

# CREWES 2018 multi-azimuth walk-away VSP field experiment

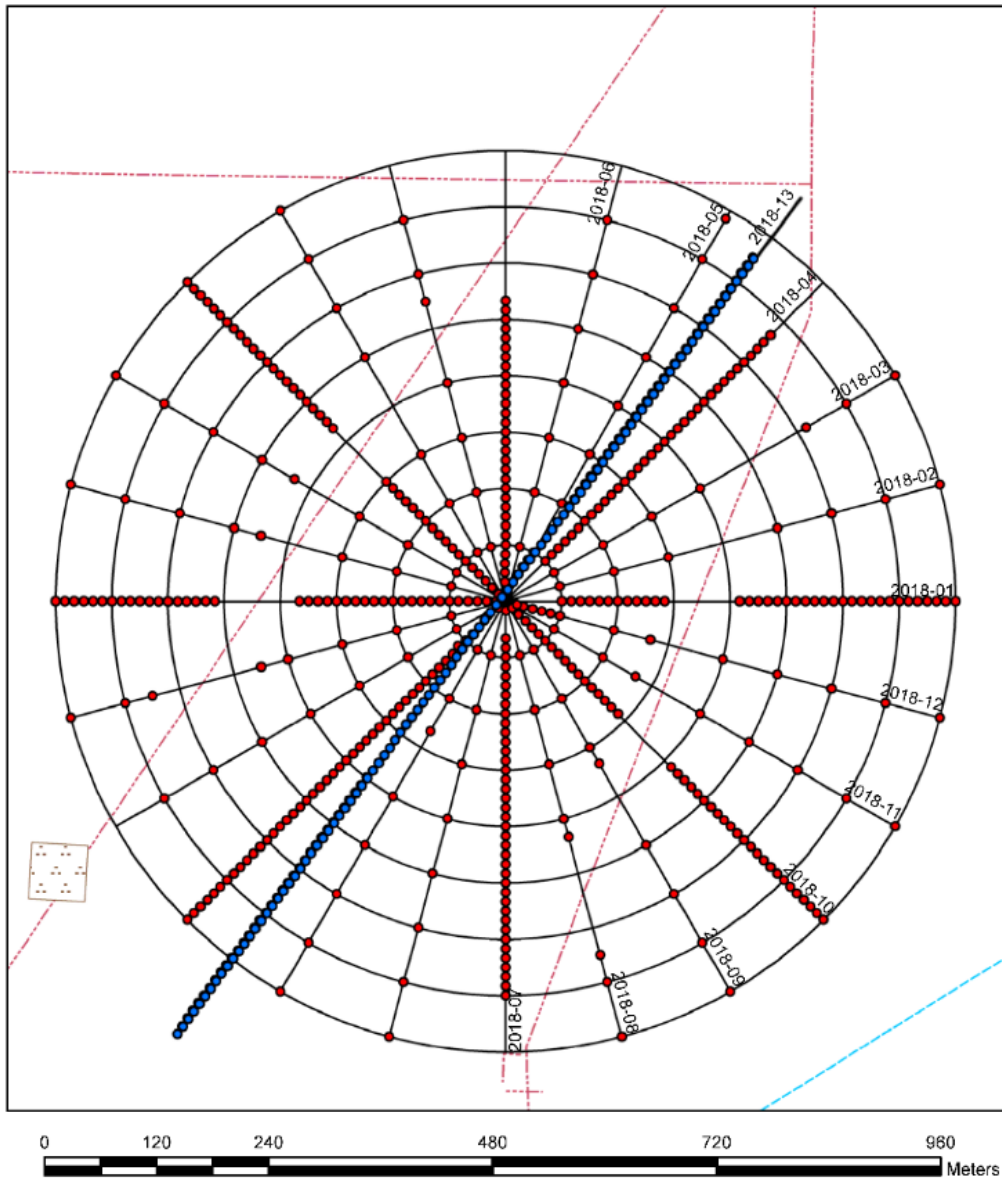
Kevin W. Hall, Kevin L. Bertram, Malcolm Bertram, Kris  
Innanen, Don Lawton

CREWES Meeting, Banff, Nov 29, 2018

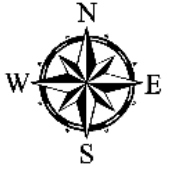
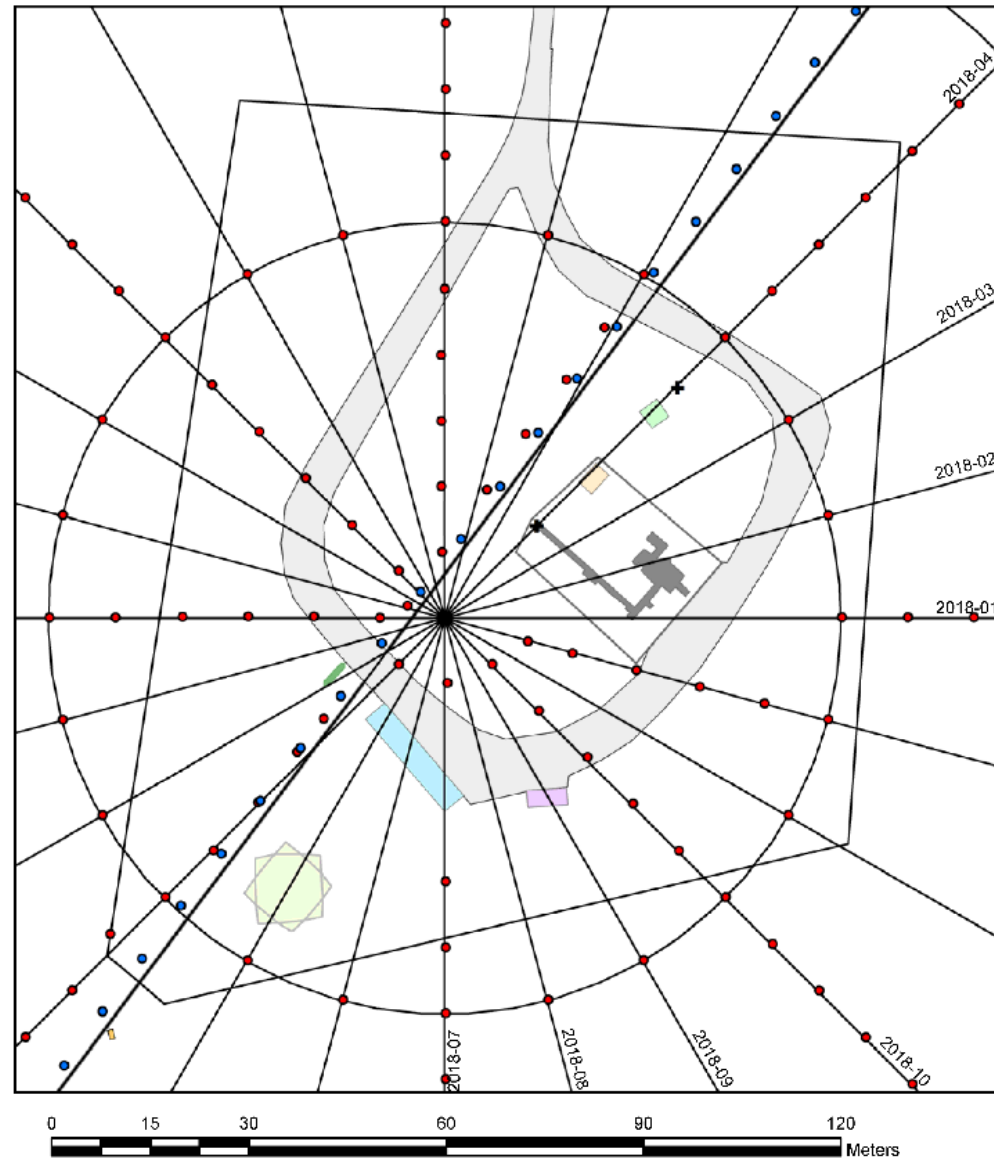


# Survey maps

## Newell County 2018 TL



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- Legend**
- Newell County TL 2018 Receivers
  - Newell County TL 2018 VP
  - Newell County TL Permitted Lines
  - Newell County TL 60m Rings
  - Camli Well Locations
  - Barbed Wire Fence
  - Injection Well - fence
  - Equipment Shed
  - Observation Shack
  - Classroom
  - Propane Tank
  - Electrode Shed
  - Injection Well Shack
  - Well Site Hardware Outline
  - Gravel Road
  - Historic Site (No Access)
  - Hydrocarbon Pipelines
  - Water Pipelines
  - Horizontal Fibre
  - Fibre/Fretzel 2018\_lines



Inova Univib

Linear Sweep

1-150 Hz

16 s

0.5 s half-cosine

tapers

3 s listen



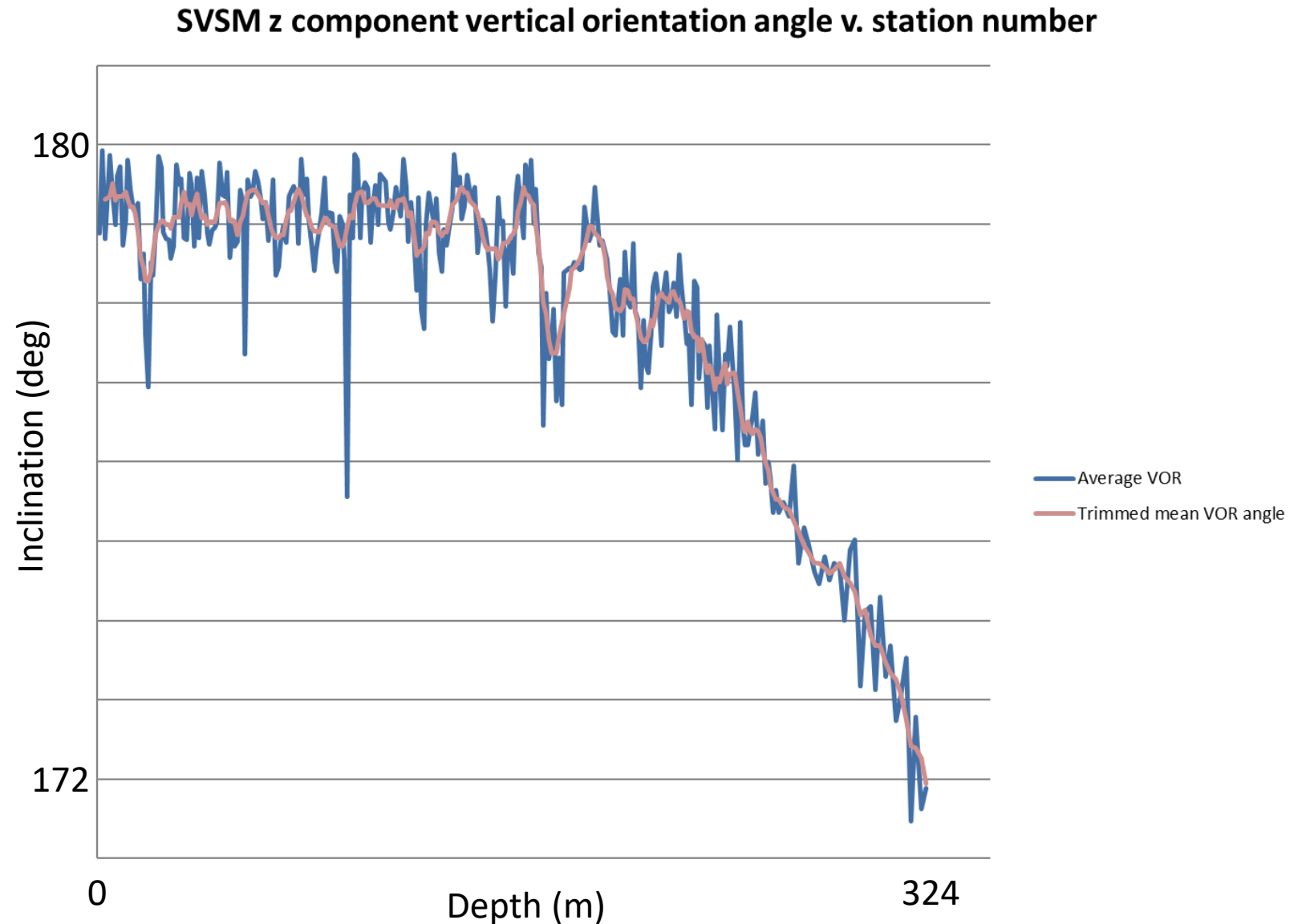


## Inova VectorSeis

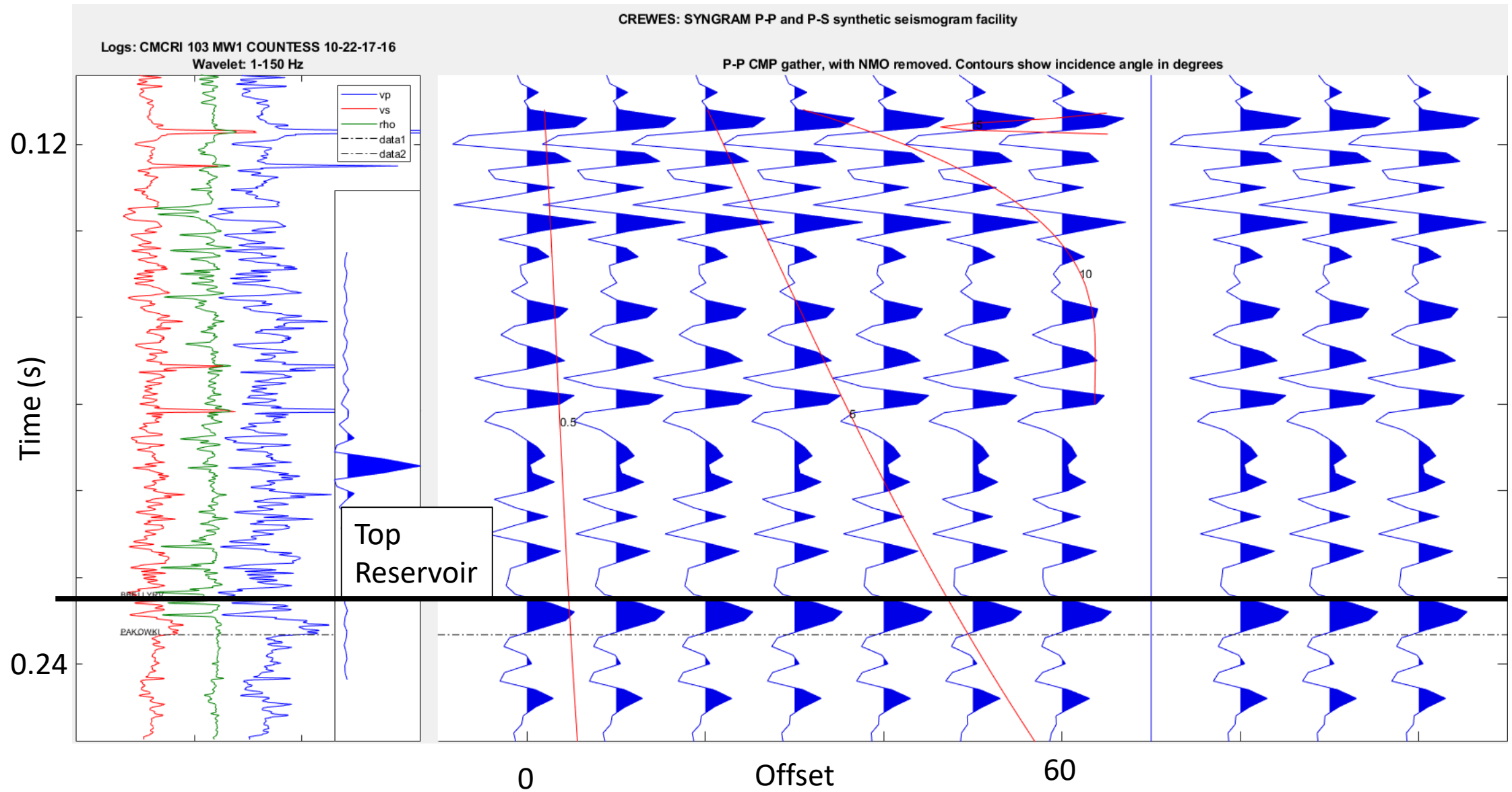
- 1 m depth interval

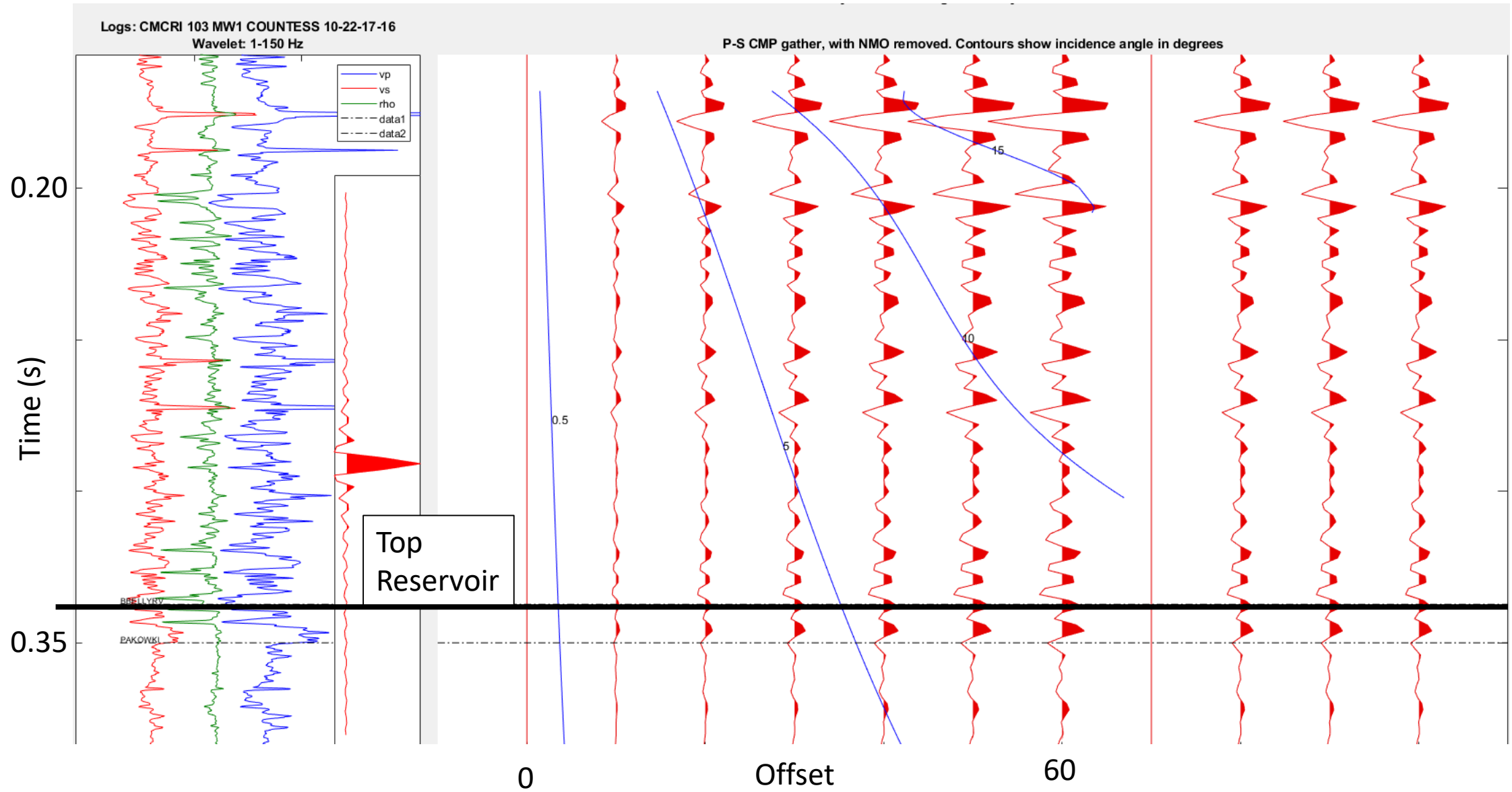
Deviation from vertical at bottom:

- 0.3 m vertical
- 5.6 m horizontal
- unknown azimuth



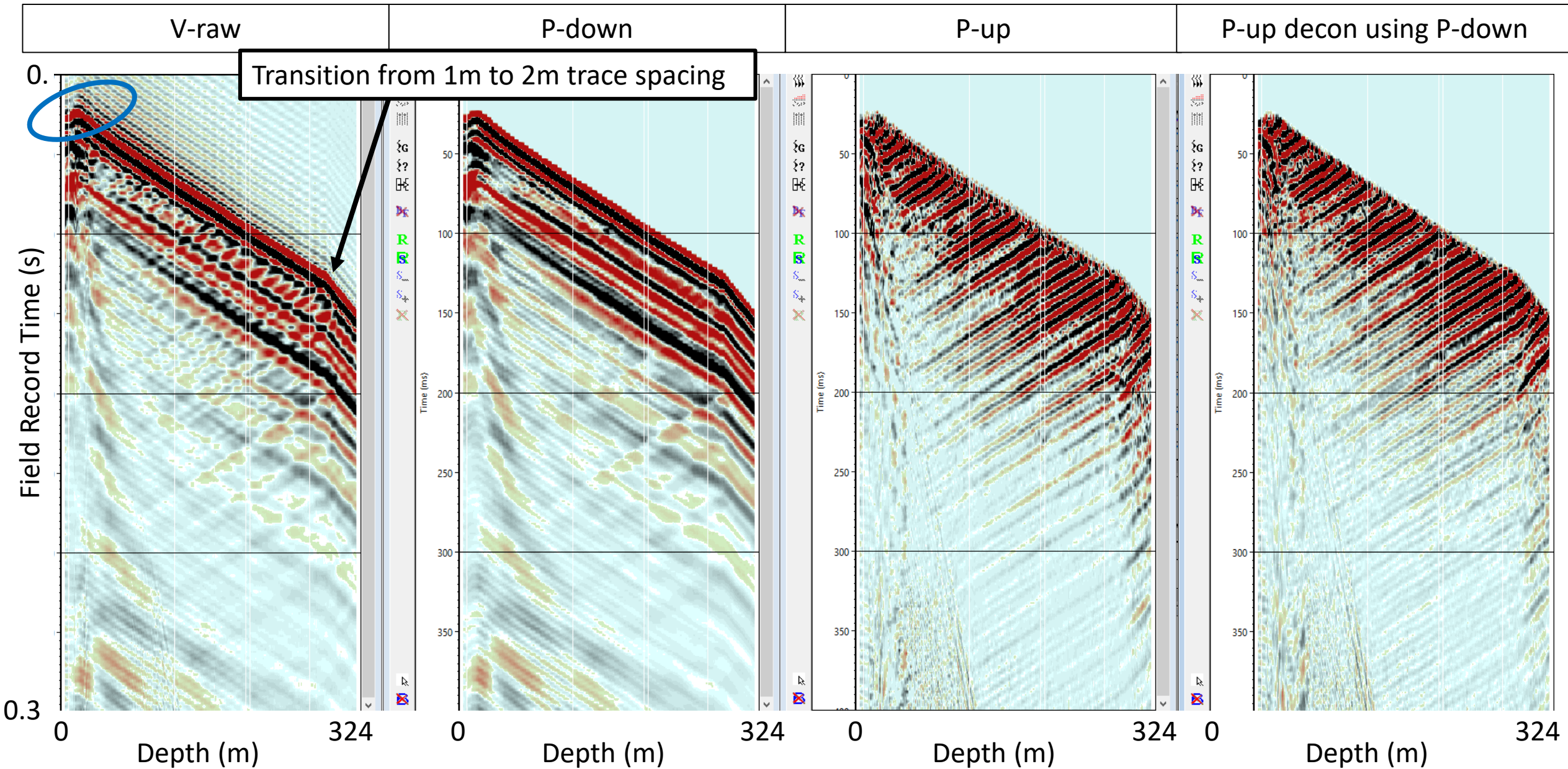






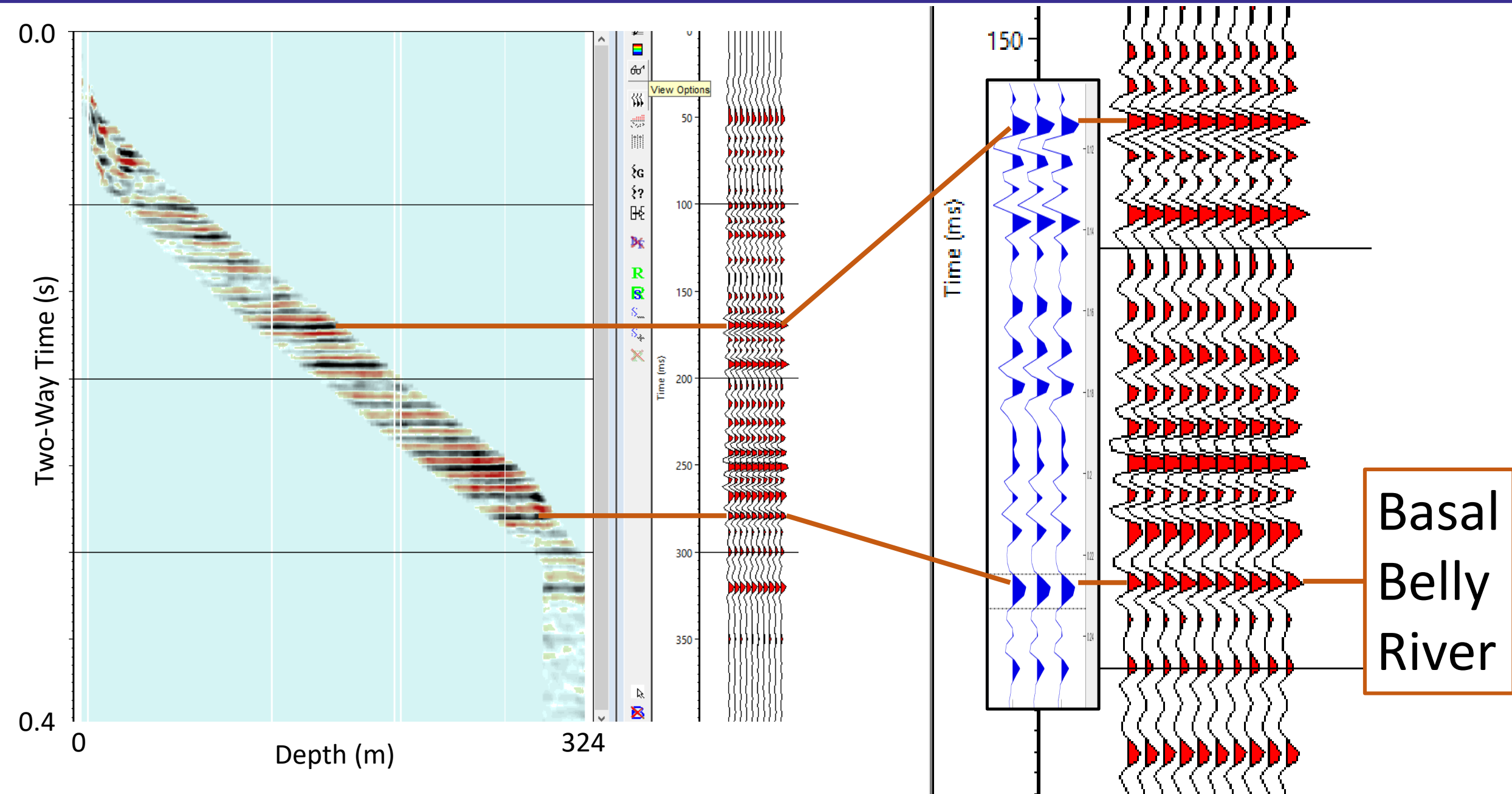


# Zero offset VSP, VP 1149, 6 m from well head: wavefield separation





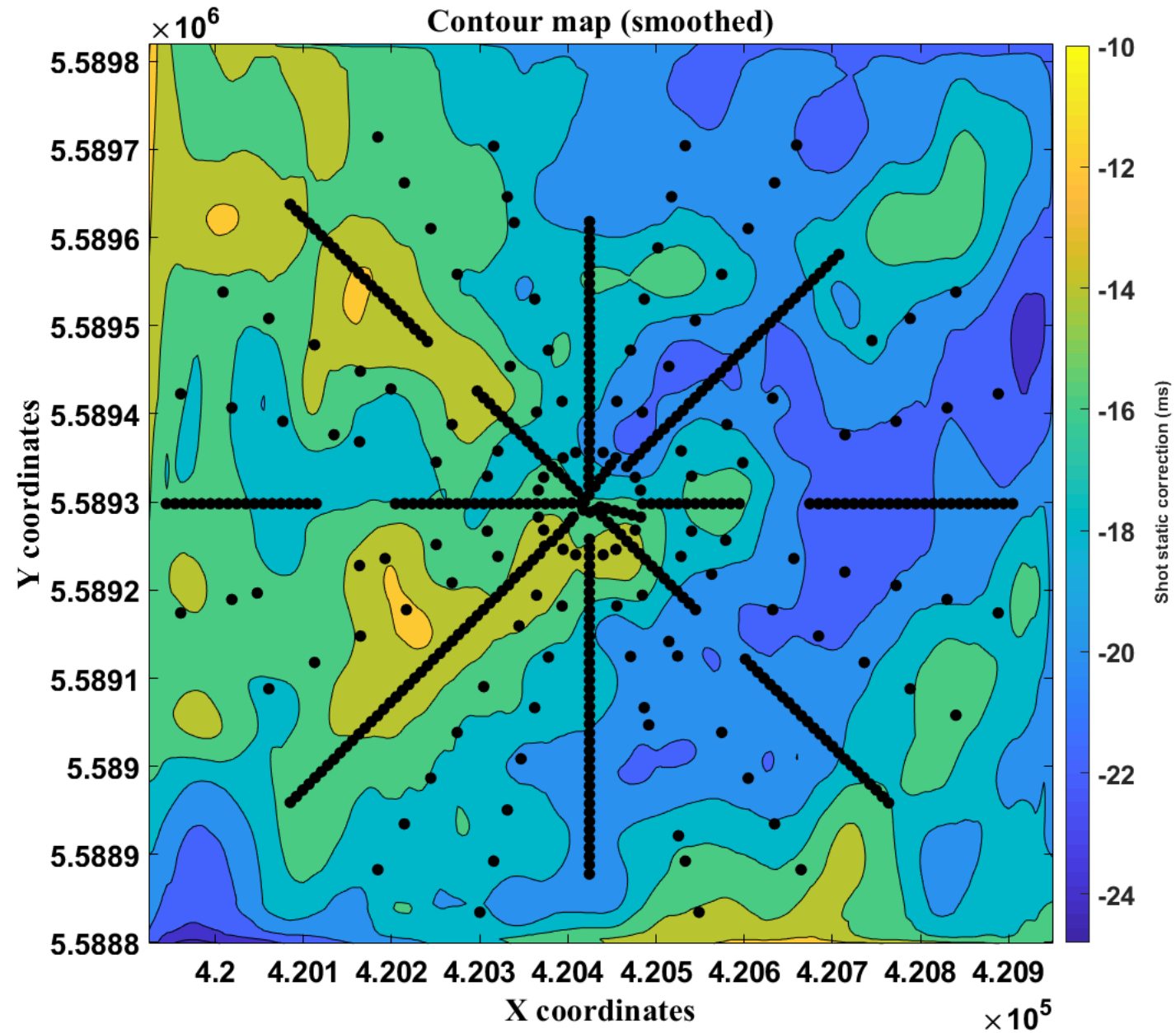
# Zero offset VSP corridor stack compared to synthetic





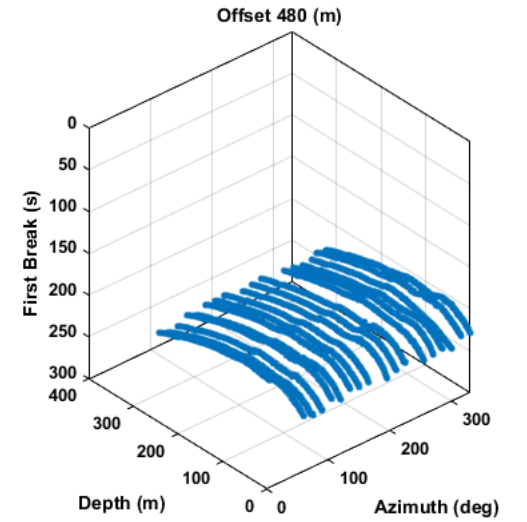
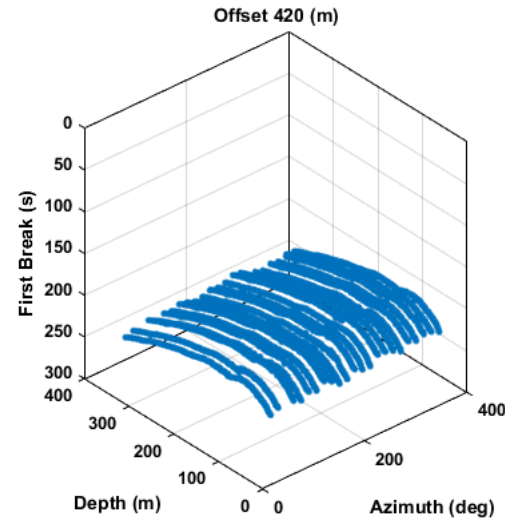
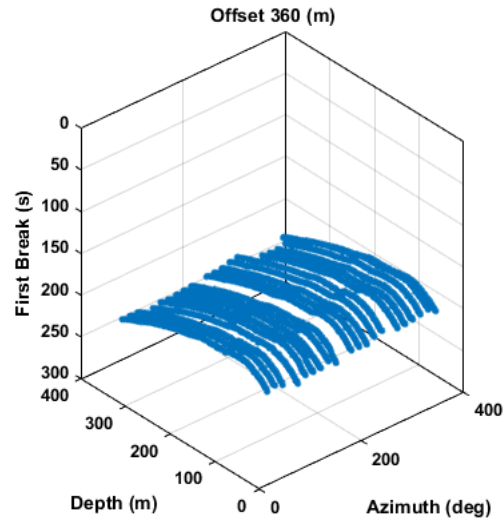
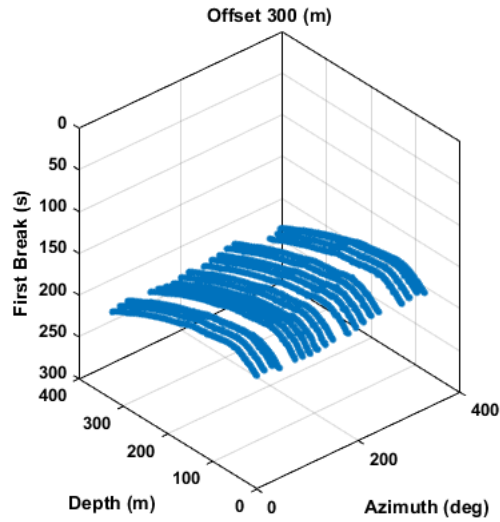
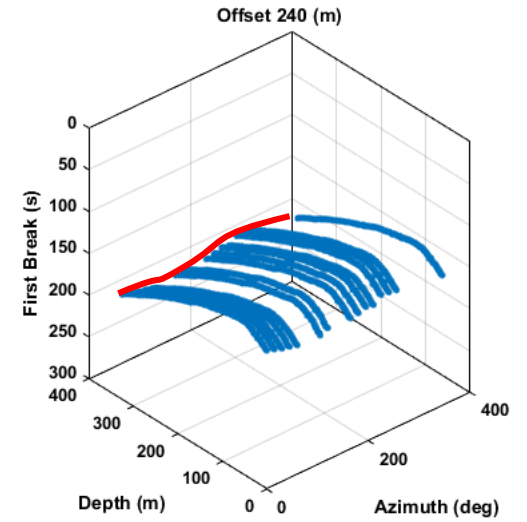
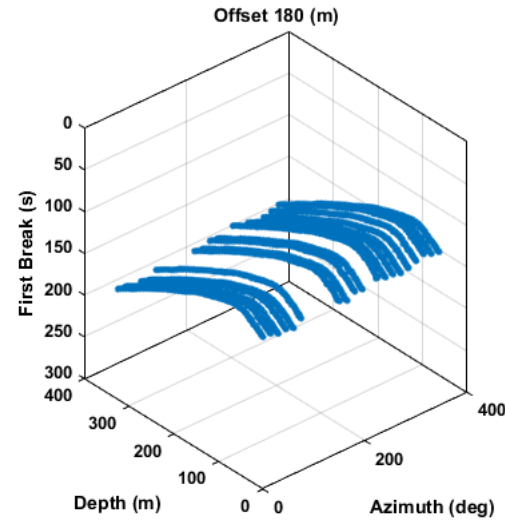
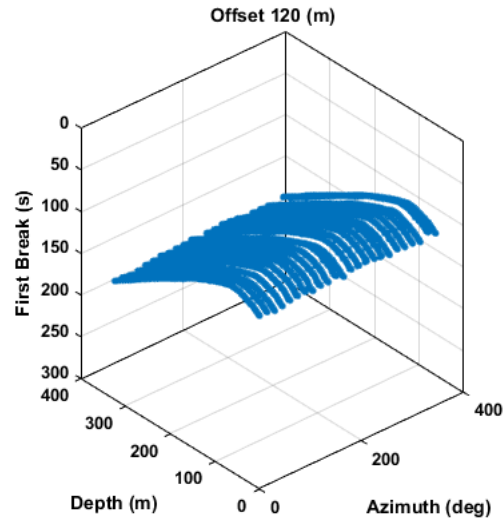
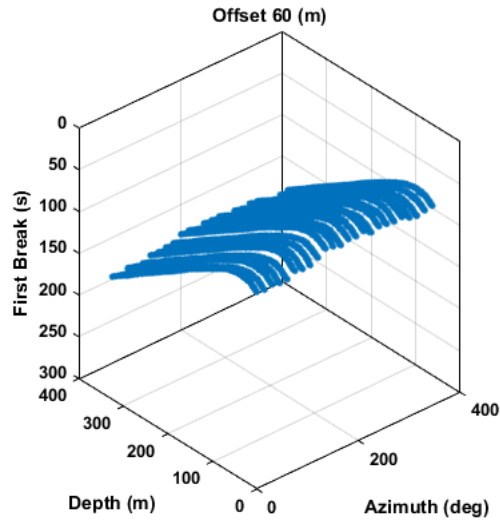


# 2018 VSP VP overlain on interpolated and smoothed 2014 shot statics



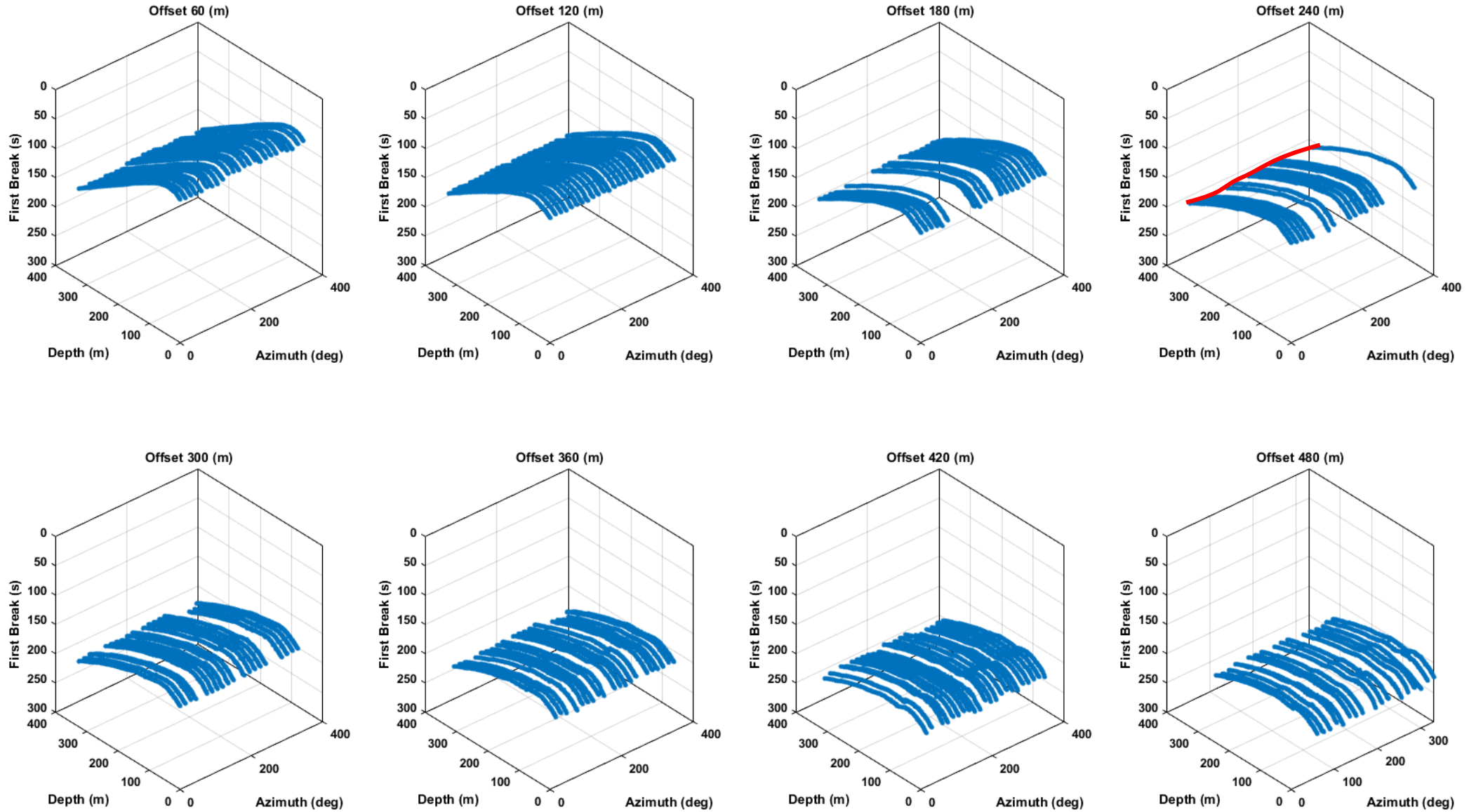


# Offset panels: First-break picks – looking for anisotropy





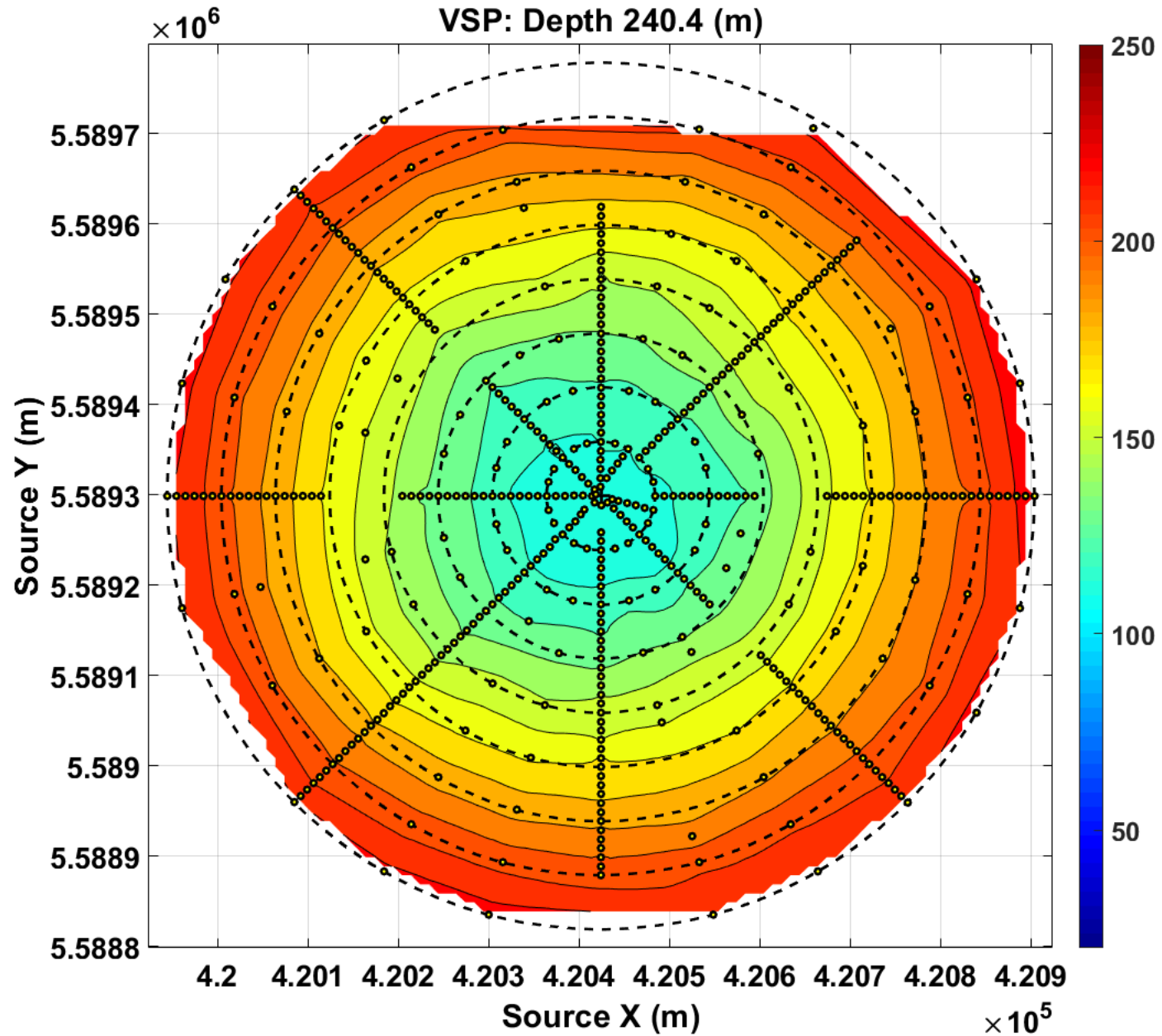
# Offset panels: First-break picks – looking for anisotropy



Now with source statics!



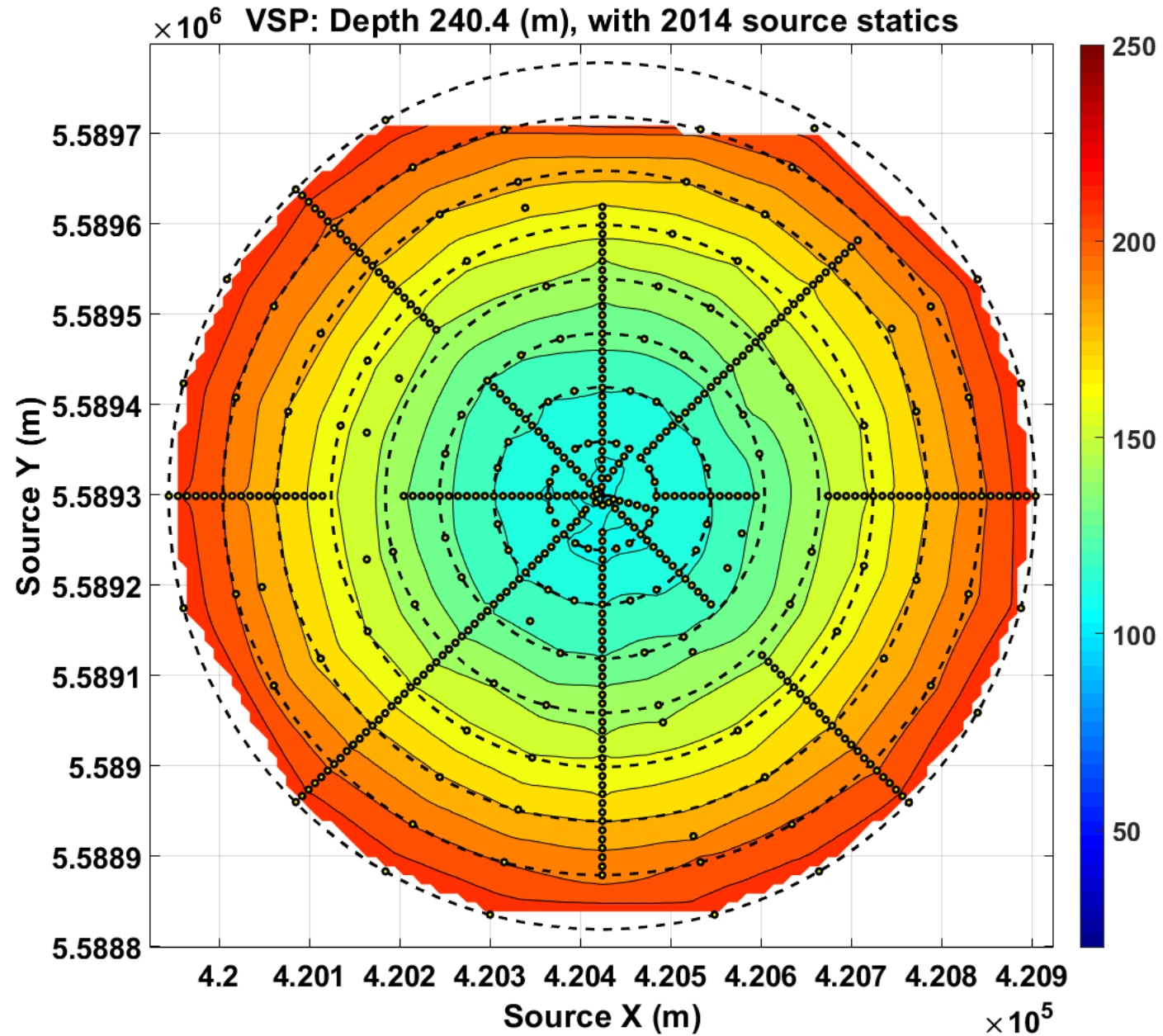
# Contour map: First-break picks – looking for anisotropy







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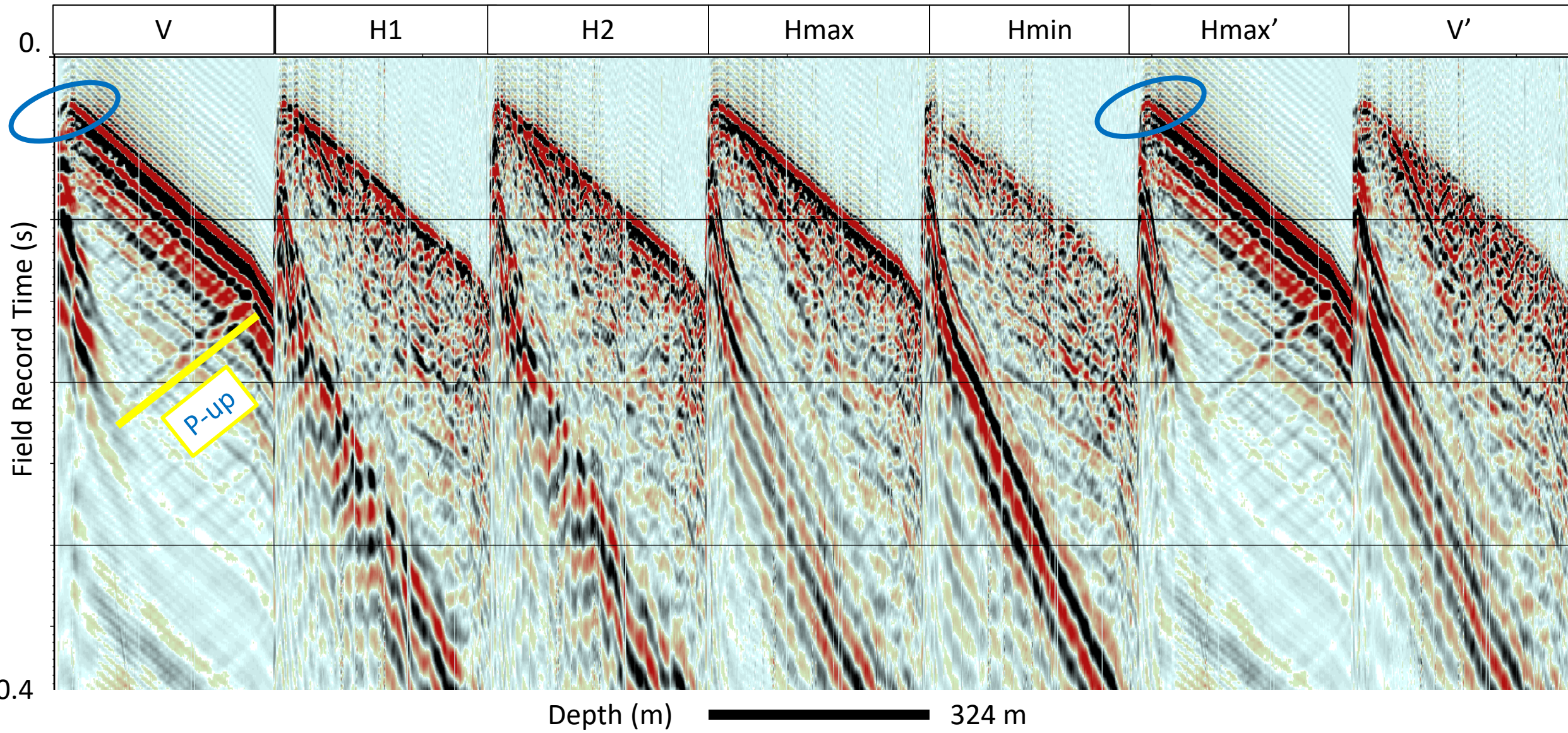
Now with source statics!





# Far offset VSP, VP 1151; 20 m from wellhead, component rotation

Time Invariant Component Rotation

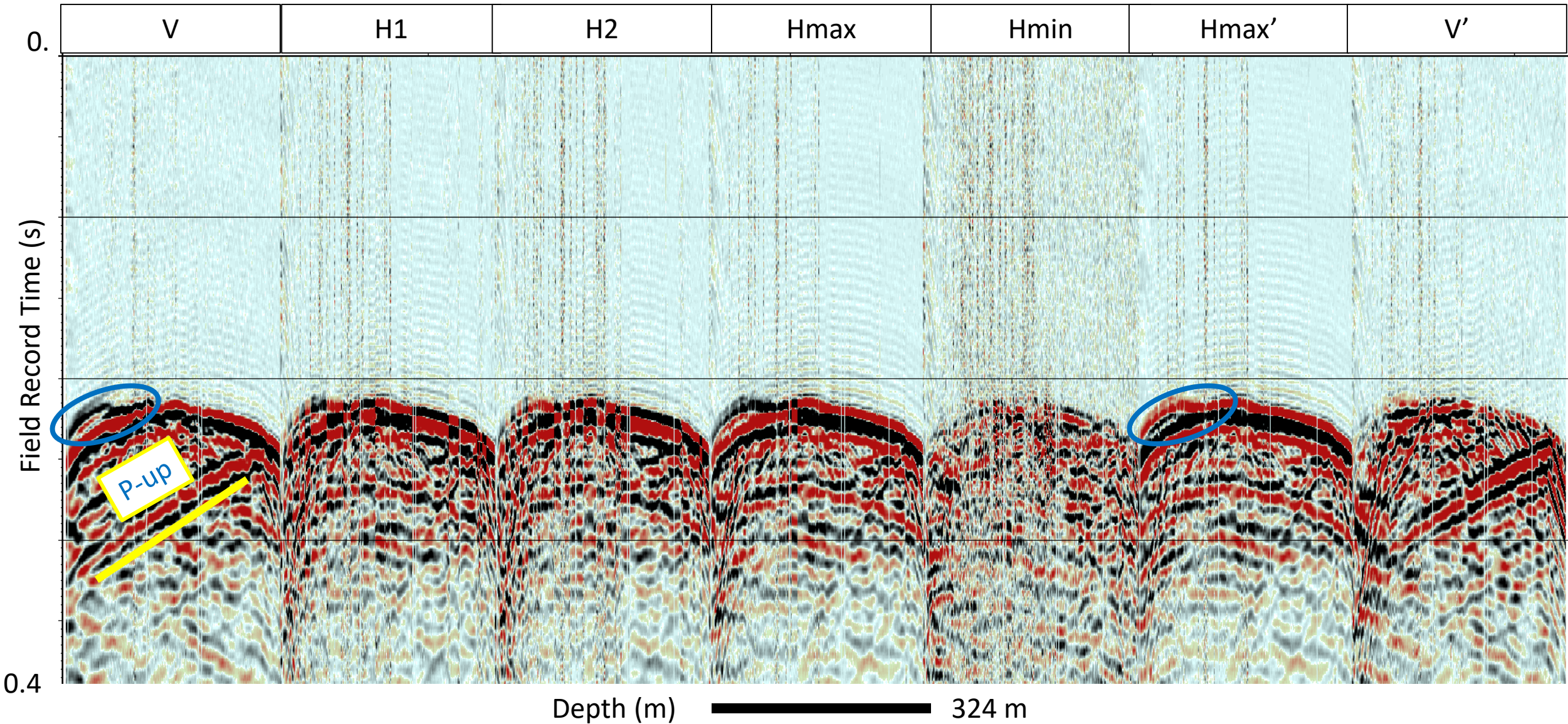






# Far offset VSP, VP 1101; 480 m from wellhead, component rotation

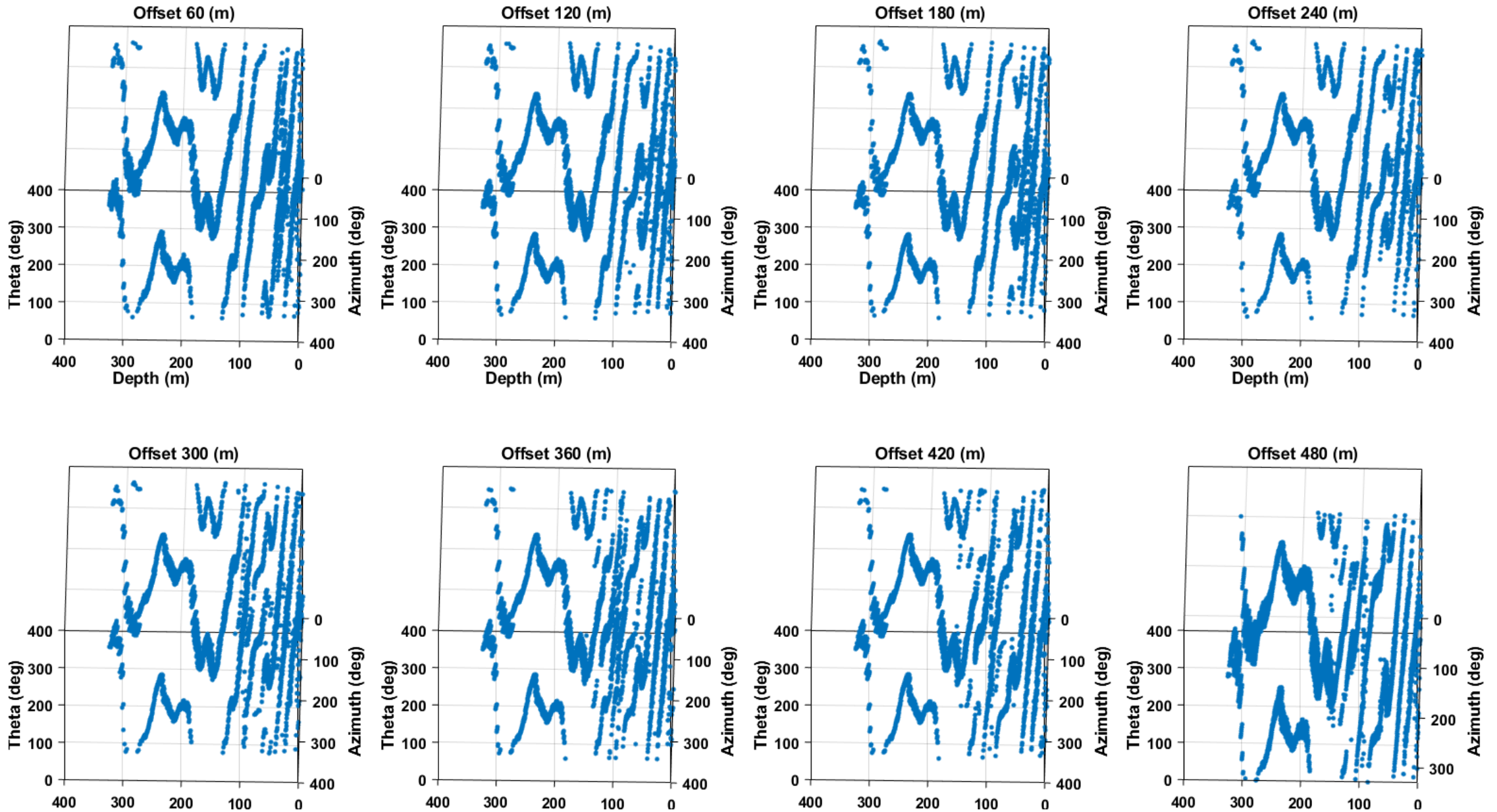
Time Invariant Component Rotation







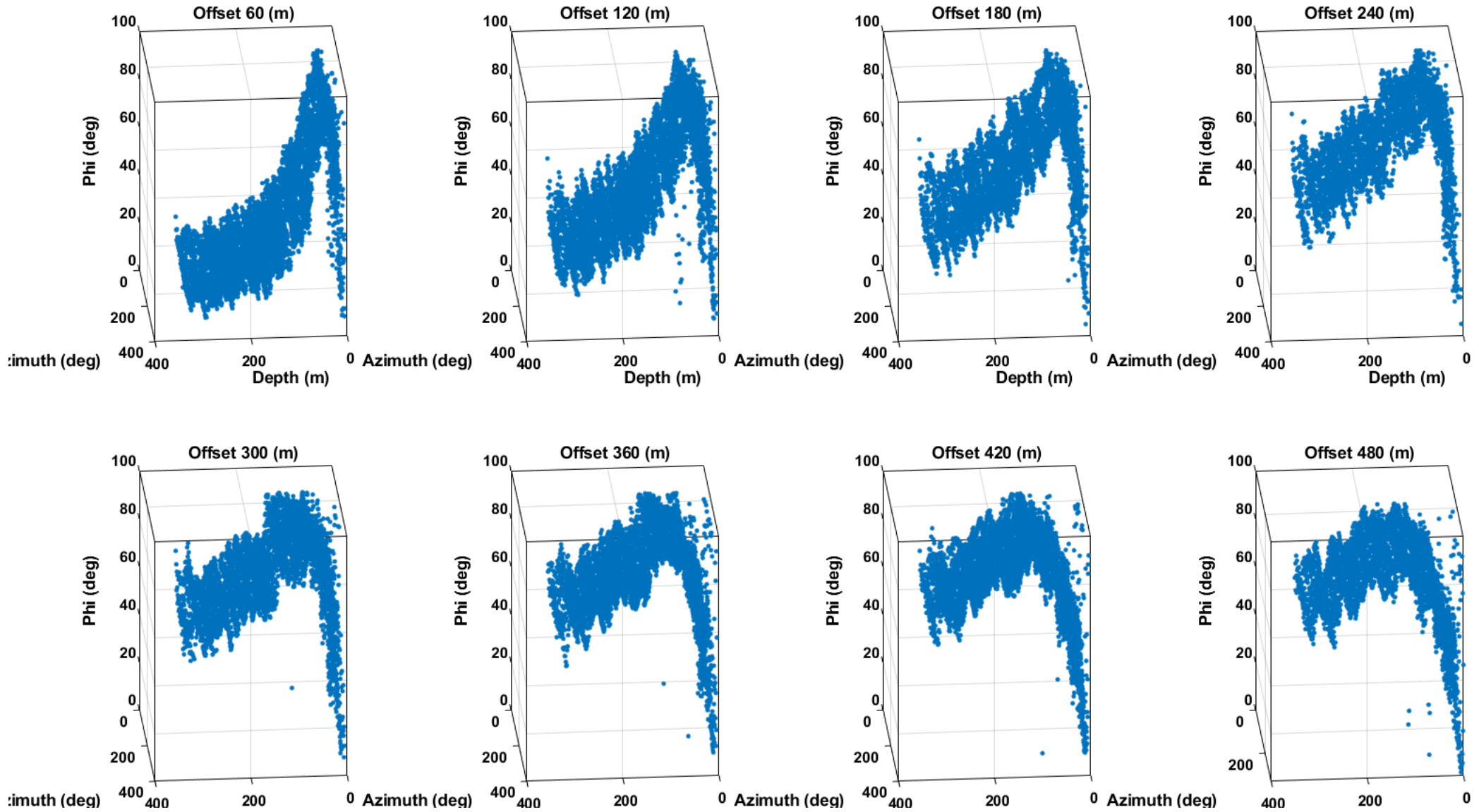
# Offset panels: Rotation angle theta [H1,H2 -> Hmin,Hmax]







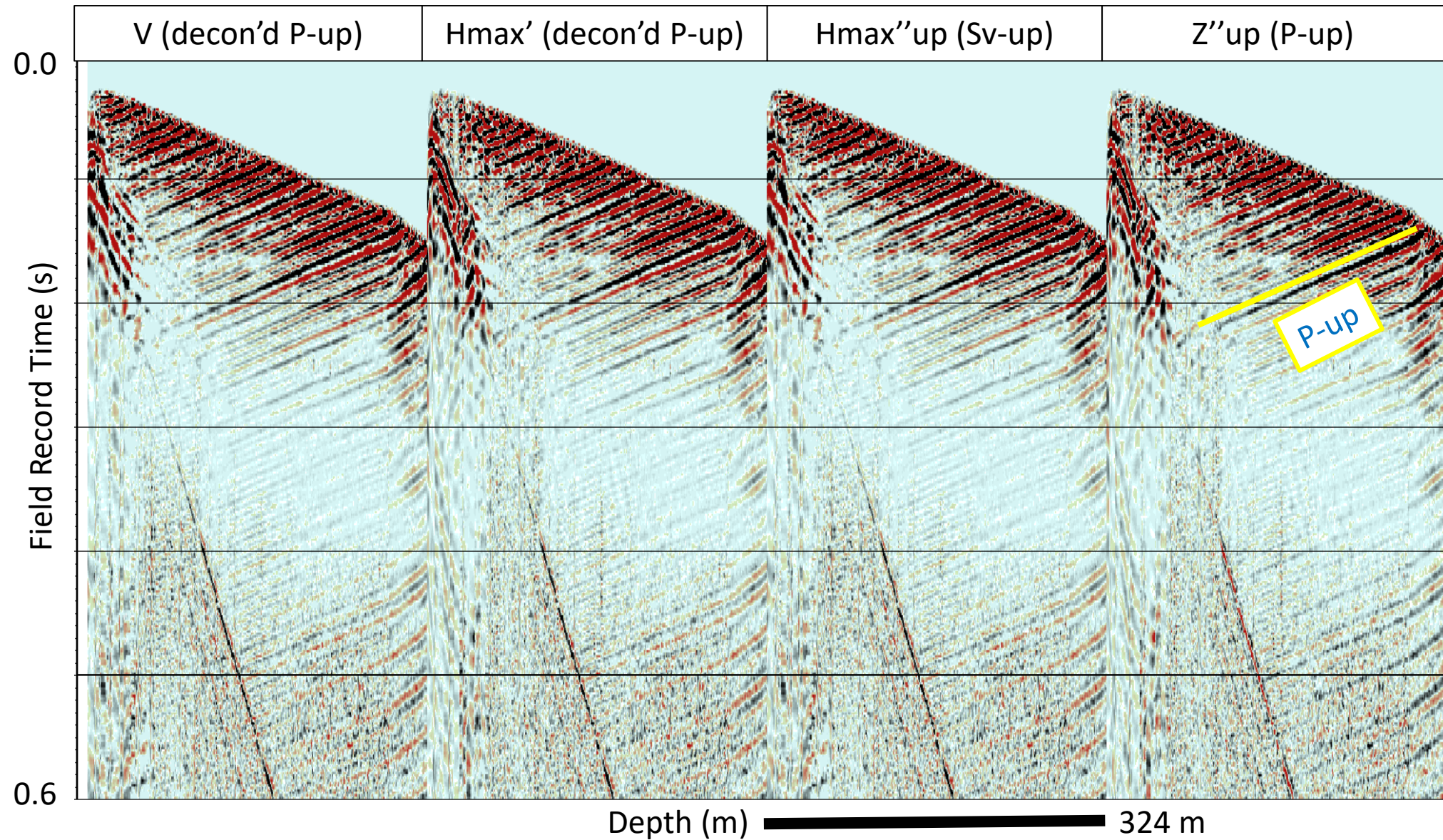
# Offset panels: Rotation angle phi [Hmax,V -> Hmax',V']





# Far offset VSP, VP 1151; 20 m from wellhead, component rotation

Time Variant Component Rotation

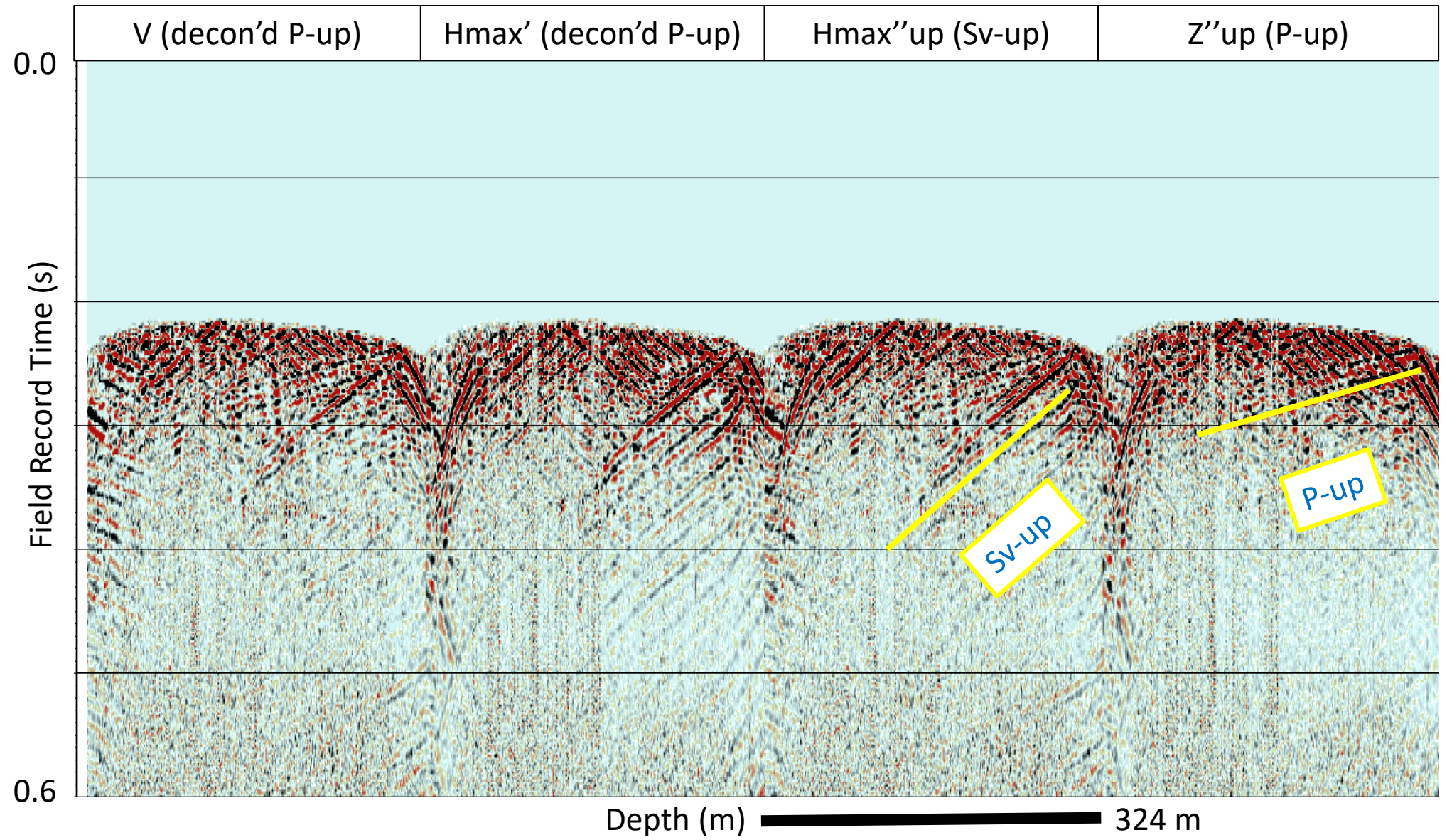






# Far offset VSP, VP 1101; 480 m from wellhead, component rotation

Time Variant Component Rotation



## **Zero-offset VSP**

- Processed to deconvolved corridor stack
- Good match with synthetic

## **Anisotropy:**

- Evidence for weak HTI on site
- Less compelling after source statics

## **Far-offset VSP:**

- Processed to Hmax'' up (Sv) and Z'' up (P) (component rotations and deconvolution)

## **Future Work**

- Parameter testing and QC
- Refined well ties and interpretation
- Creation of 3D anisotropic depth model (isotropic?)
- Completion of far-offset P-P and P-S VSP processing
- Comparison to fibre and geophone data
- Full waveform





## **Field Operations**

- Fotech Solutions
- GPUSA
- High Definition Seismic Corporation
- Inova Geophysical

## **Software:**

- Mathworks
- Raul Cova (CREWES)
- Schlumberger

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- Canada First Research Excellence Fund
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