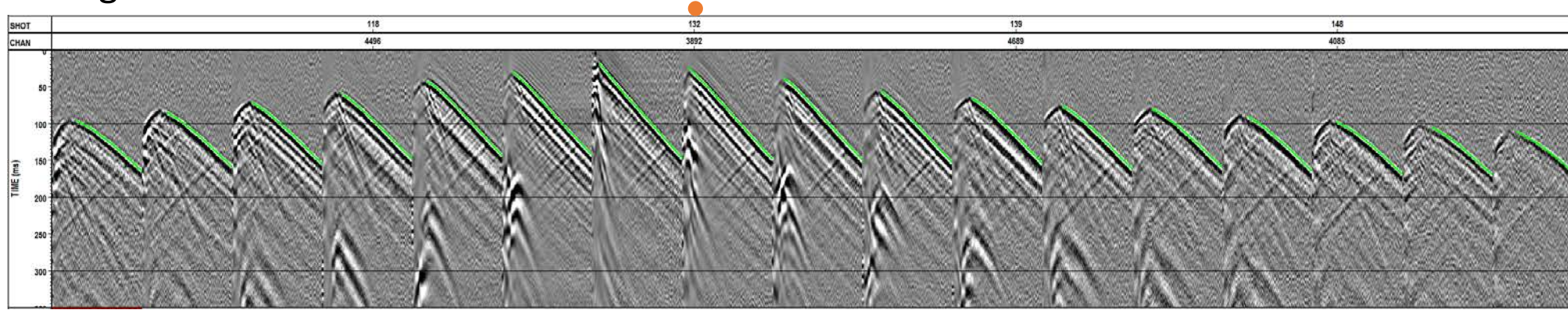
Straight fibre  
Helical wound fibre



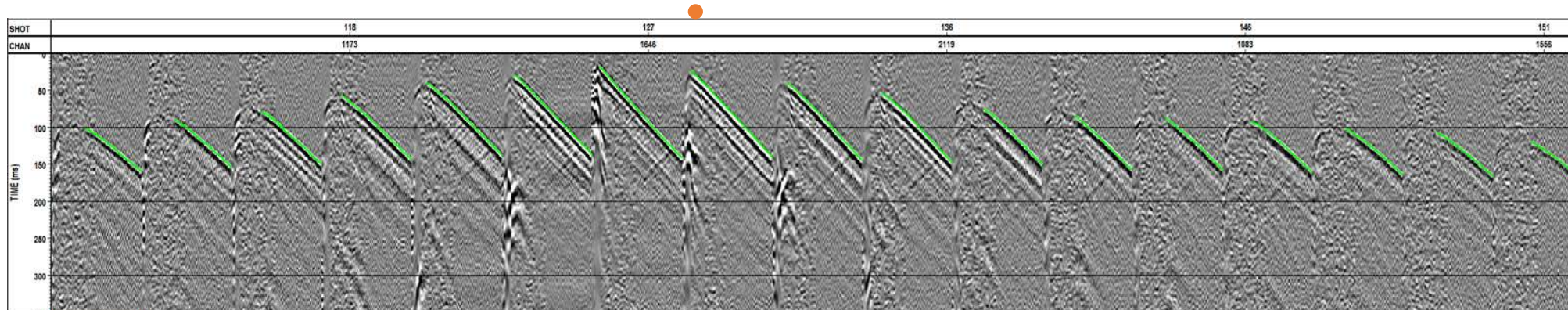


# Processing flow – geometry and first break times

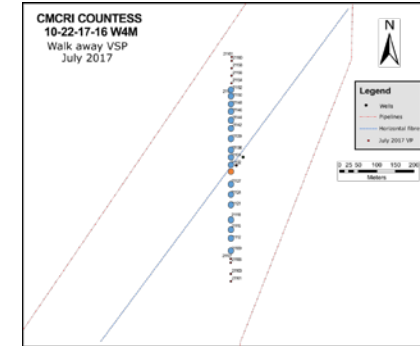
## Straight fibre



## Helical fibre



● Zero offset VP

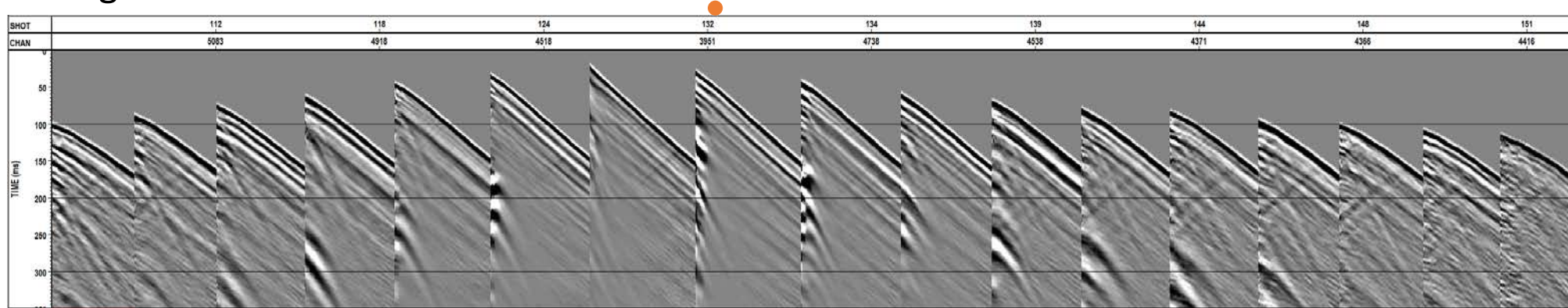




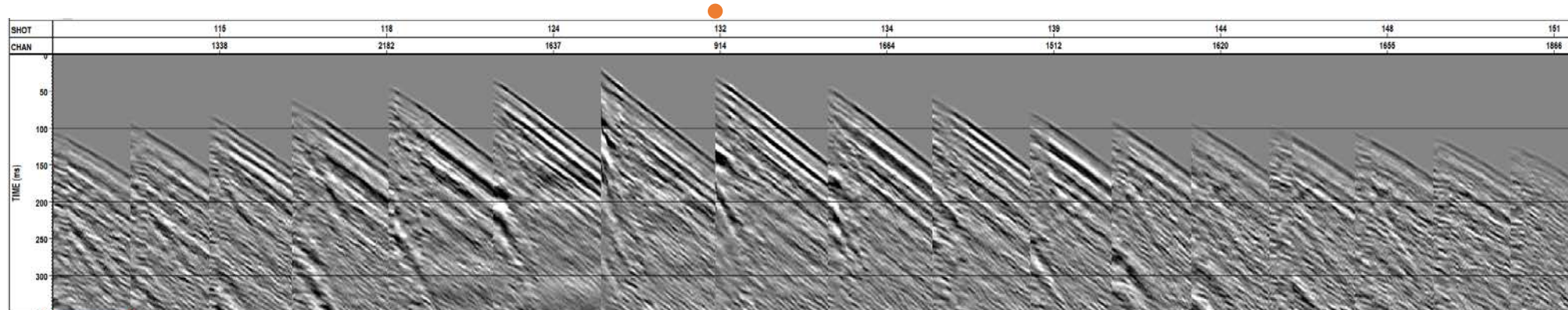
# Processing flow – wavefield separation

Downgoing wavefield

## Straight fibre



## Helical fibre



● Zero offset VP

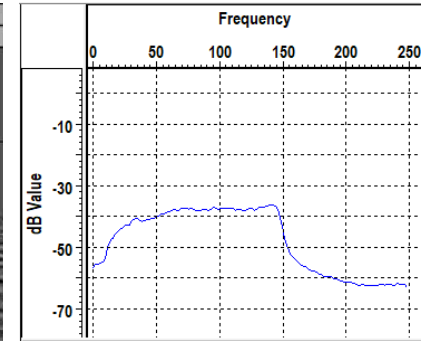
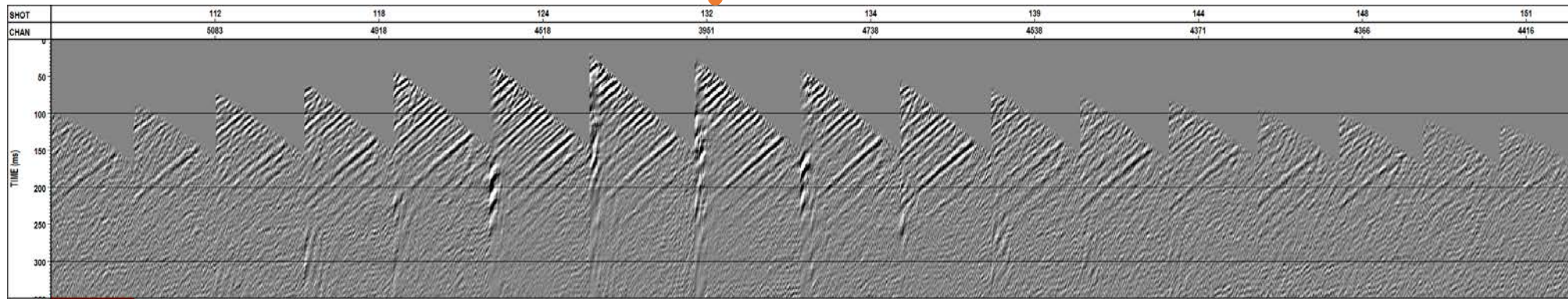




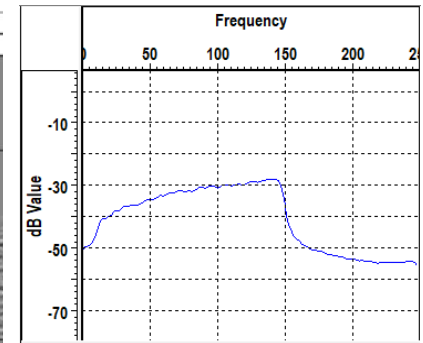
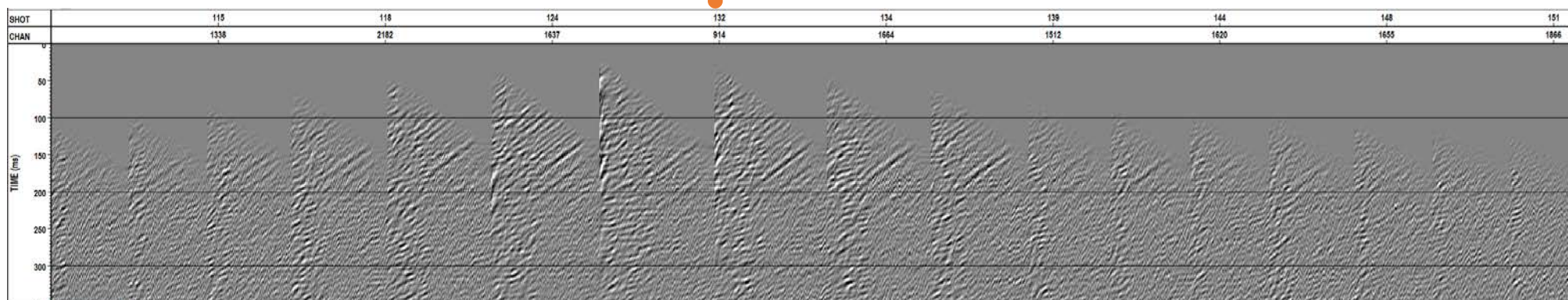
# Processing flow – wavefield separation

Upgoing wavefield

Straight fibre



Helical fibre



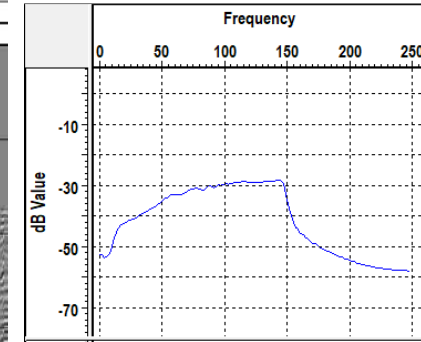
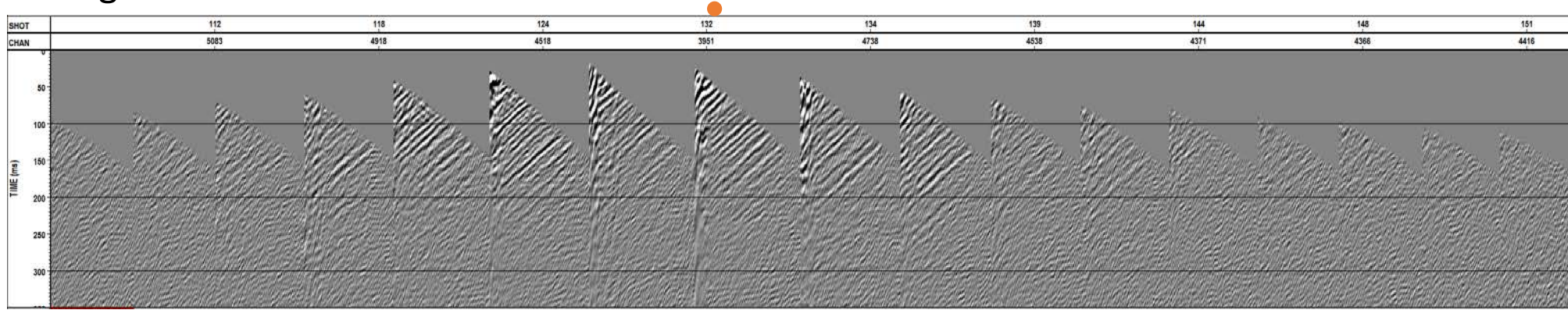
● Zero offset VP



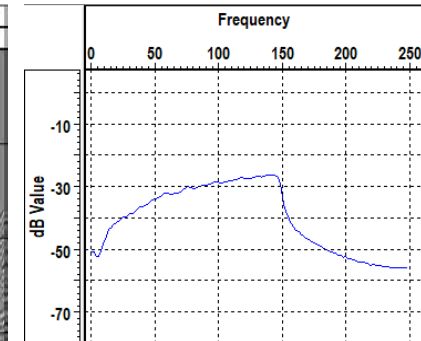
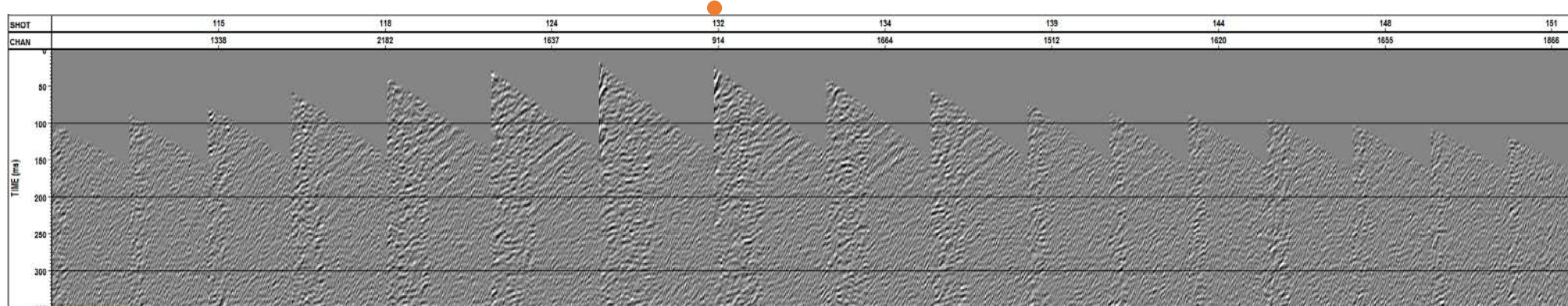
# Processing flow – deconvolution operator

Upgoing wavefield after deconvolution

## Straight fibre



## Helical fibre

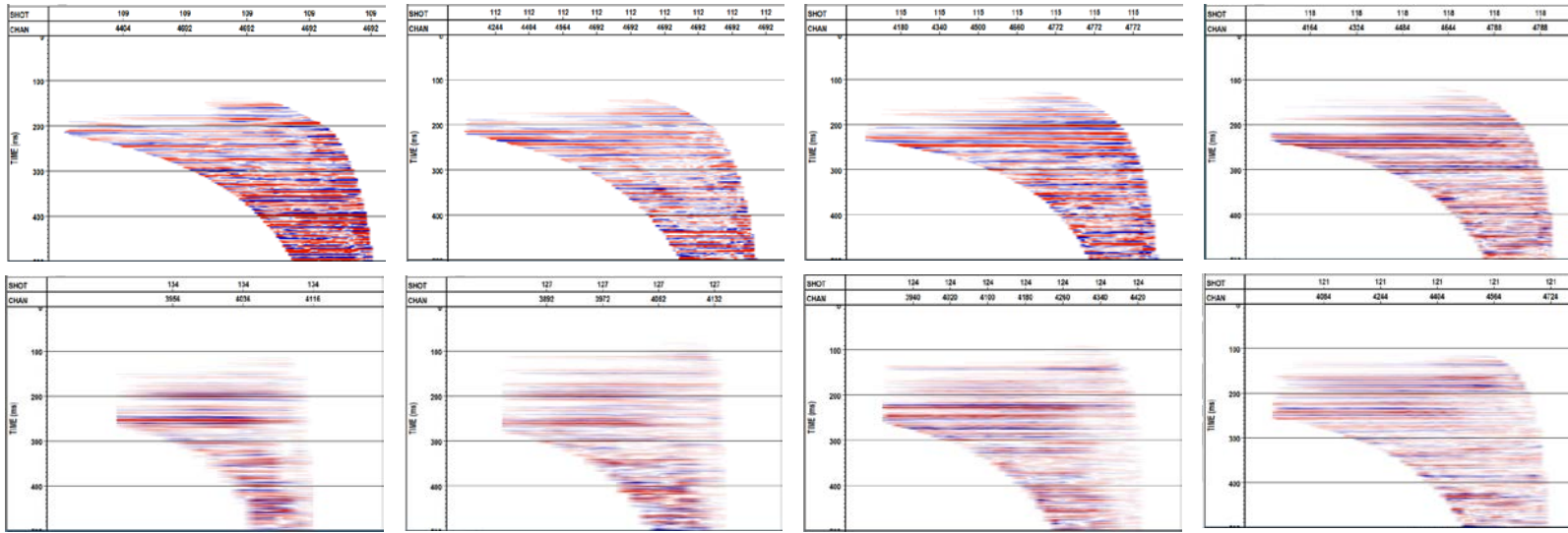


● Zero offset VP

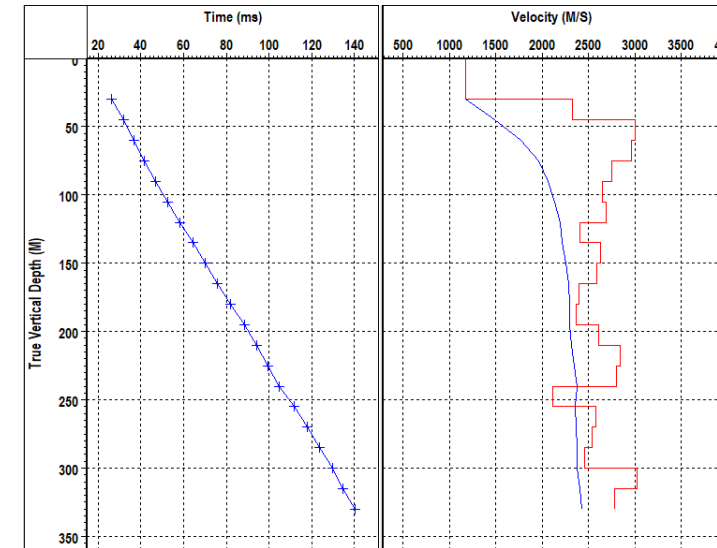
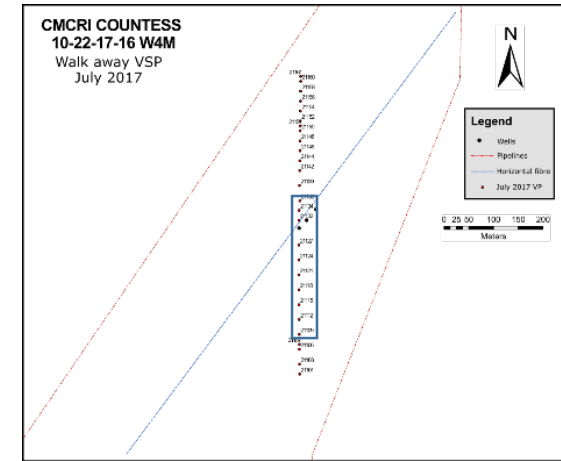
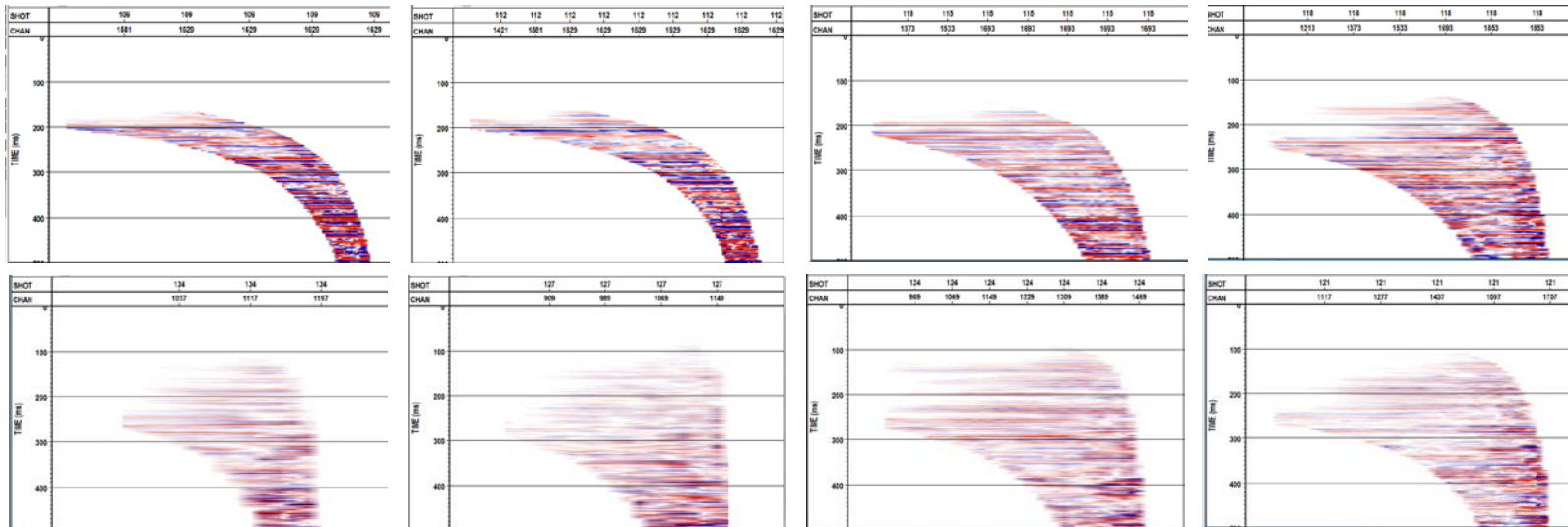


# Processing flow – VSP-CDP transform

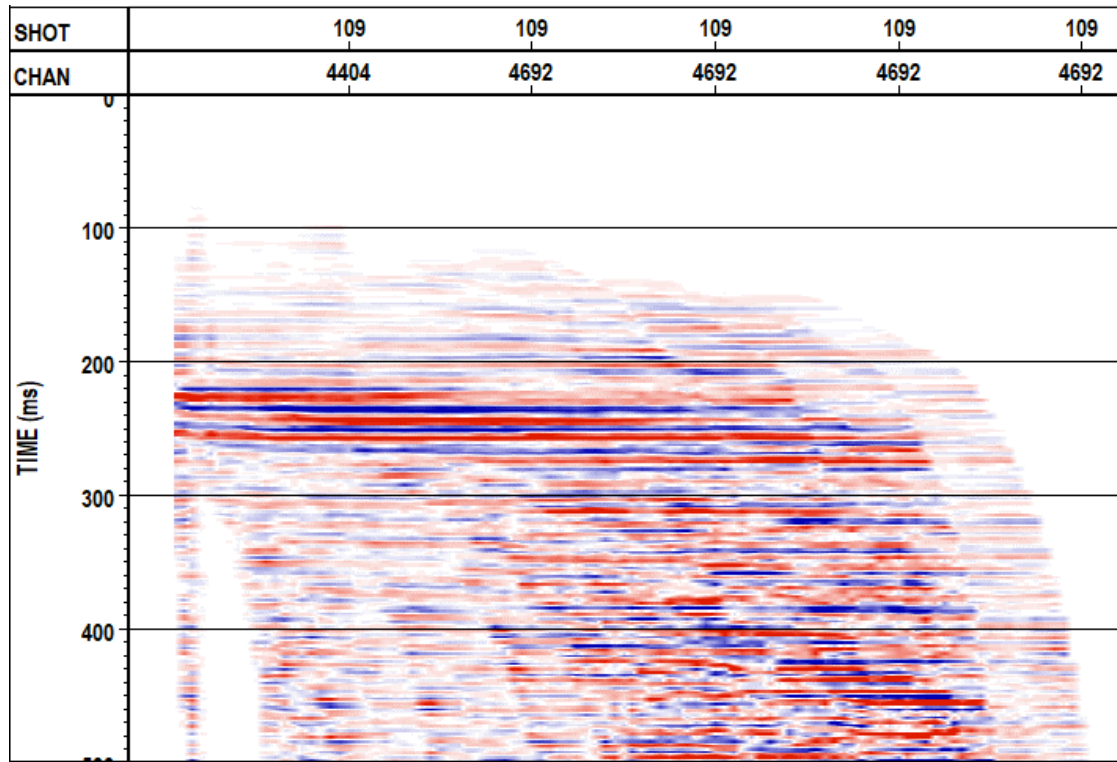
## Straight fibre



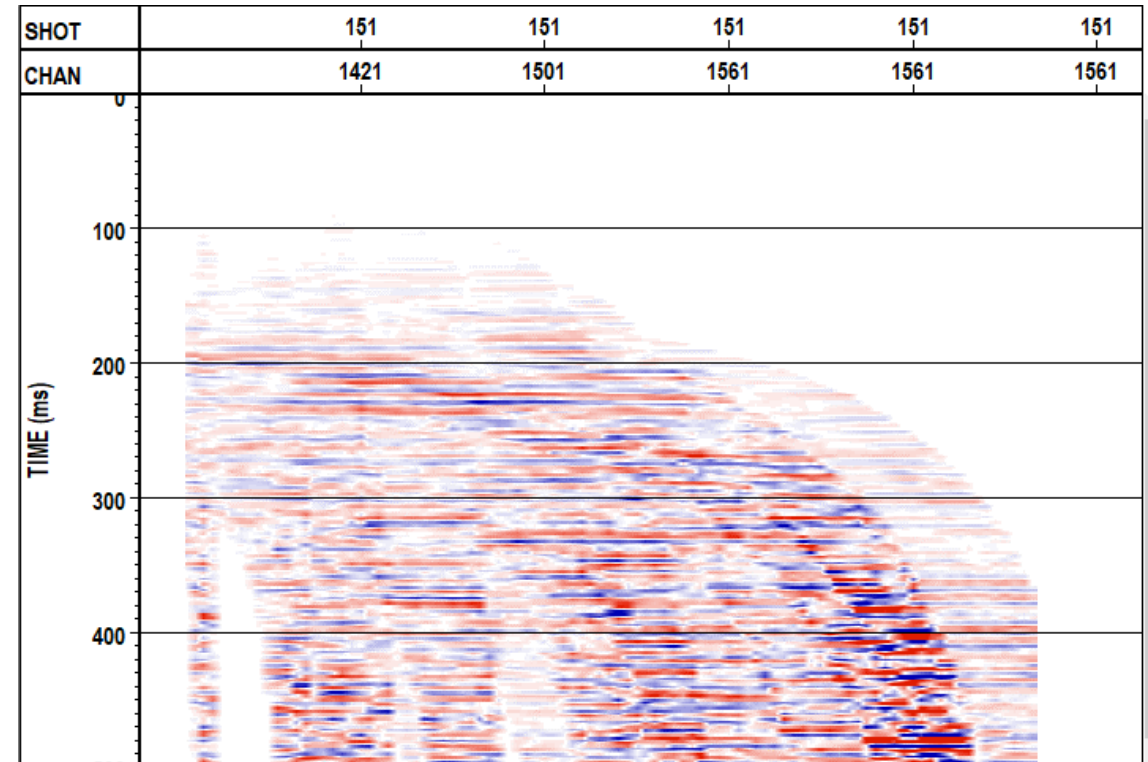
## Helical fibre



## Straight fibre

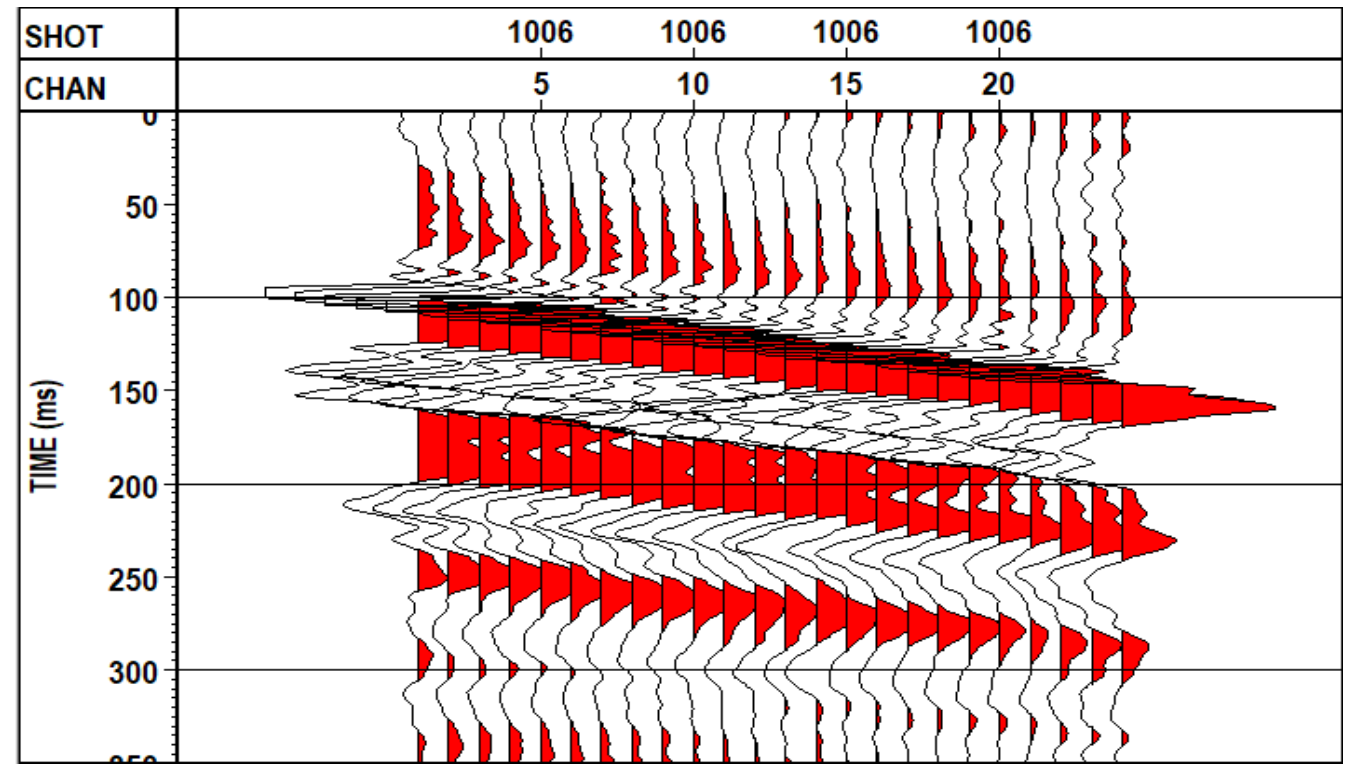


## Helical fibre





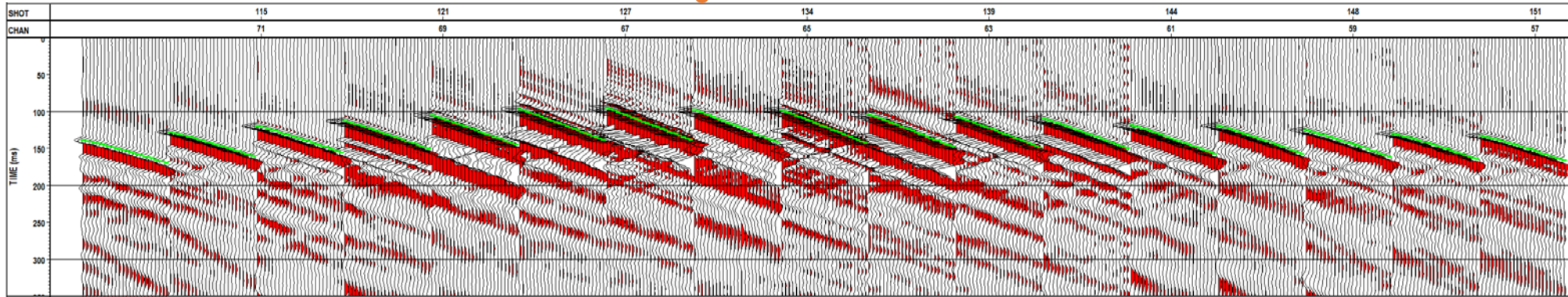
## Vertical component Rotated data



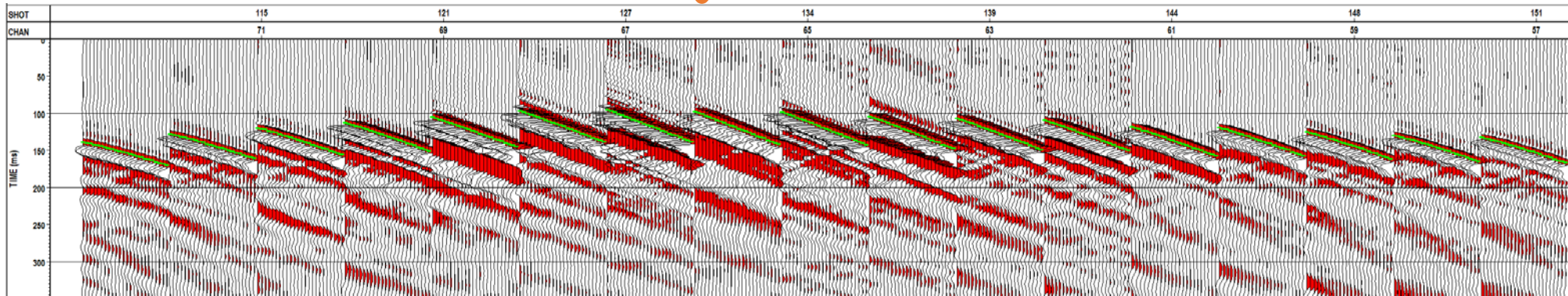


# Processing flow – geometry and first break times

## Vertical component



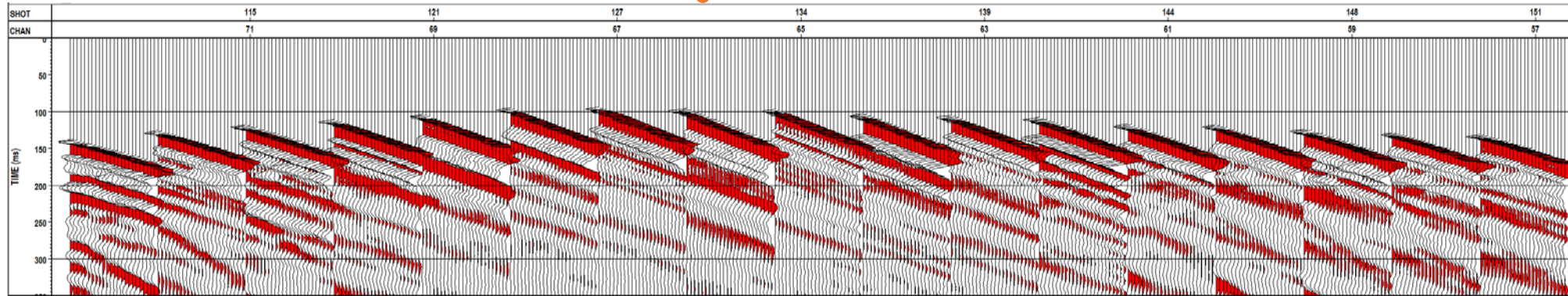
## Rotated data



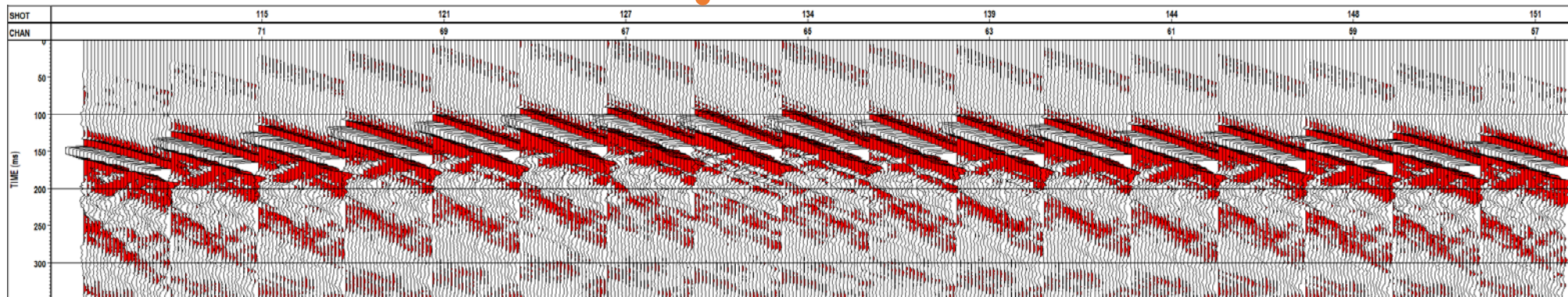
● Zero offset VP



### Vertical component



### Rotated data



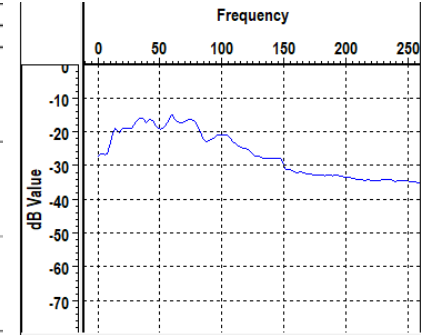
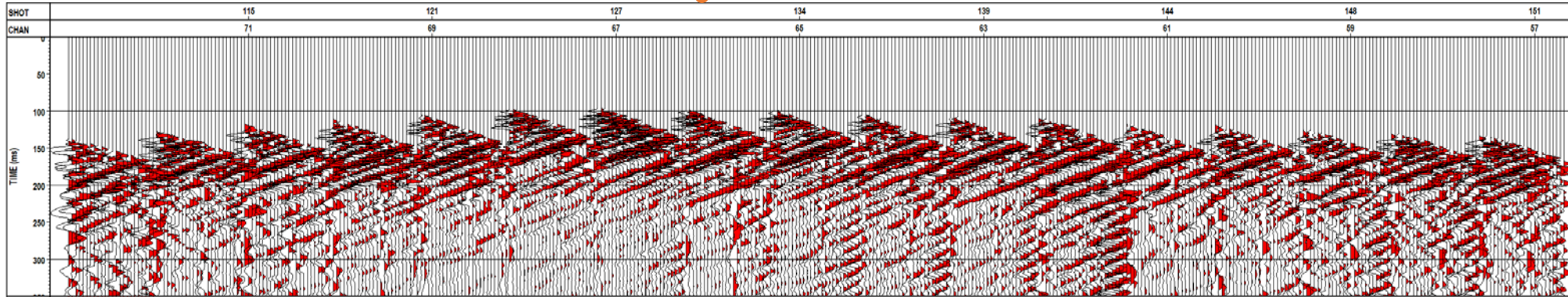
● Zero offset VP



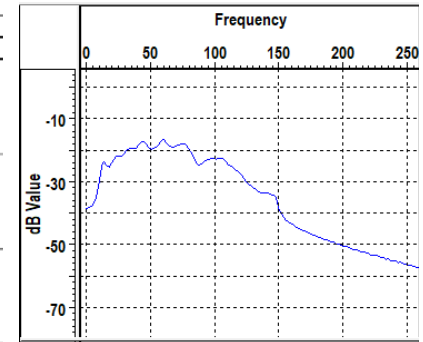
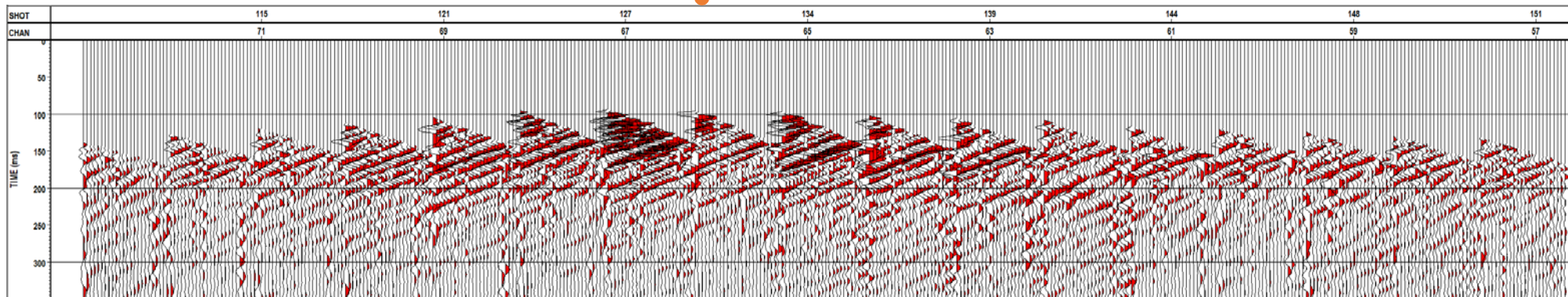
# Processing flow – wavefield separation

Upgoing Geophones

## Vertical component



## Rotated data



● Zero offset VP

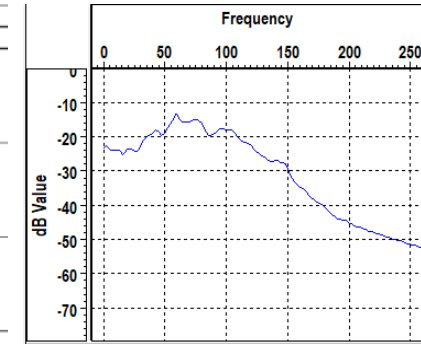
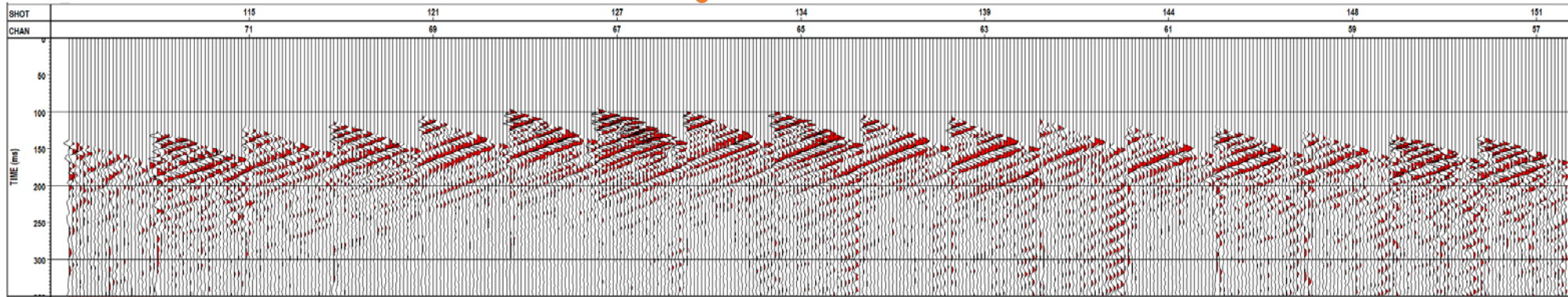




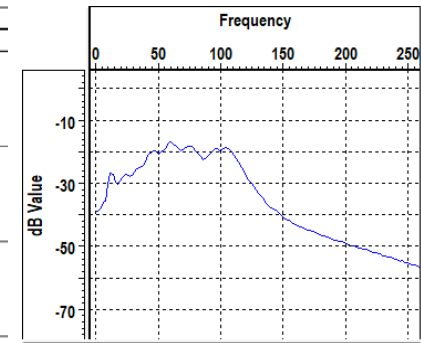
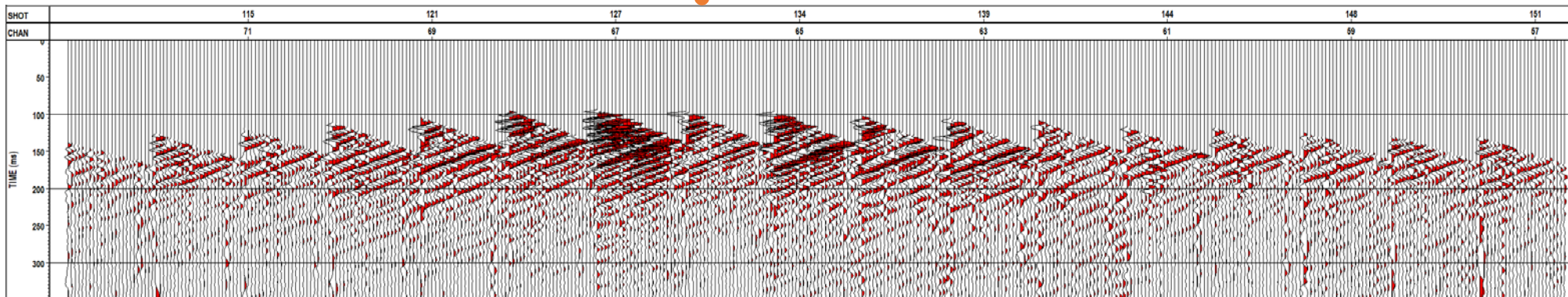
# Processing flow – deconvolution operator

Upgoing wavefield after deconvolution

## Vertical component



## Rotated data

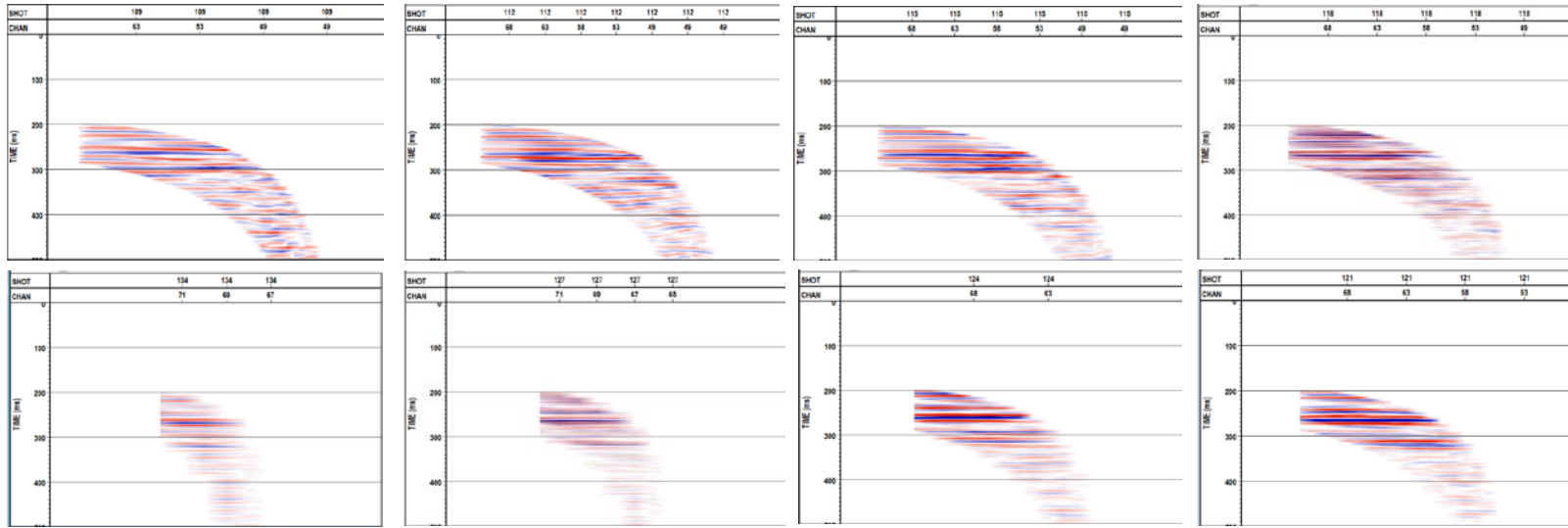


● Zero offset VP

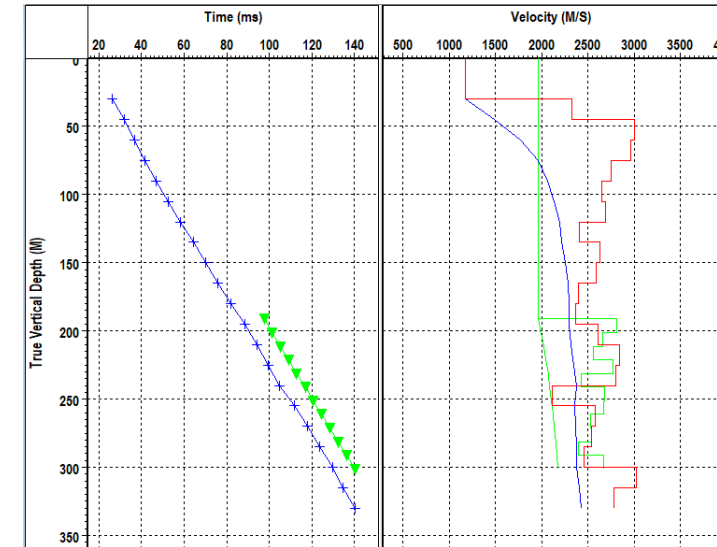
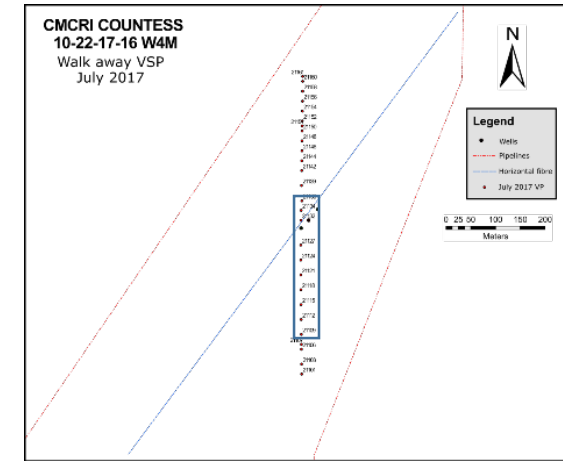
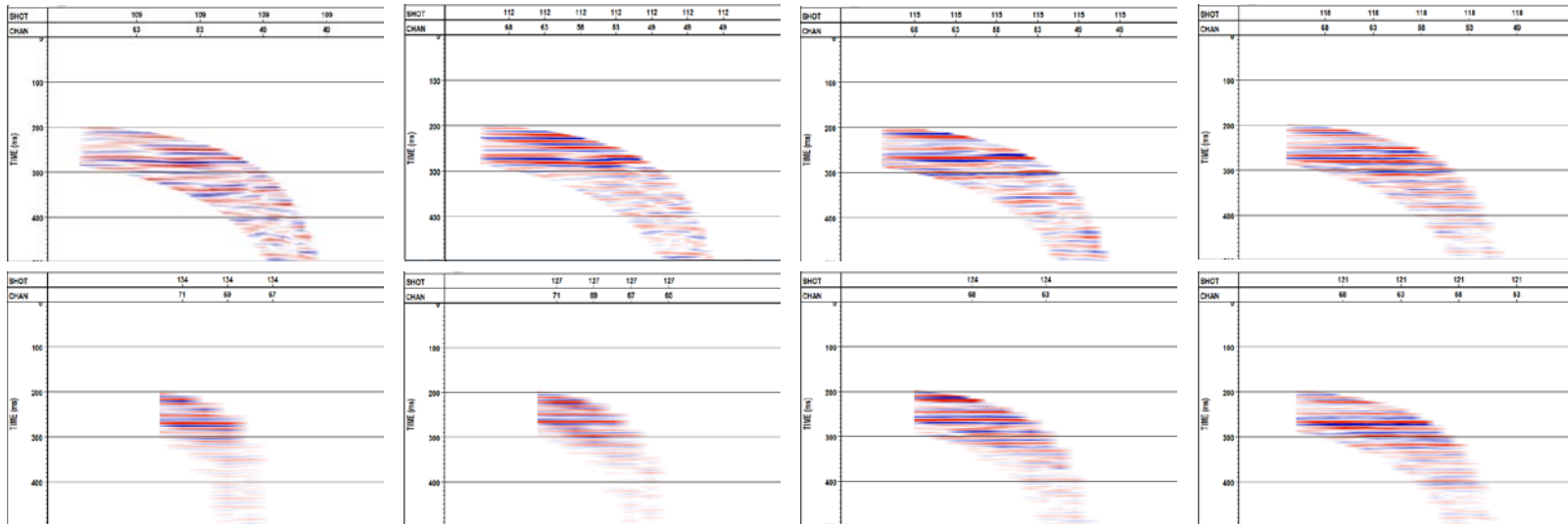


# Processing flow – VSP-CDP transform

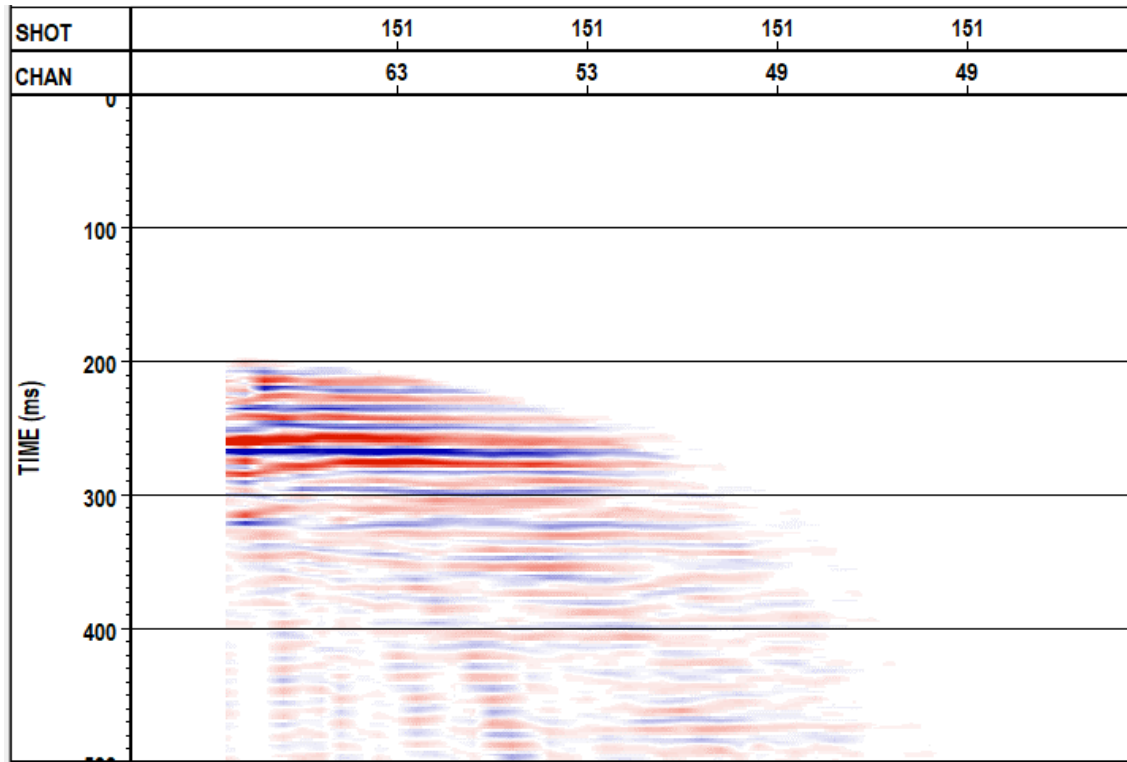
## Vertical component



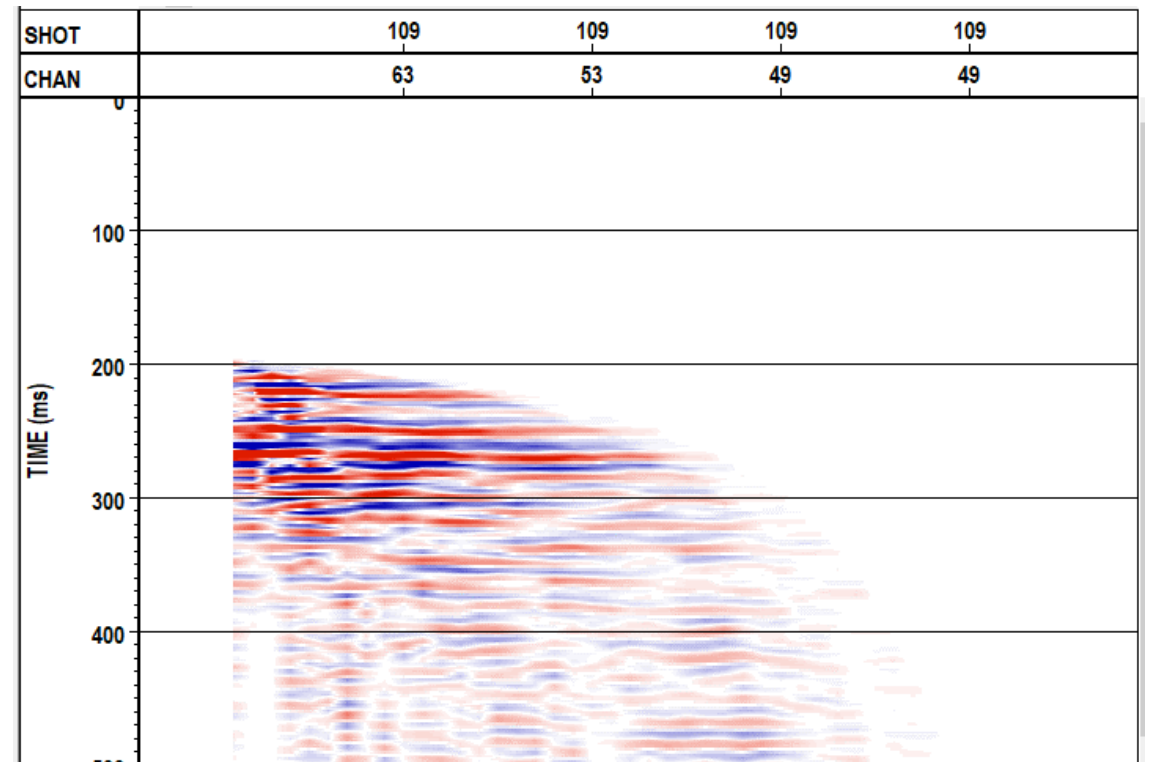
## Rotated data



Vertical component



Rotated data



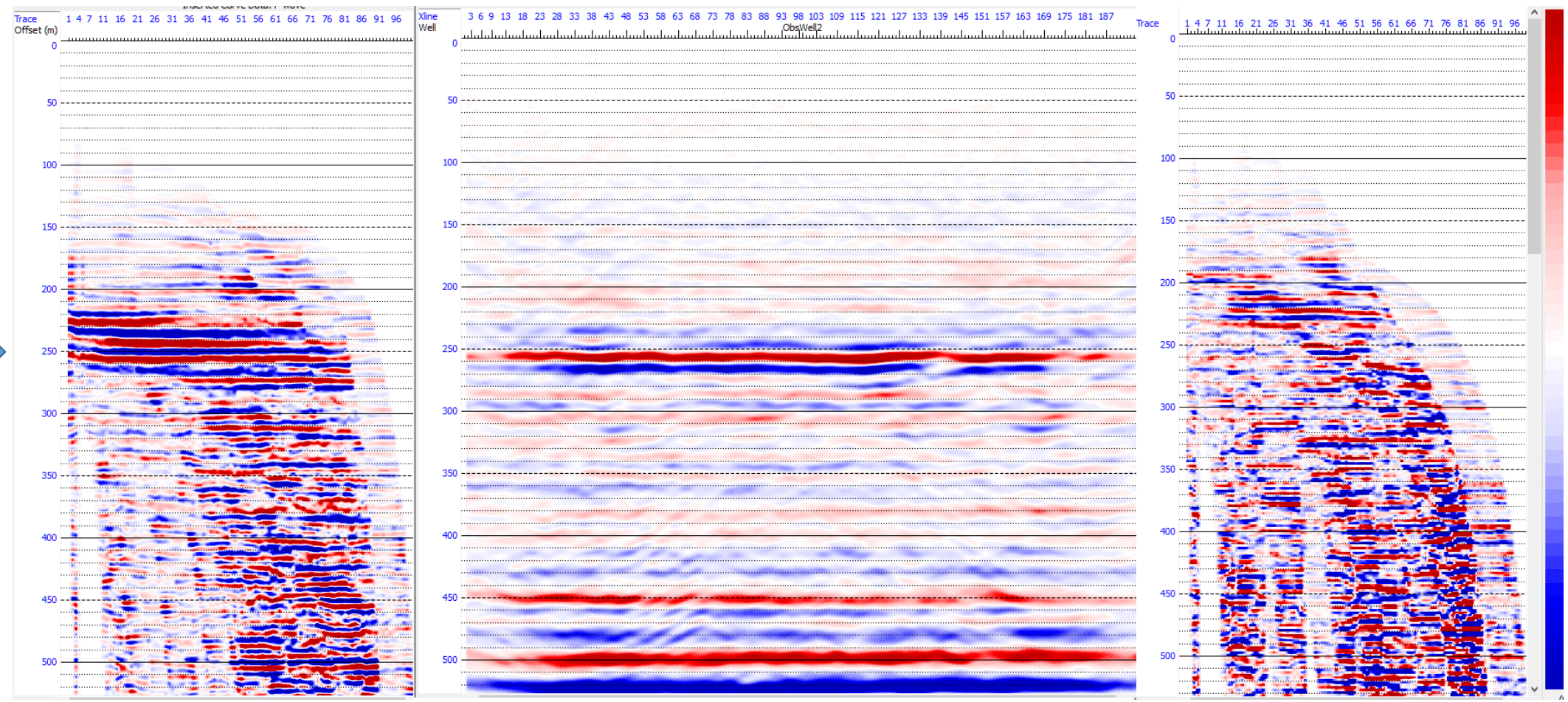


# Results – comparison with 3D seismic

Raw straight fibre

Inline 3D seismic

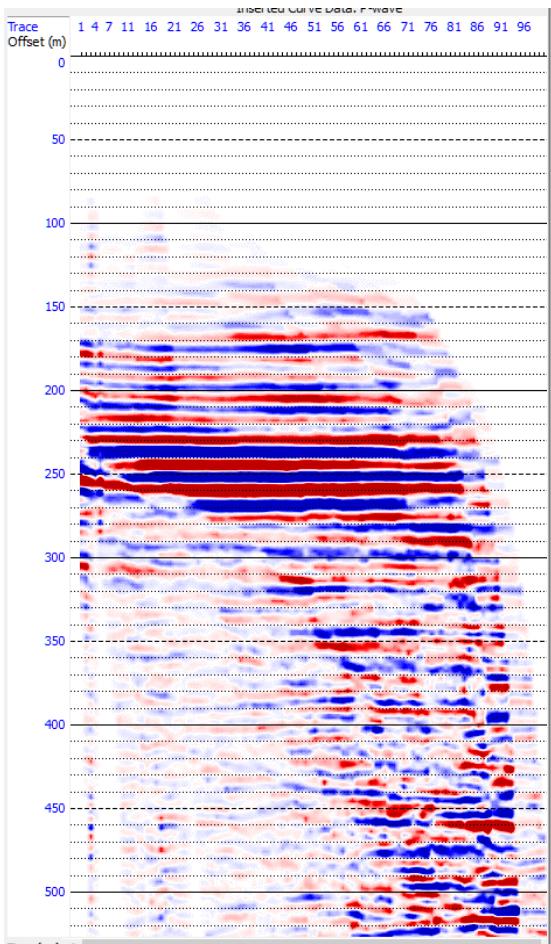
Raw helical fibre



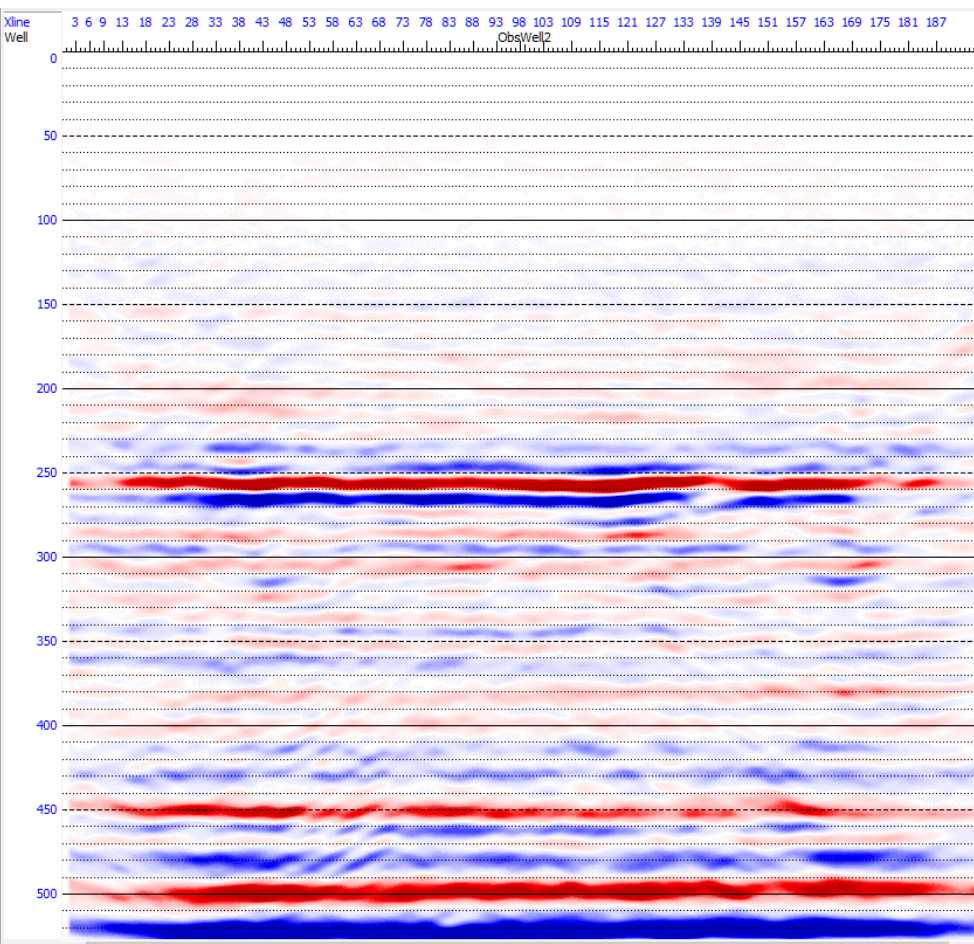


# Results – comparison with 3D seismic

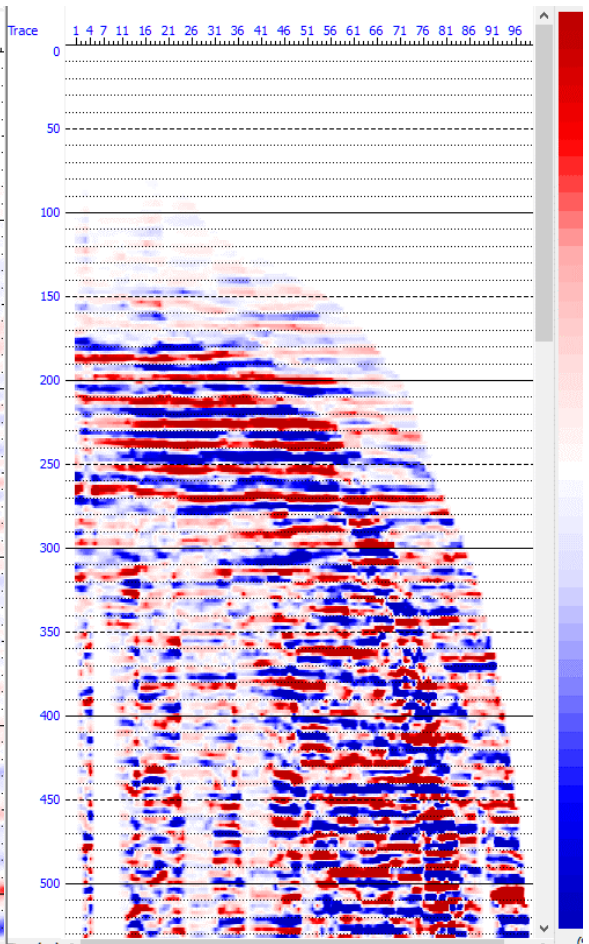
## Integrated straight fibre



## Inline 3D seismic



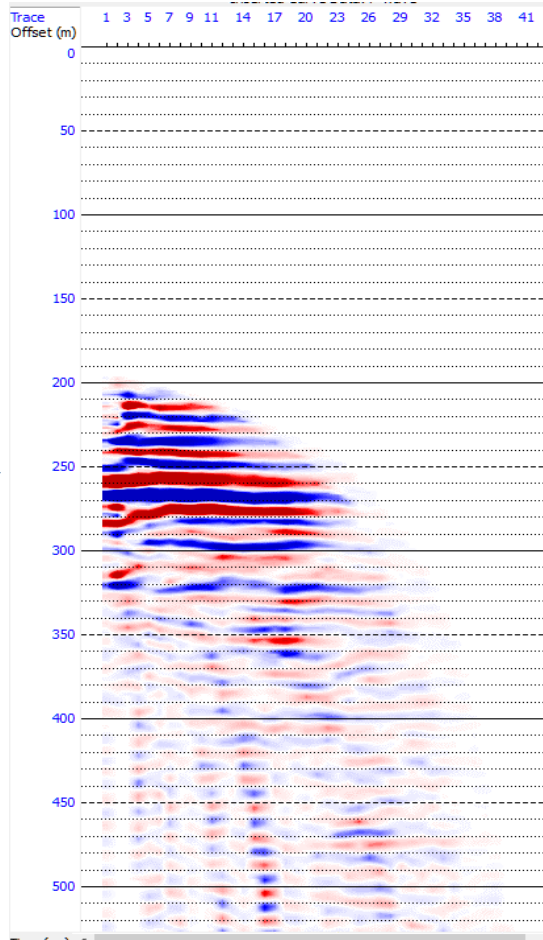
## Integrated helical fibre



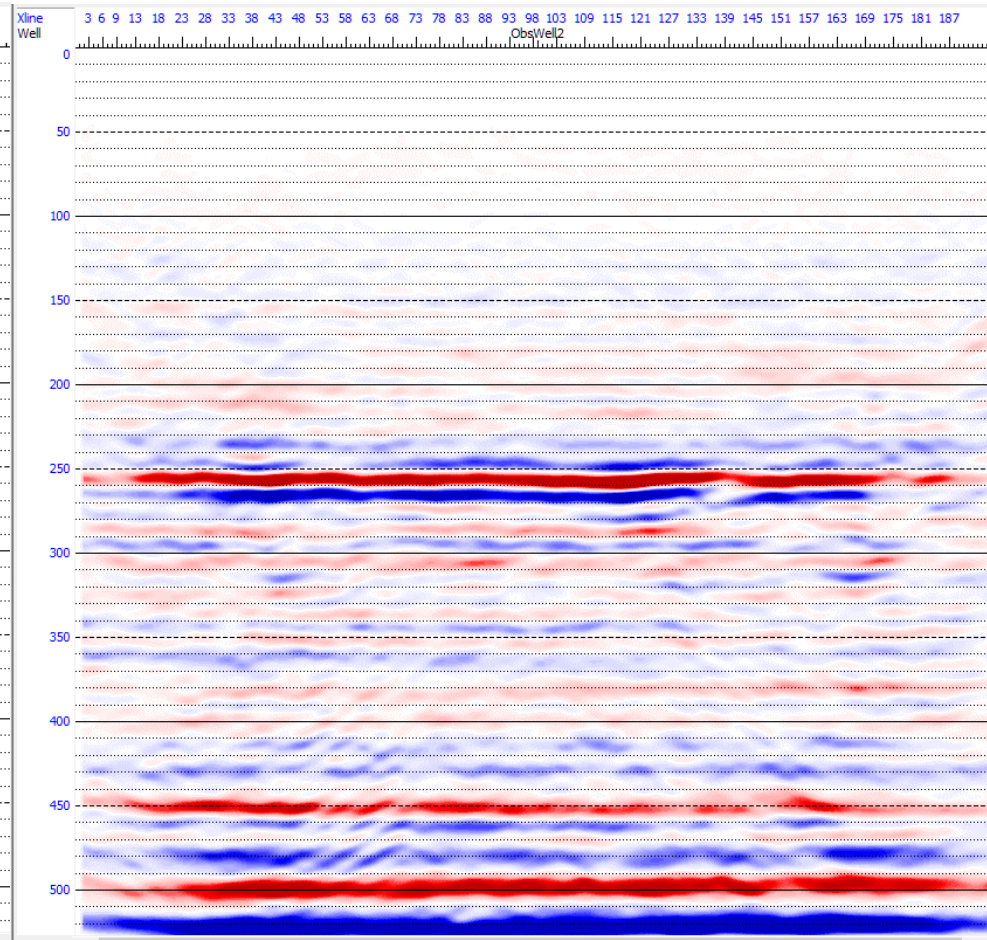


# Results – comparison with 3D seismic

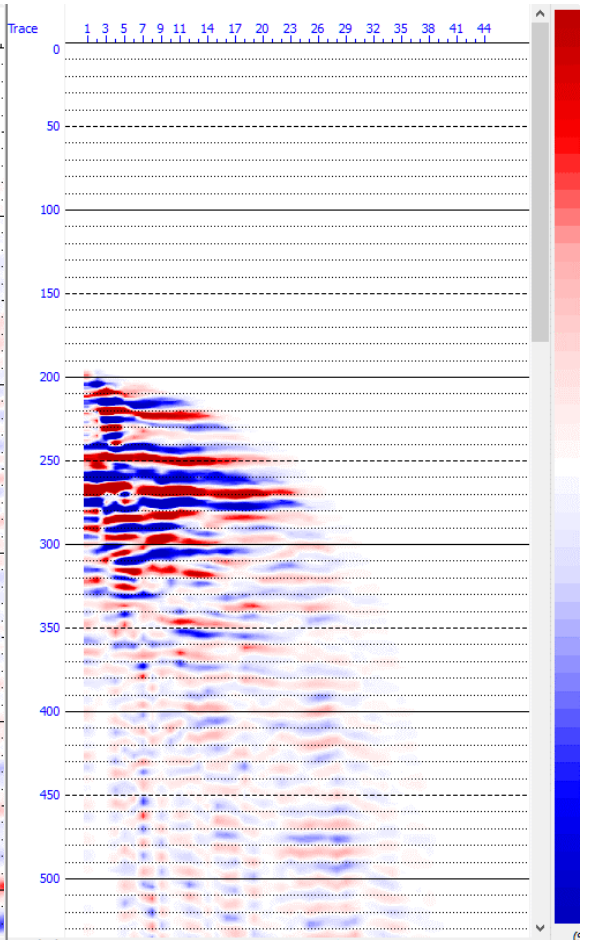
## Vertical component



## Inline 3D seismic



## Rotated data





## Processing walk away VSP

### Straight fibre

- Raw DAS
- Integrated DAS

### Helical wound fibre

- Raw DAS
- Integrated DAS

### 3C Geophones

- Vertical Component
- Multicomponent

- There is a good correlation between the DAS datasets and the geophone data. DAS yields better imaging results in the shallow section thanks to the full coverage of the fibre optic cables in the well.
- A clear identification of the target was achieved for the raw and integrated straight fibre, although the results obtained for the helical fibre seem less continuous in the zone of interest.
- A good correlation was obtained between the stacked sections and a 3D surface survey passing through observation well 2.

DAS measurements seem to be a promising approach for subsurface imaging and continuous monitoring



- CREWES sponsors
- CMC Research Institute Inc.
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- Lawrence Berkeley National Laboratory
- Schlumberger for Vista software