

# 3D3C seismic data from the Brooks site

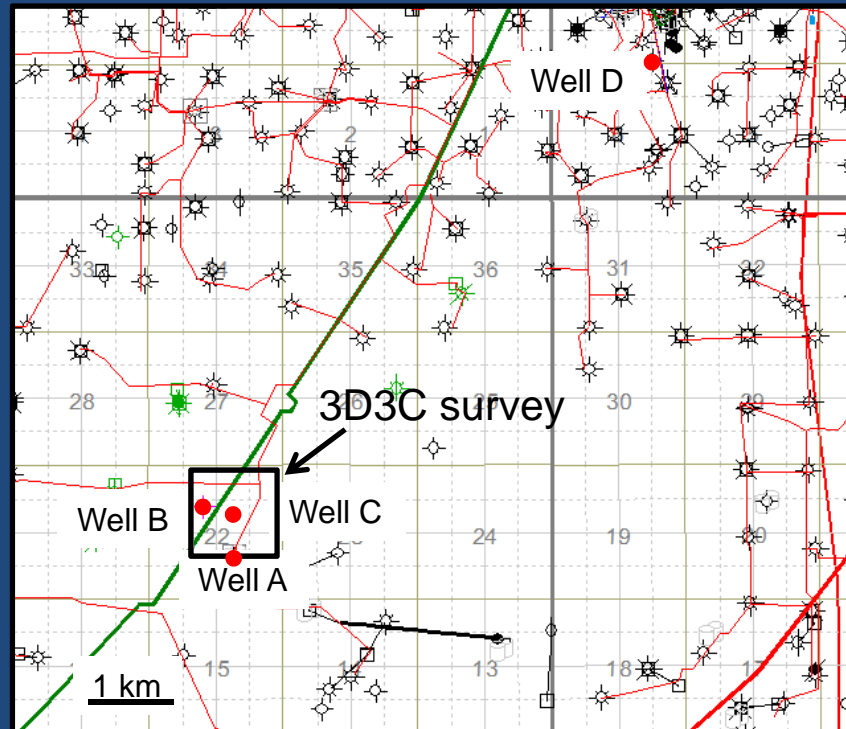
J. Helen Isaac and Don C. Lawton



## Outline

- Study area
- Seismic data and synthetic seismograms
- Interpretation and  $V_p/V_s$
- Summary
- Acknowledgements

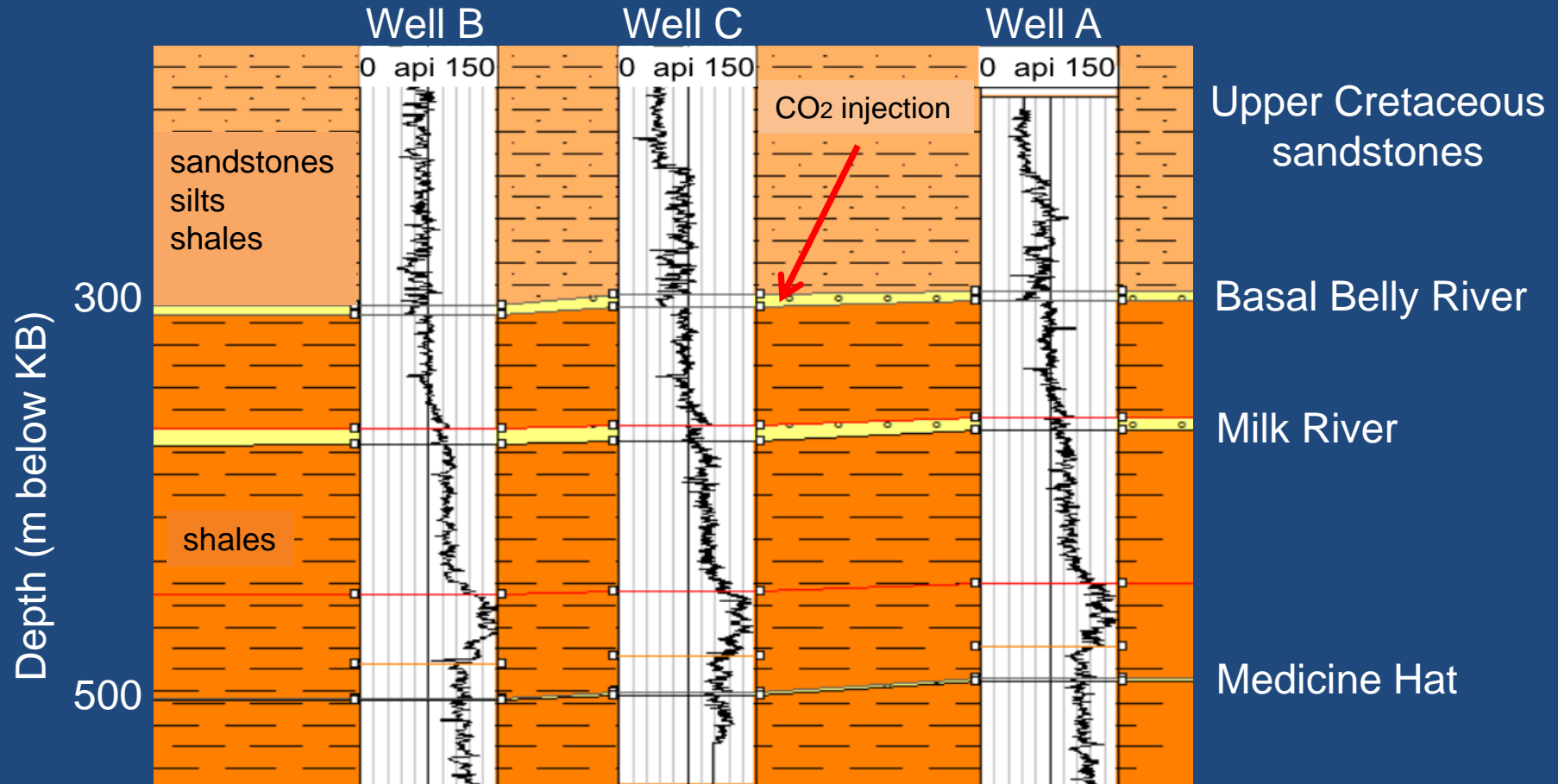
# Study Area



Field Research Station  
near Brooks, Alberta

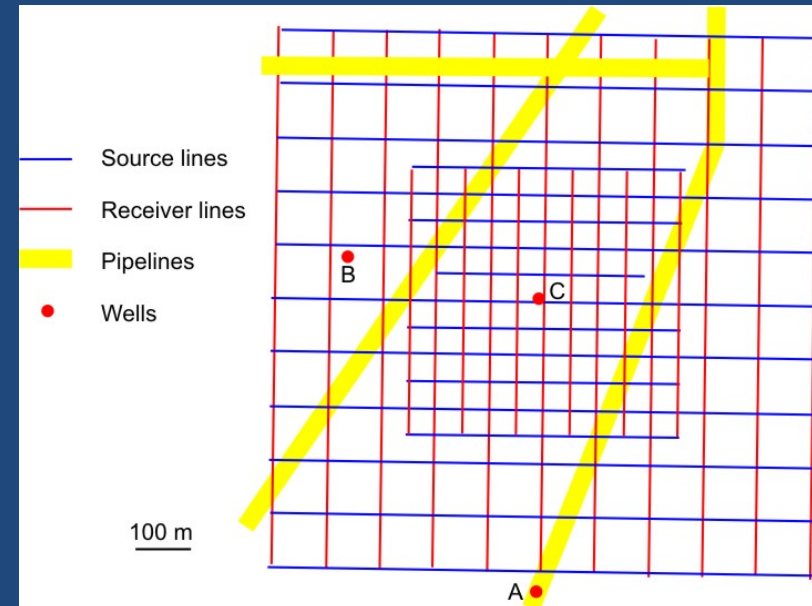
CO<sub>2</sub> Containment and Monitoring  
Institute

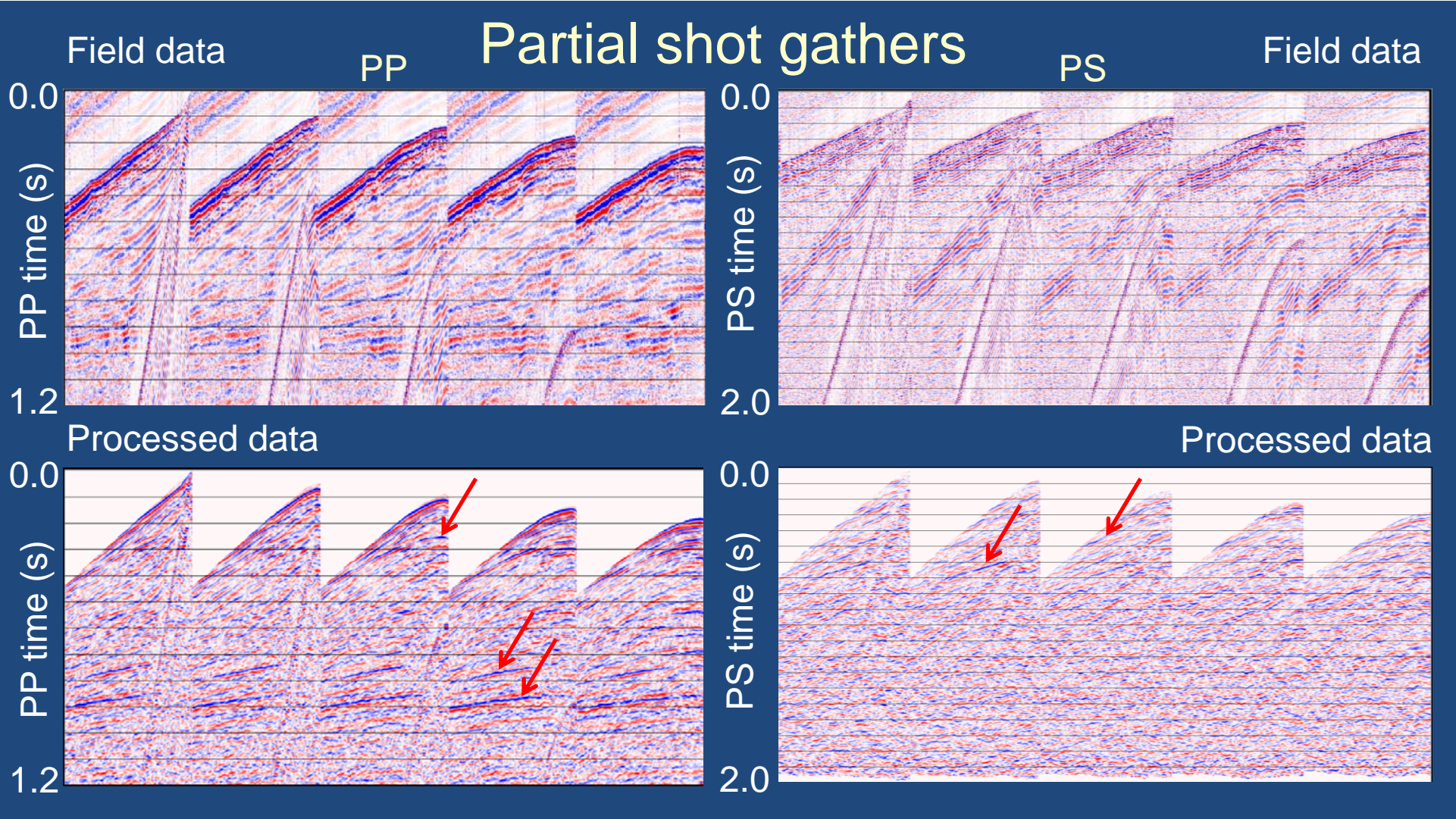
# Gamma ray logs in the study area



# 2014 3D3C Seismic Data

- 1 km<sup>2</sup> baseline 3D3C seismic survey acquired in May 2014
- Outer: 11 source and receiver lines at 100 m
- Inner: 6 source and receiver lines at 50 m
- Source and receiver stations at 10 m
- Source sweep 8-150 Hz for 16 s

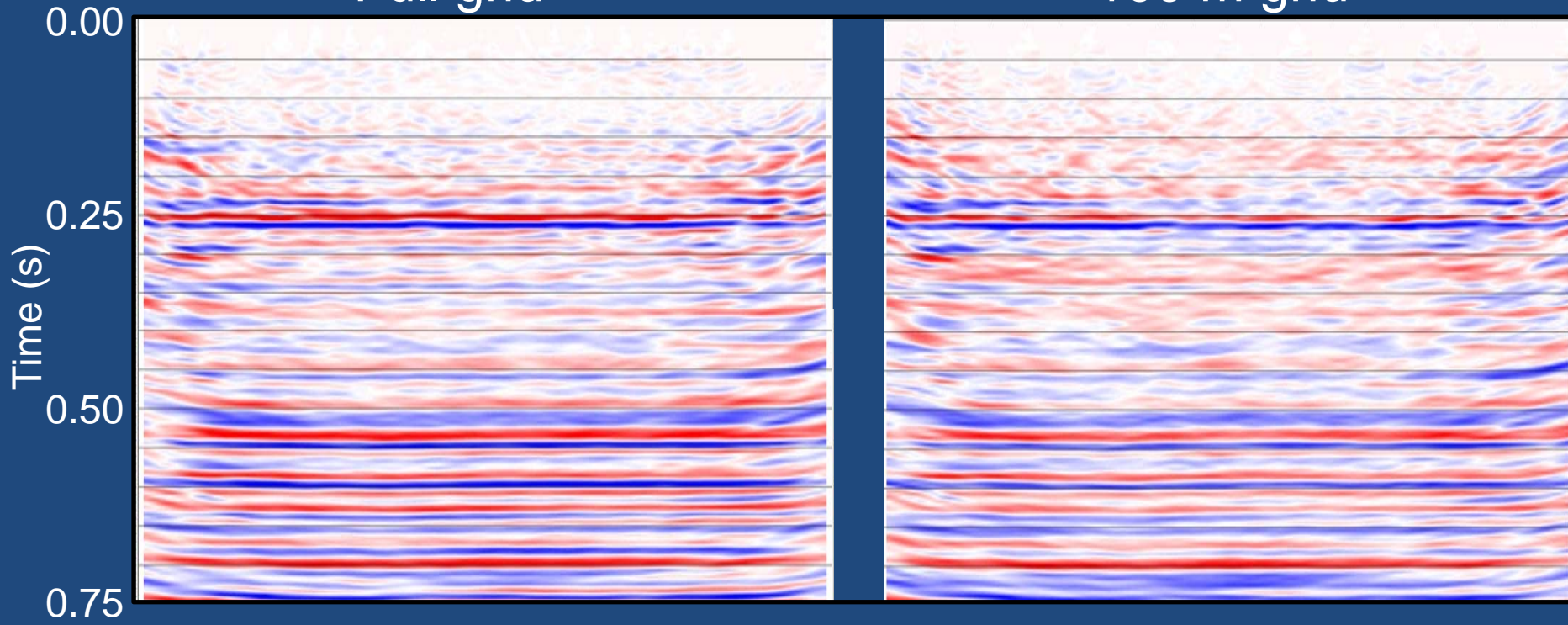




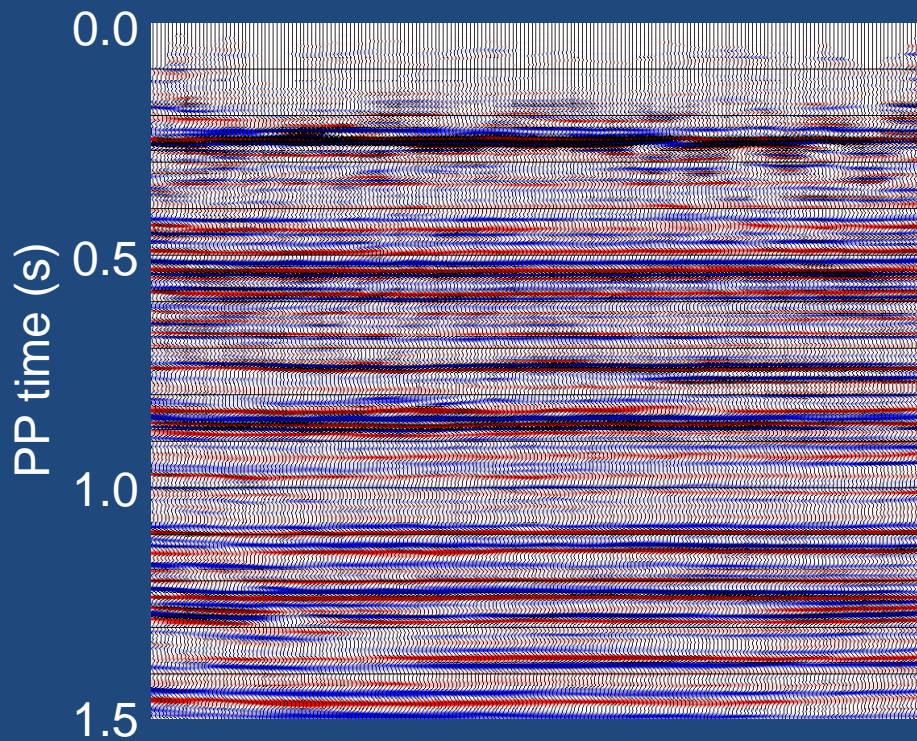
# Migrated PP inline 101

Full grid

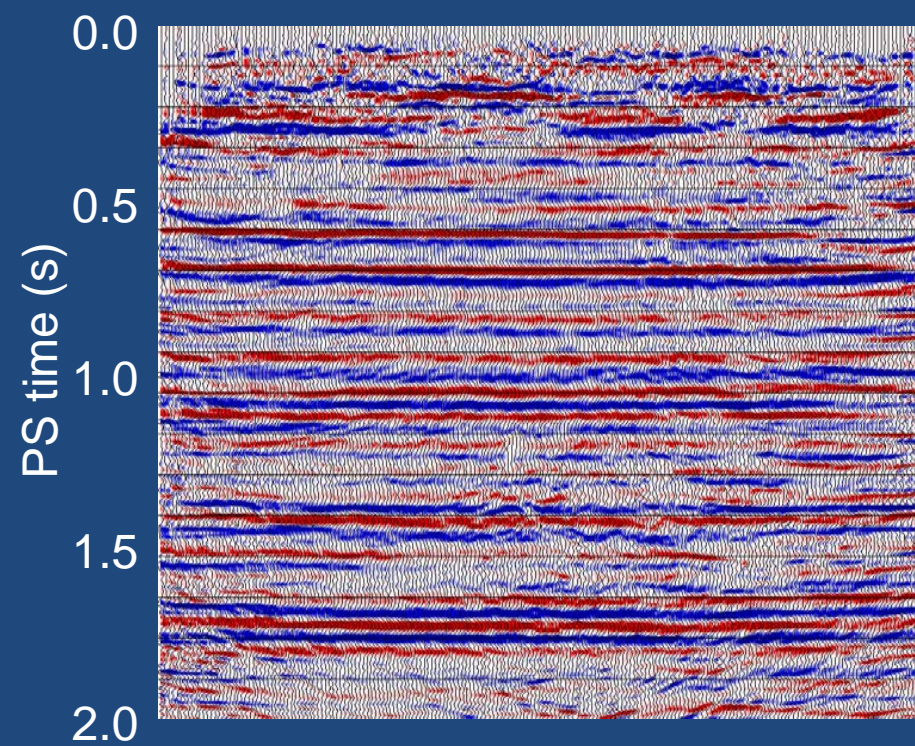
100 m grid



PP inline 101

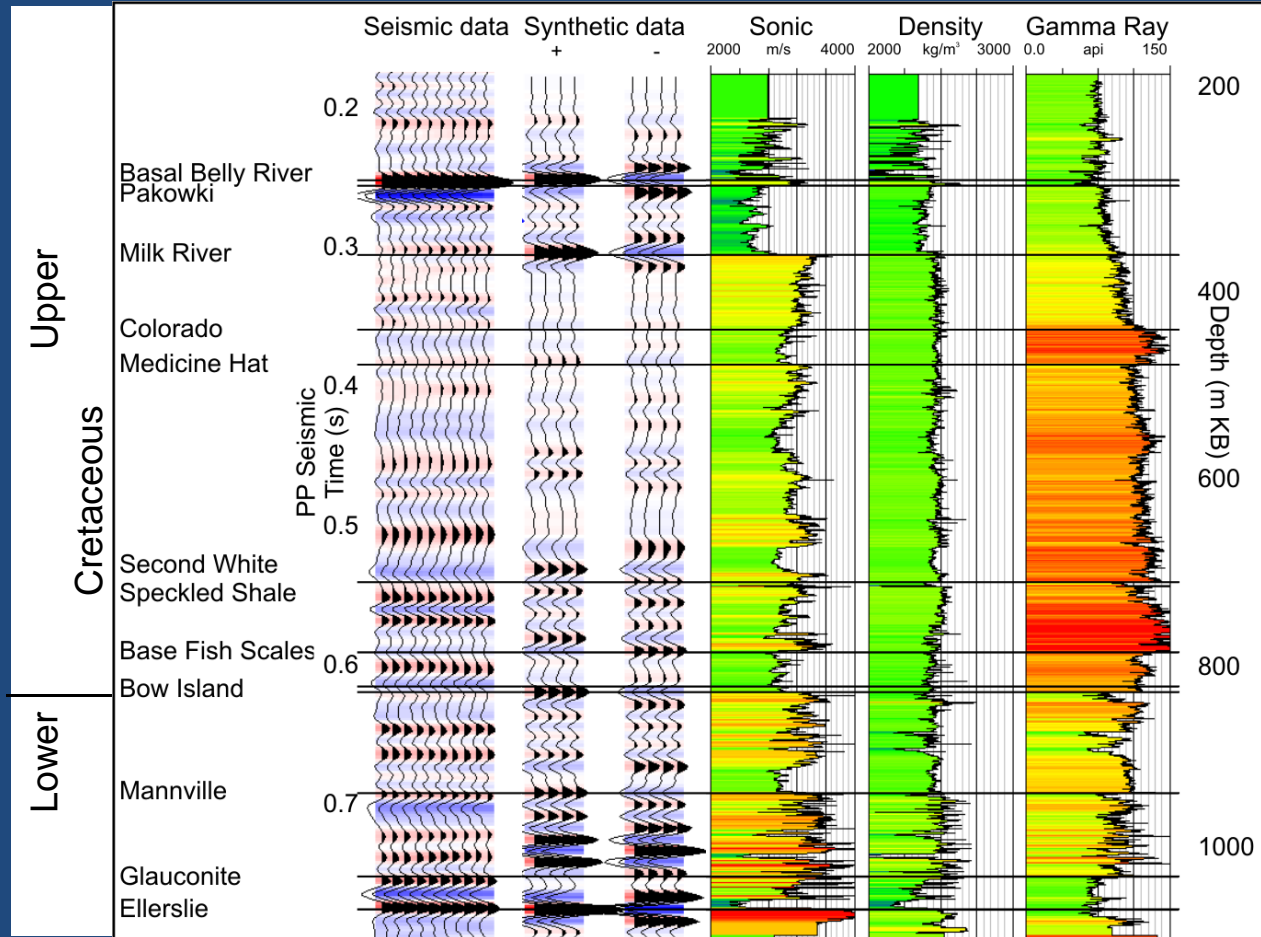


PS inline 101

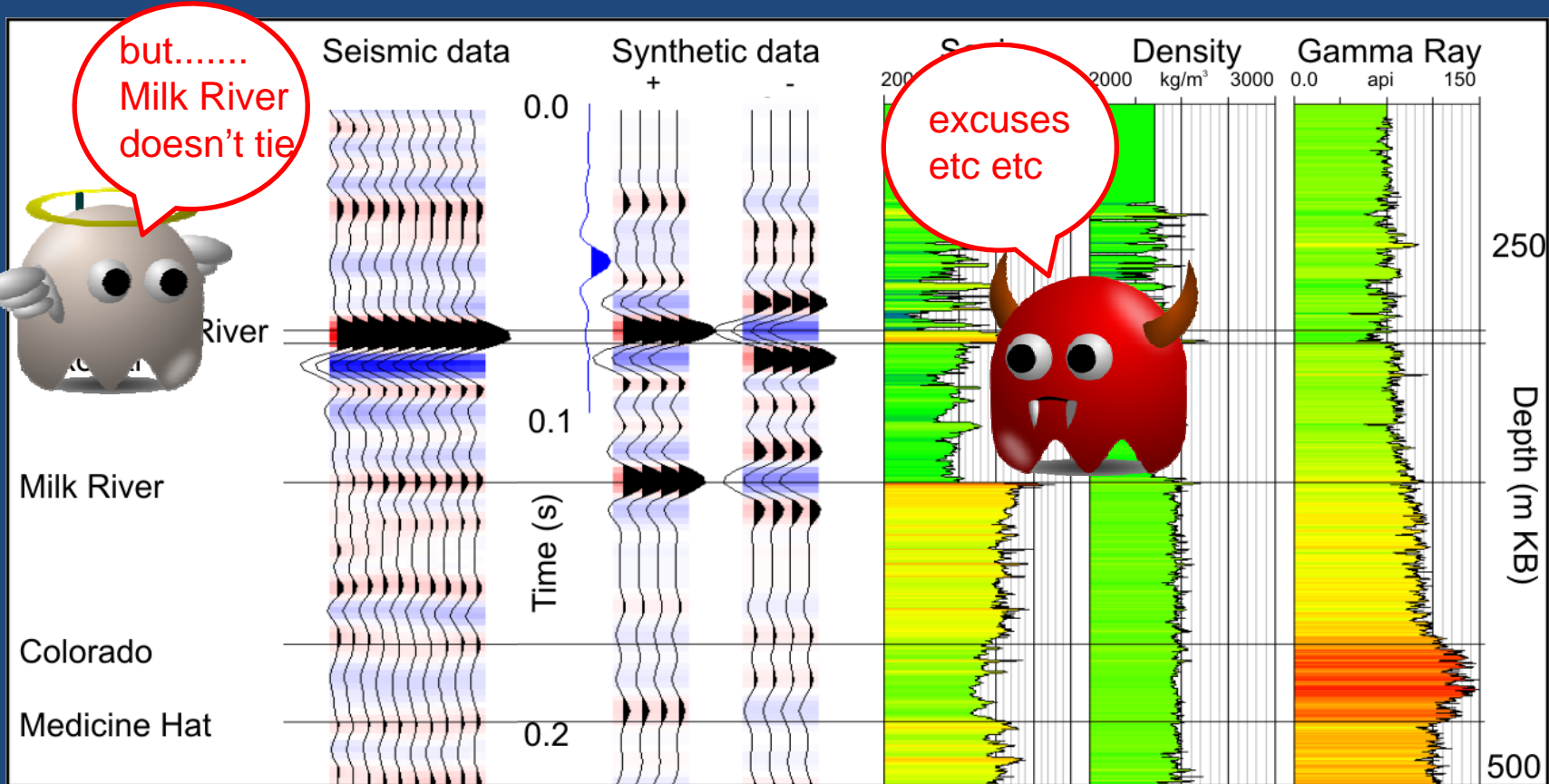




# PP seismic data tie to well A



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## Milk River sandstone, Southern Alberta



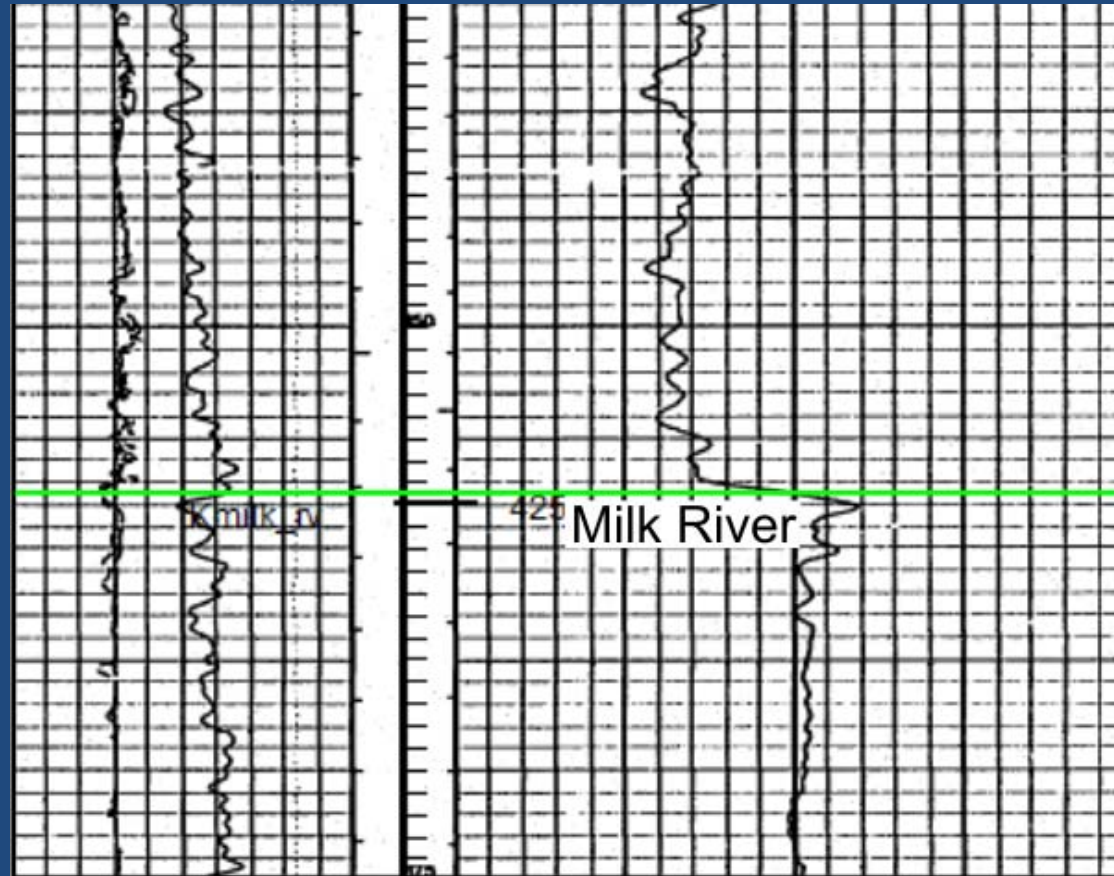
## Why is there a mis-tie at the Milk River?

- There is a problem with the digitised sonic log
- There is a problem with the data processing
  - velocity, mute, multiples
- There is a problem with the synthetic seismogram

# Original rastered log of well A

Gamma ray

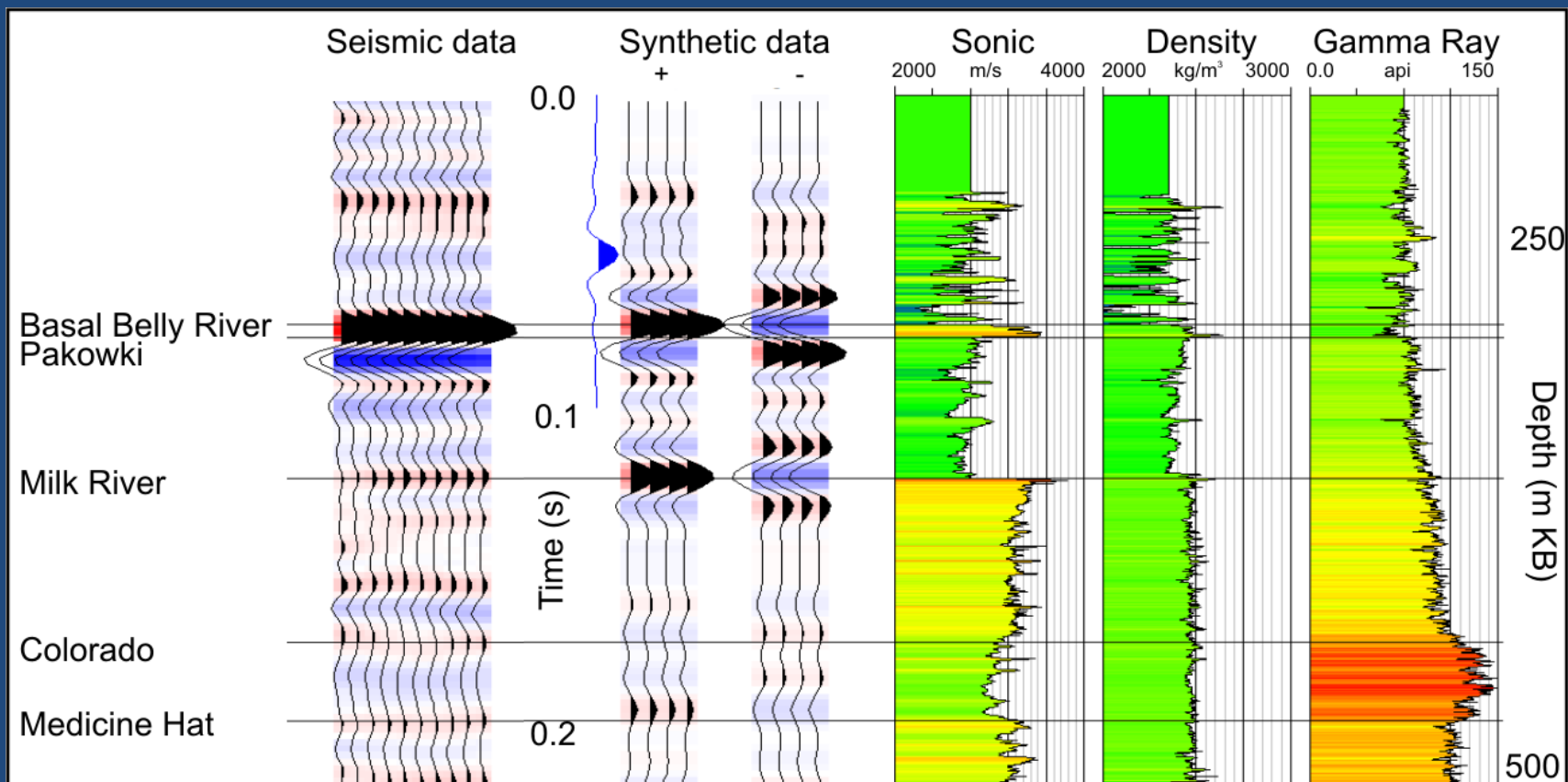
Sonic



## Why is there a mis-tie at the Milk River?

- ~~X~~ There is a problem with the digitised sonic log
- There is a problem with the seismic data processing
  - velocity, mute, multiples
- There is a problem with the synthetic seismogram

# PP seismic data tie to well A

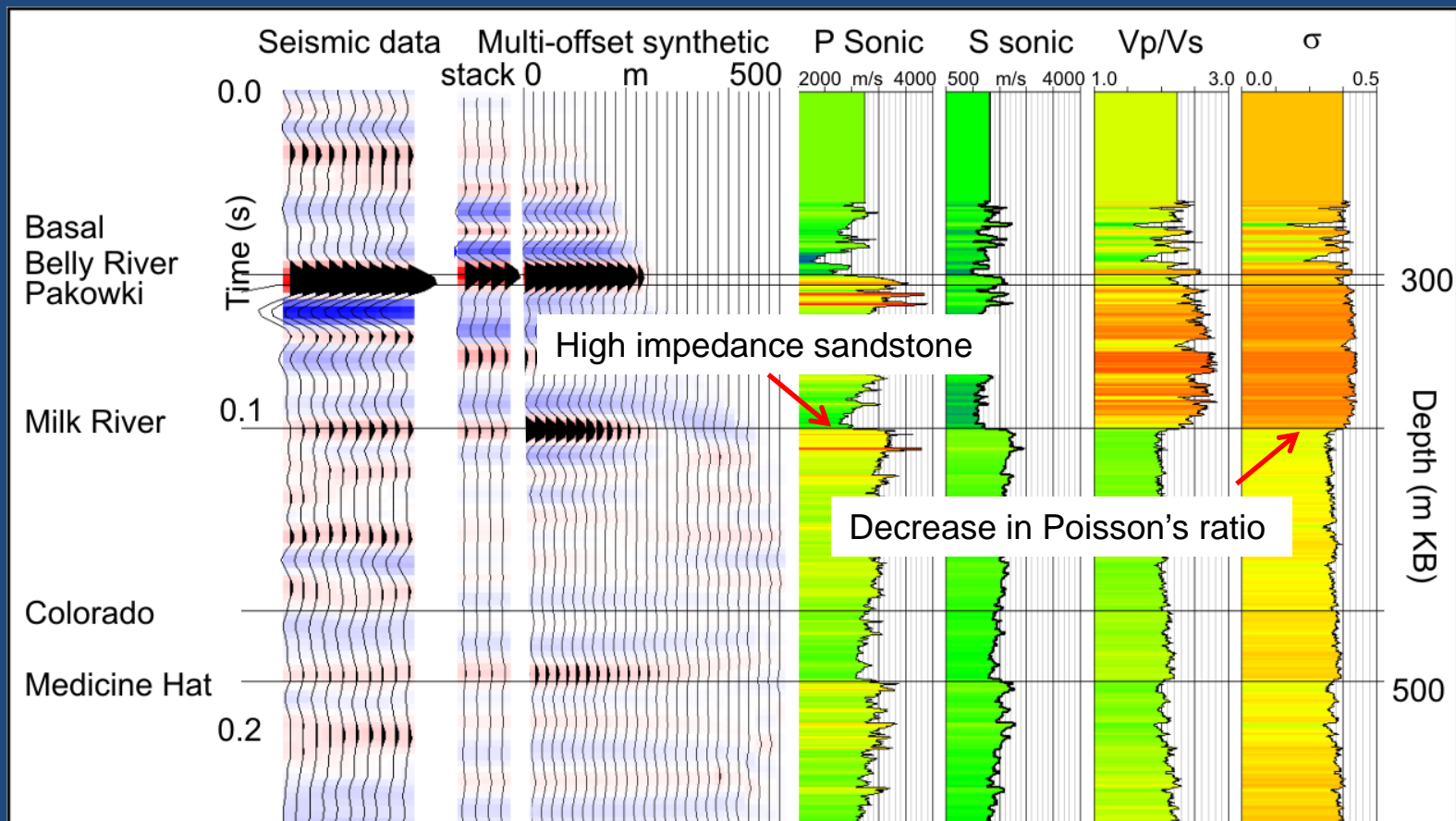


## Synthetic seismogram

- Synthetic is zero-offset (normal incidence)
- Seismic data are CDP stacks of multiple offsets
- Therefore, I should make a synthetic with multiple offsets
- But.....I need a shear sonic log and well A does not have one
- Well D (8 km away) has a dipole log

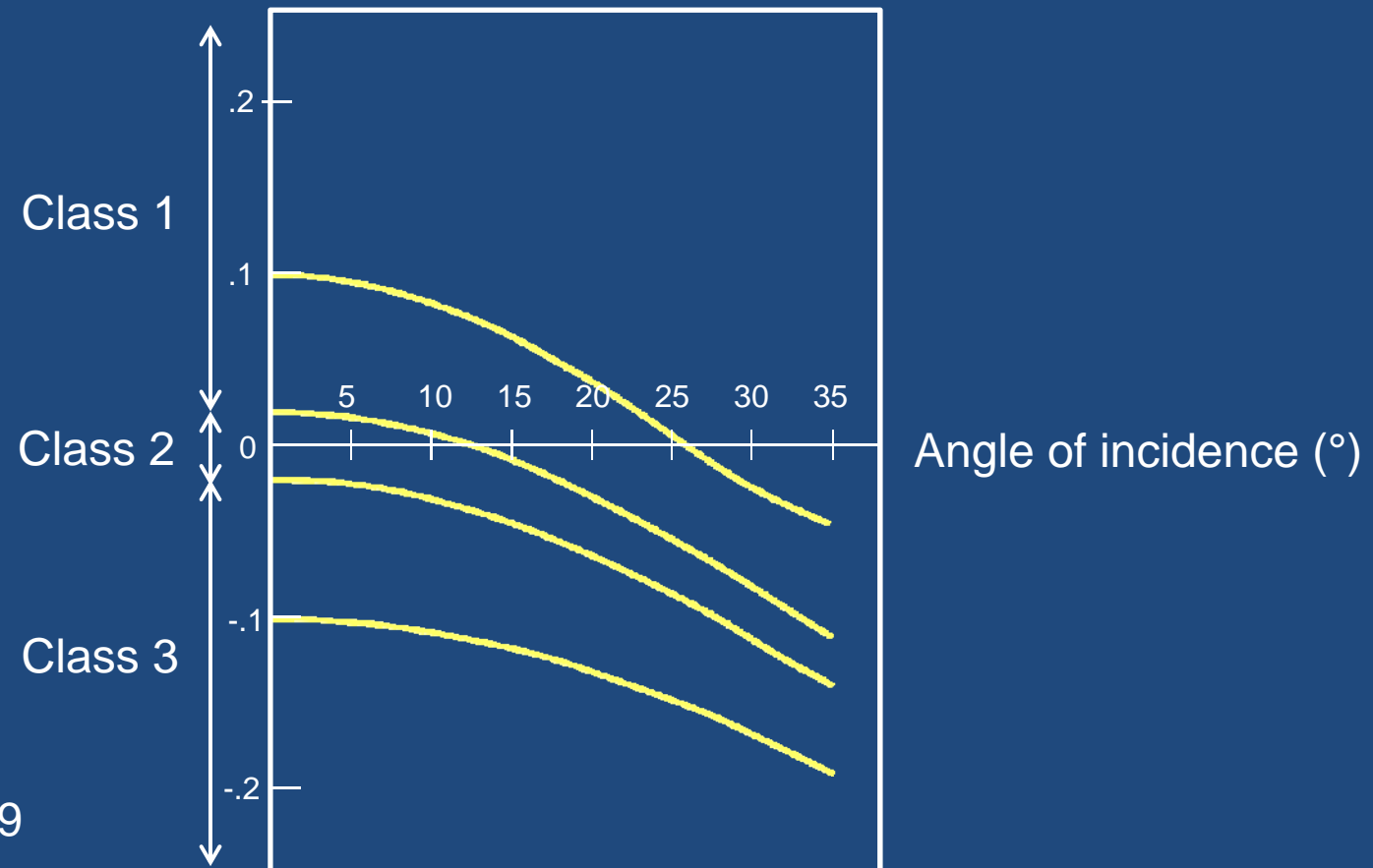


# PP seismic data tie to well D



# Classification of gas sands

P-wave reflection coefficients

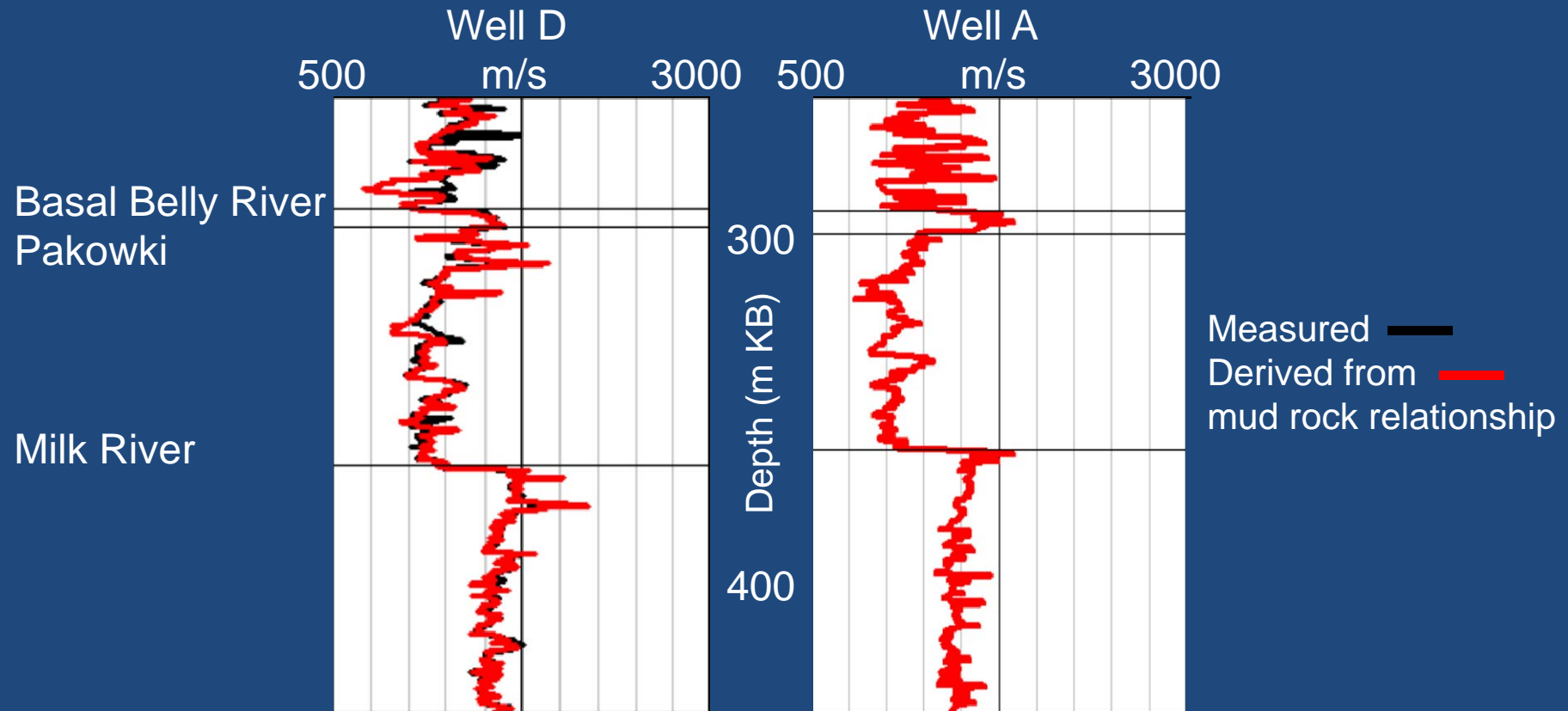


Rutherford  
and Williams, 1989

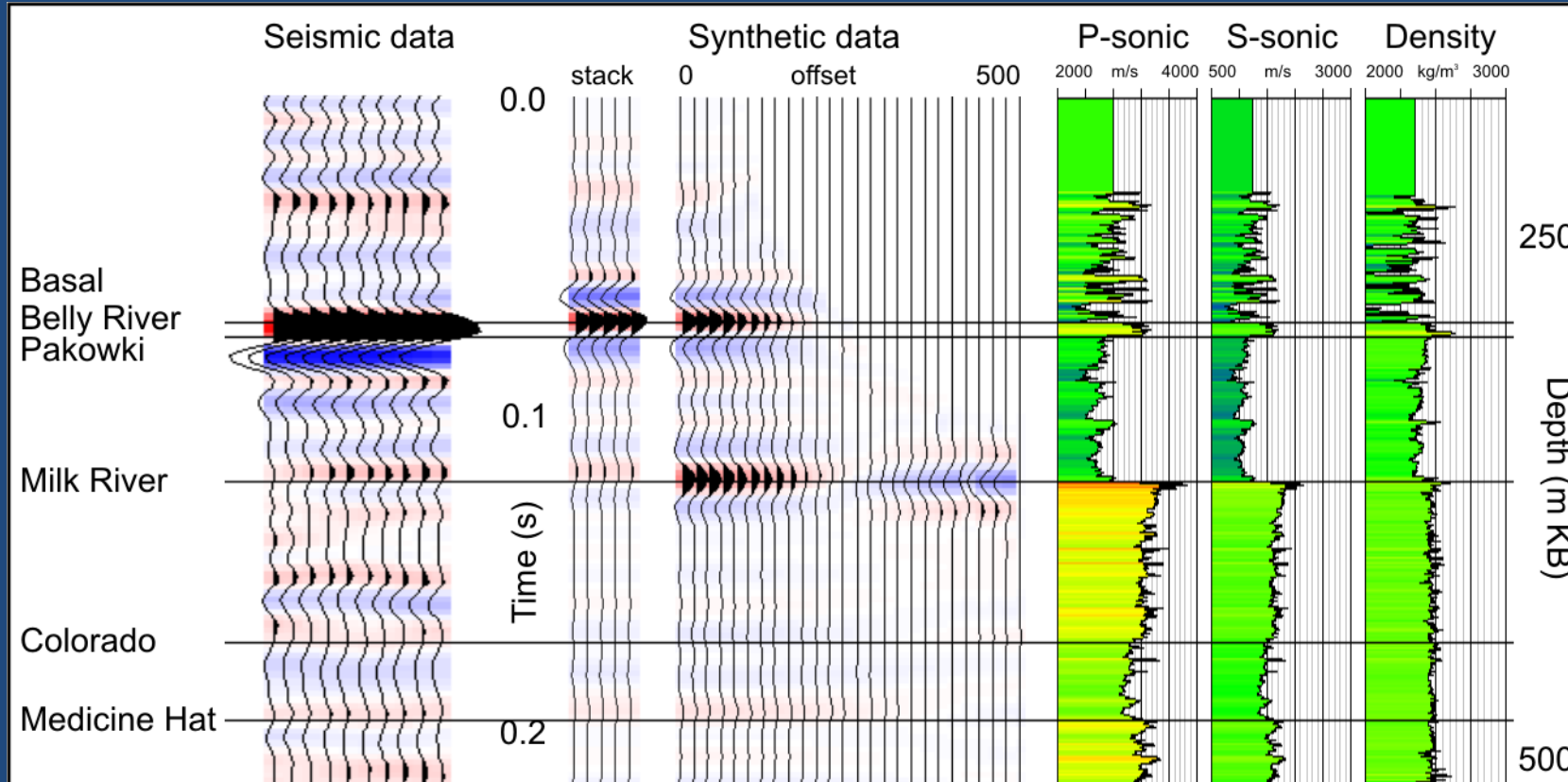
## The story so far.....

- Seismic character mismatch with normal incidence synthetic seismogram
- Seismic character ties to multi-offset synthetic for well D, 8 km away
- Some stratigraphic/pore fluid changes between study area and well D
- Would like to tie to a deep well in the study area
- Have no shear sonic logs for these wells
- How do we make one?
  - use  $V_p/V_s$  from well D? actual or blocked?
  - use shear sonic from well D with thickness adjustments?
  - use Castagna's mud-rock relationship?

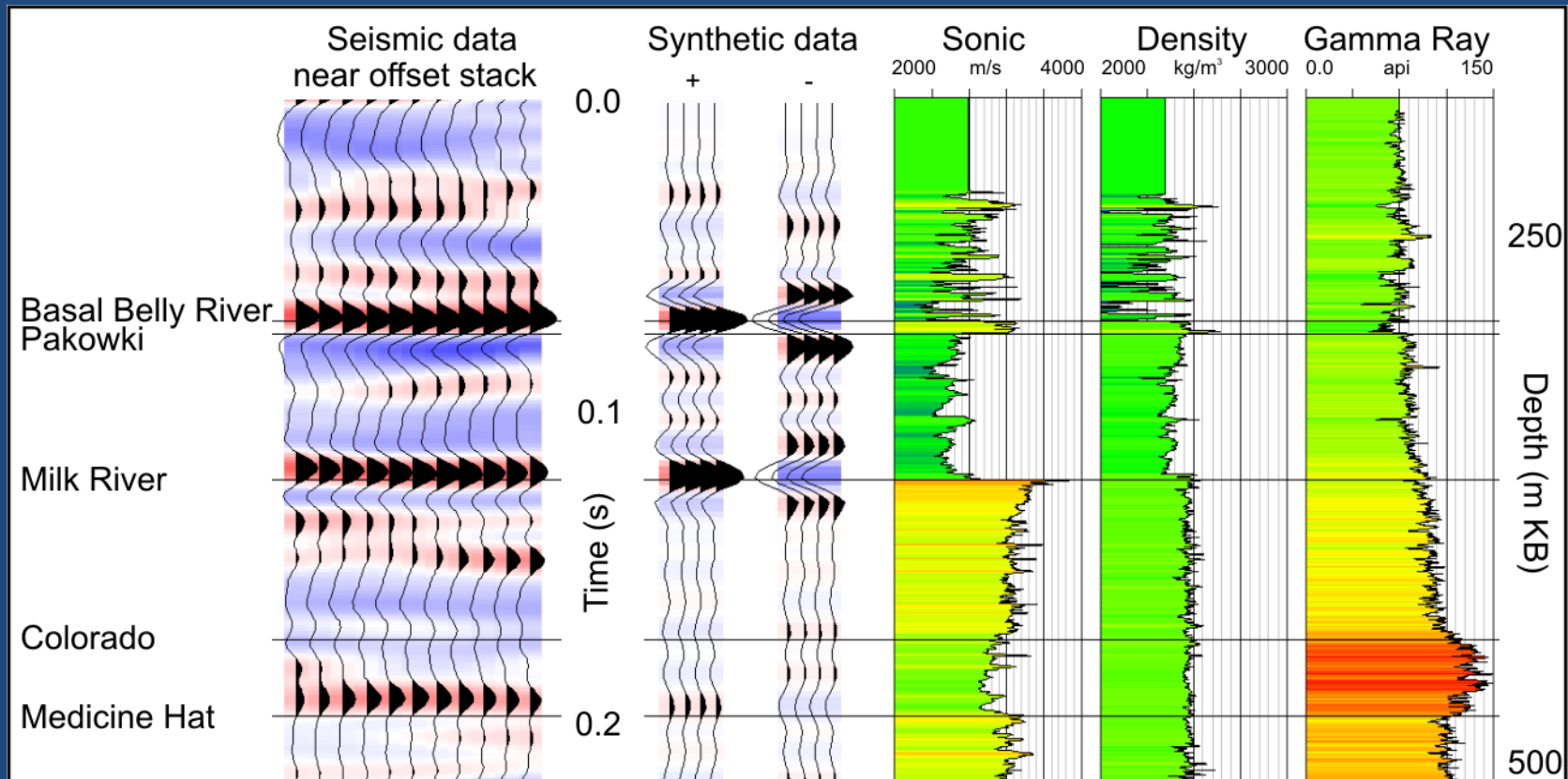
# Shear sonic logs



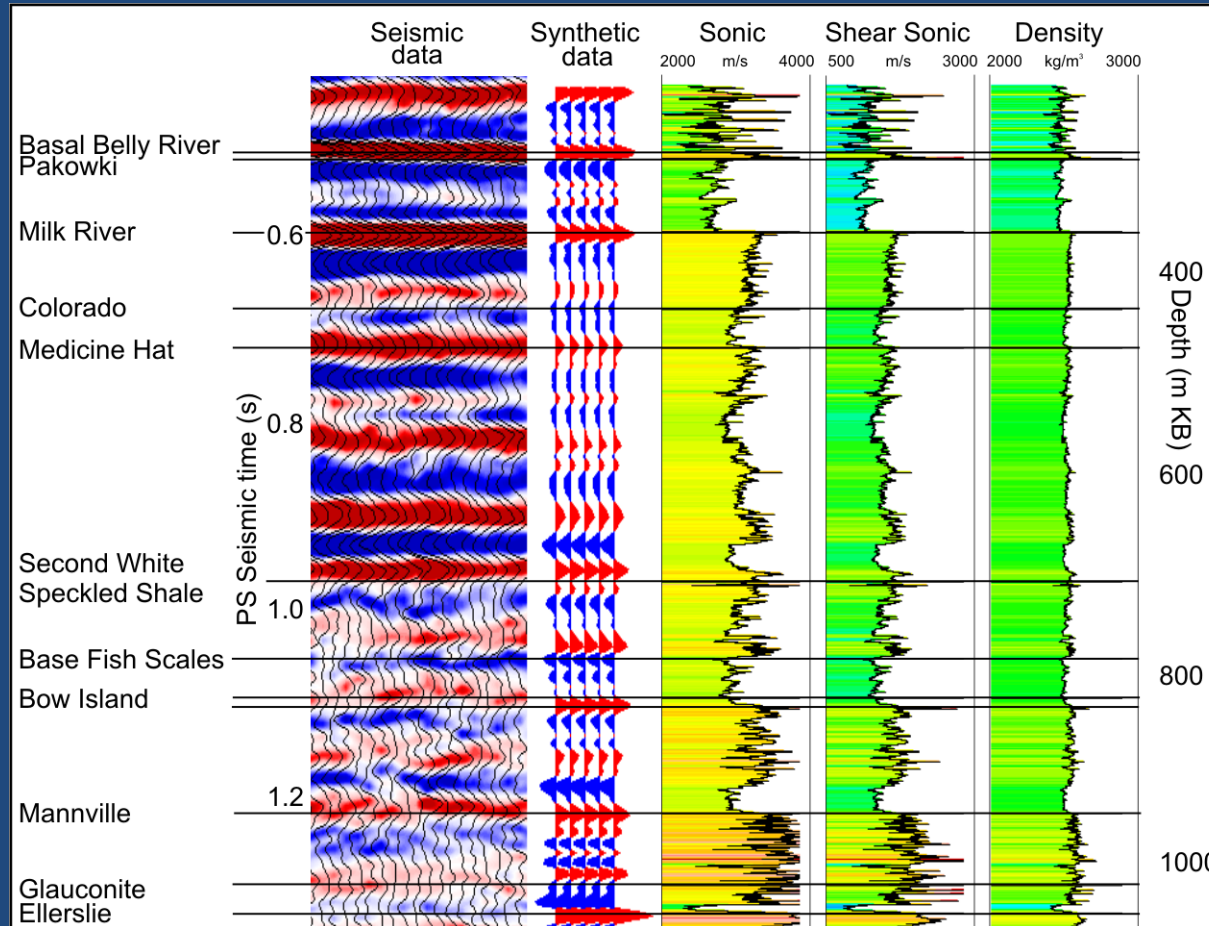
# PP seismic data tie to well A



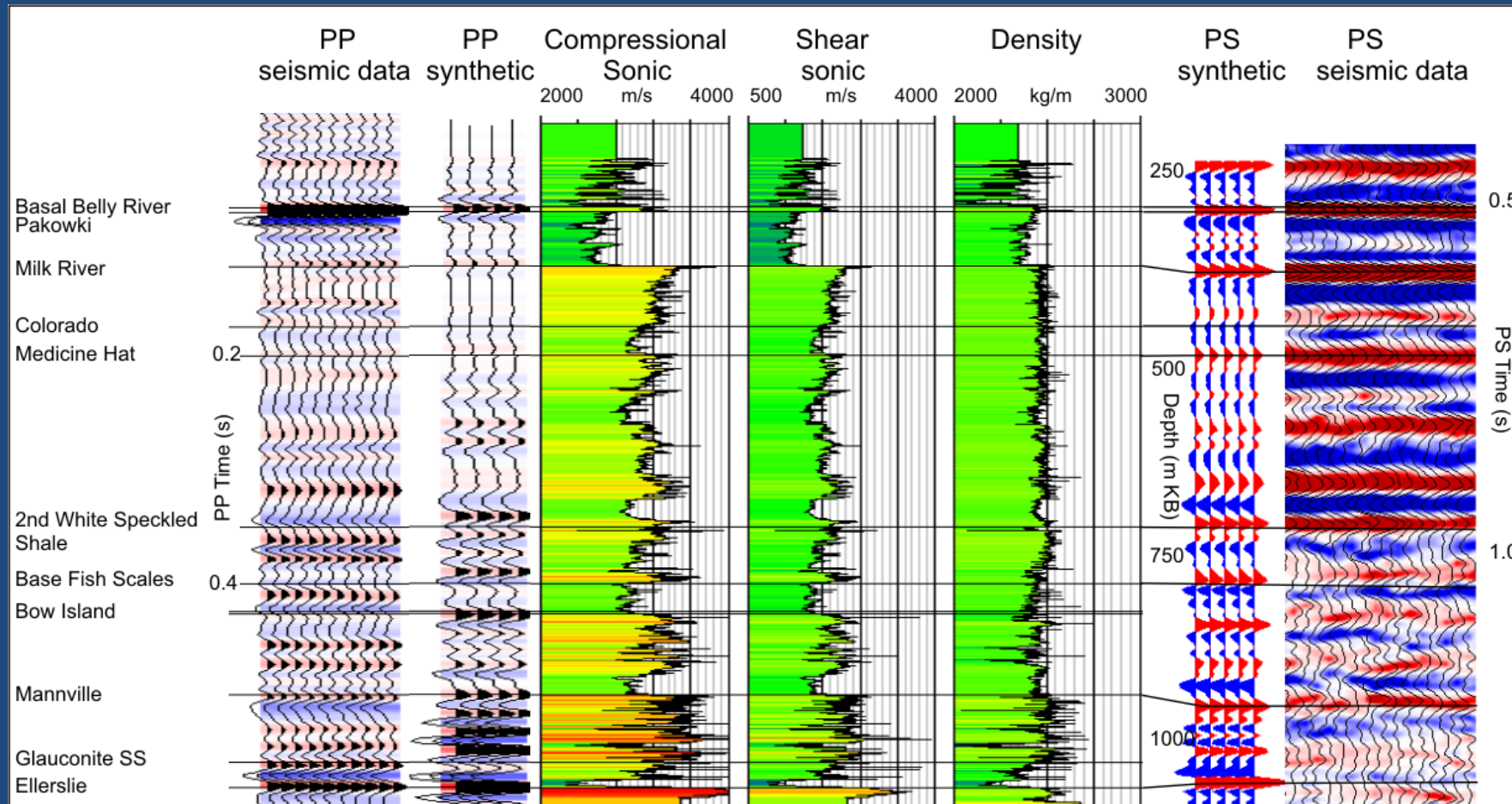
# PP near-offset stack tie to well A



# PS seismic data tie to well A

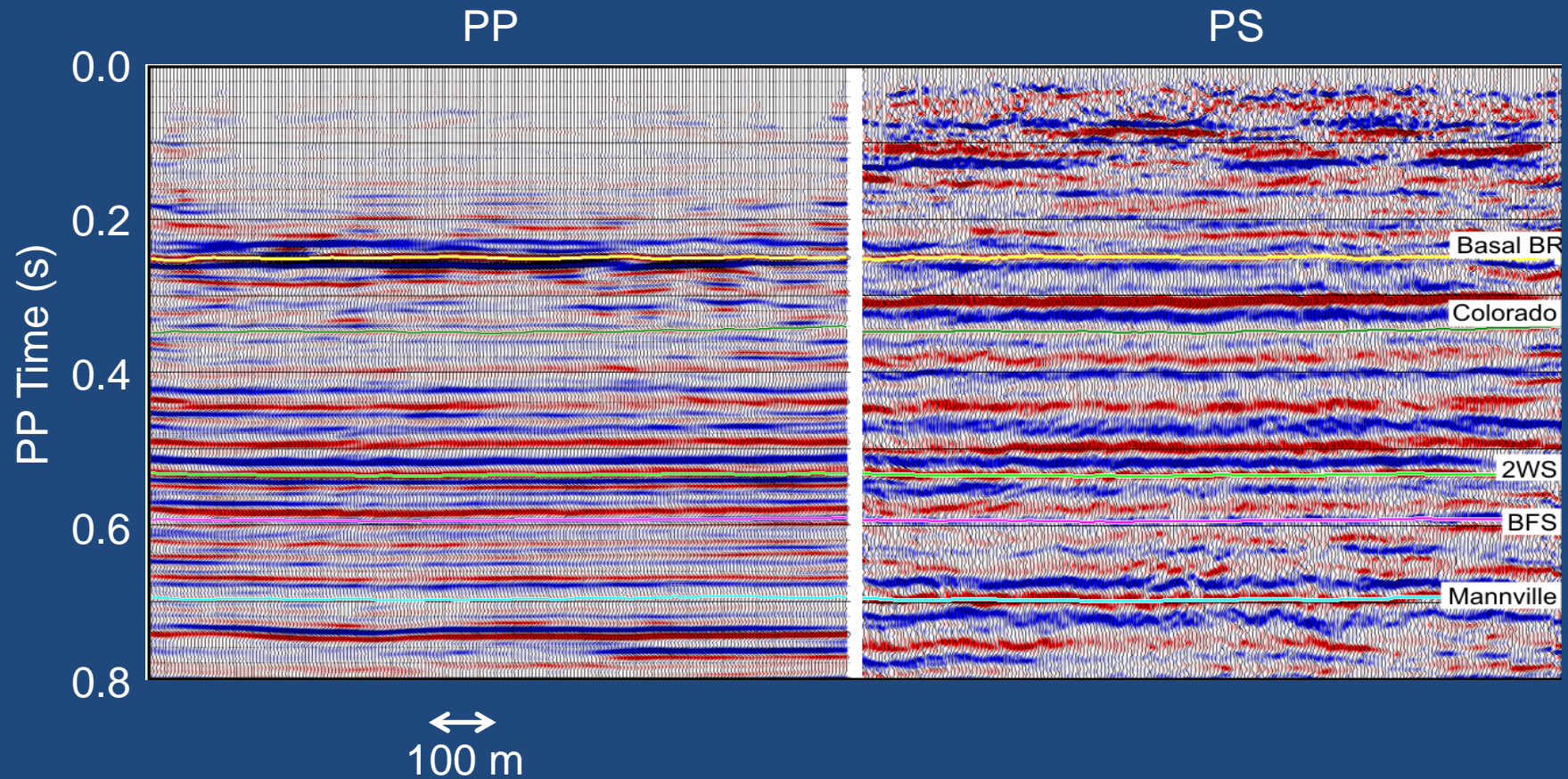


# PP and PS seismic data ties to well A



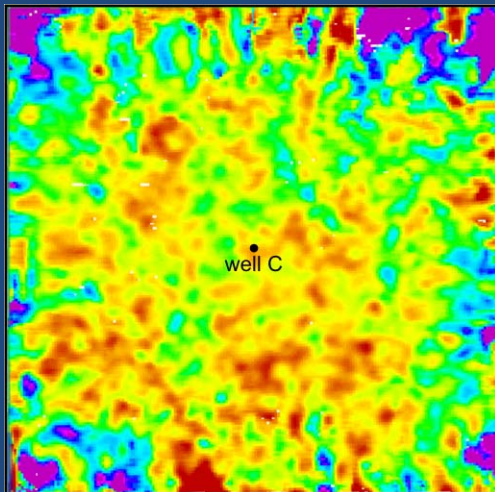


# Registered PP and PS data

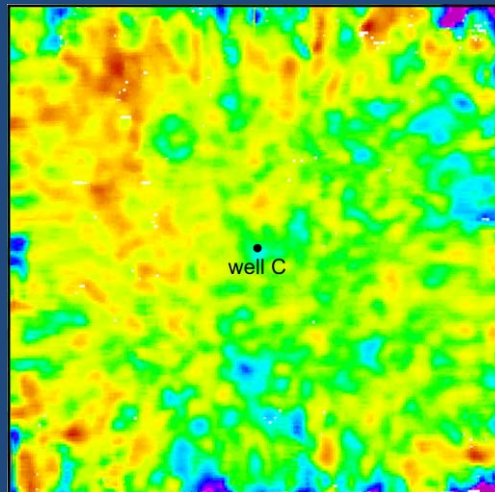


# Vp/Vs maps

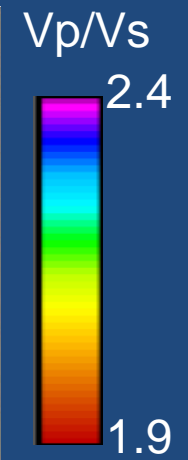
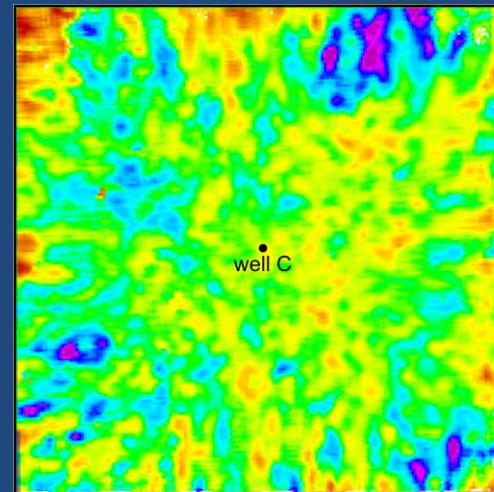
Basal Belly River – Colorado



Colorado – 2<sup>nd</sup> White Specs

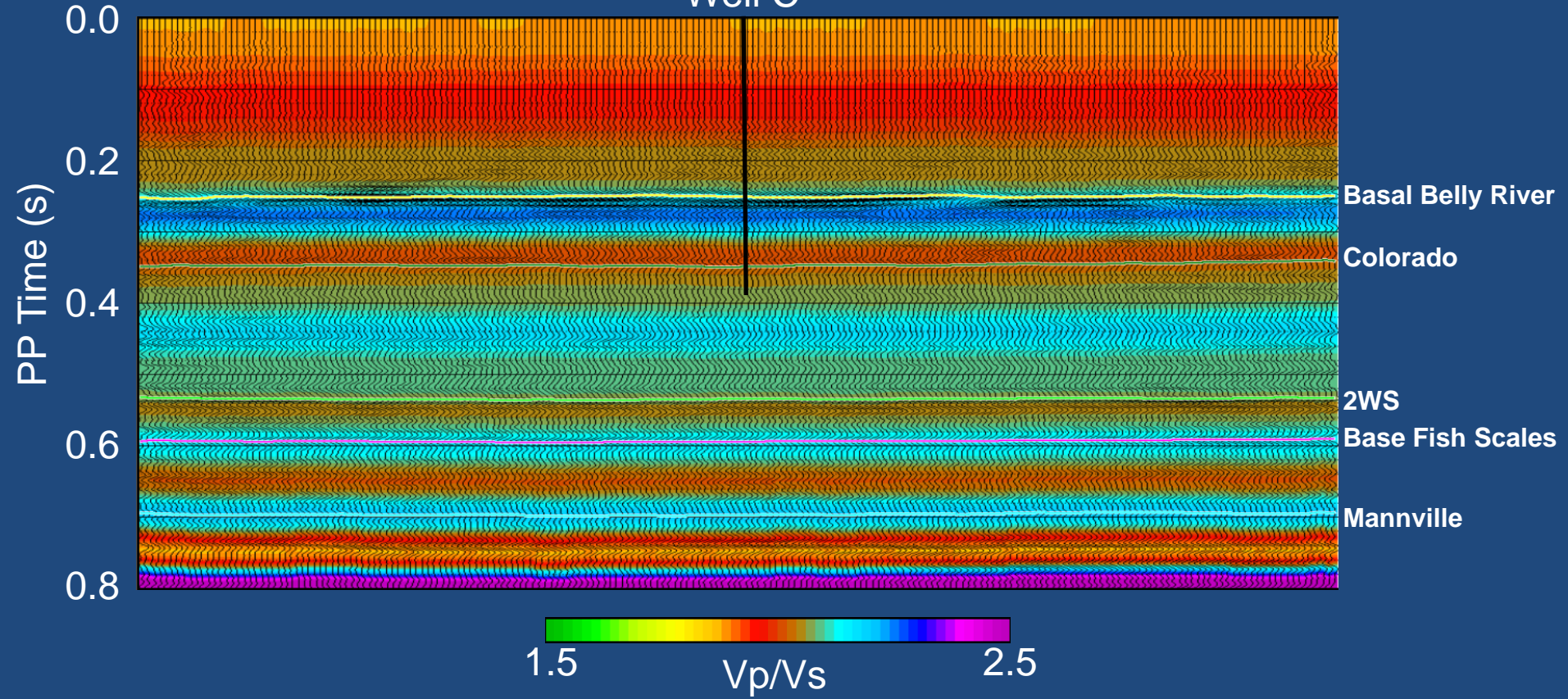


2<sup>nd</sup> White Specs - Mannville



# Vp/Vs for line 101 from joint PP-PS inversion

Well C



## Summary

- Baseline 3D3C seismic survey acquired in May 2014
- PP and PS data processed and tied to synthetic seismograms
- At top of Milk River, the normal incidence reflection coefficient is large and decreases with offset, even showing a reversal of polarity at 250 m offset / 35°
- Full seismic stack matches stacked multi-offset synthetic
- Near-offset seismic stack matches normal incidence synthetic

## Summary

- Having tied PP and PS seismic data to a well we could identify reflections and register the two datasets
- We calculated  $V_p/V_s$  over several intervals
- We performed a post-stack joint PP-PS inversion
- Further  $V_p/V_s$  analysis will be done after injection and a monitor survey has been acquired

## Acknowledgements

- CREWES sponsors
- Natural Science and Engineering Research Council of Canada
- Containment and Monitoring Institute, Carbon Management Canada
- Halliburton/Landmark (SeisSpace)
- IHS (GeoSyn)
- CGG/Hampson-Russell (Geoview)
- Geologic (geoSCOUT)