

Interpretation of PP and PS seismic data from the White Rose oilfield, offshore Newfoundland

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and
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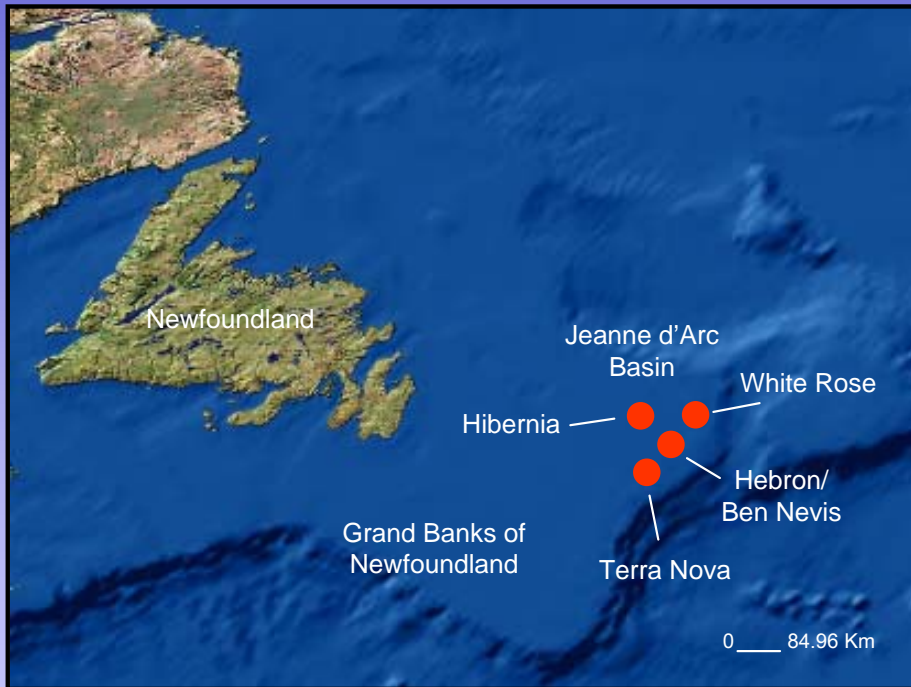
Outline

- Introduction – 4C survey, imaging problems
- Stratigraphy - White Rose oilfield, offshore Nfld
- OBS Survey & Interpretation
- Conclusions– Quality of PP & PS, correlations,
Vp/Vs analysis
- Acknowledgements

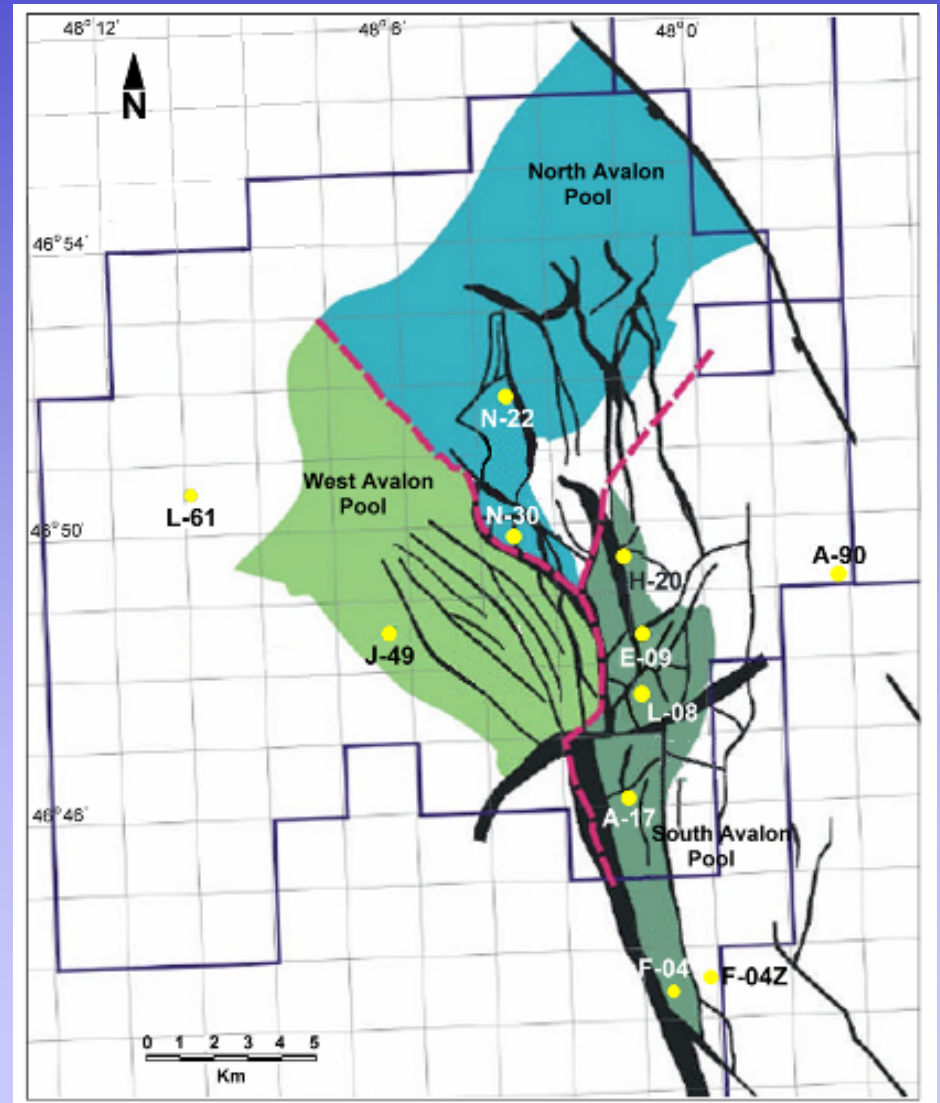
Motivations for this work

- White Rose imaging challenges (Hoffe et al., 2000):
 - Hard Water Bottom;
 - High P-wave impedance contrast at T-K unconformity;
 - Low P-wave impedance contrast at Avalon Fm (main reservoir) and overlying Nautilus Fm interface;
 - Presence of gas clouds

Location of White Rose field, Offshore Newfoundland

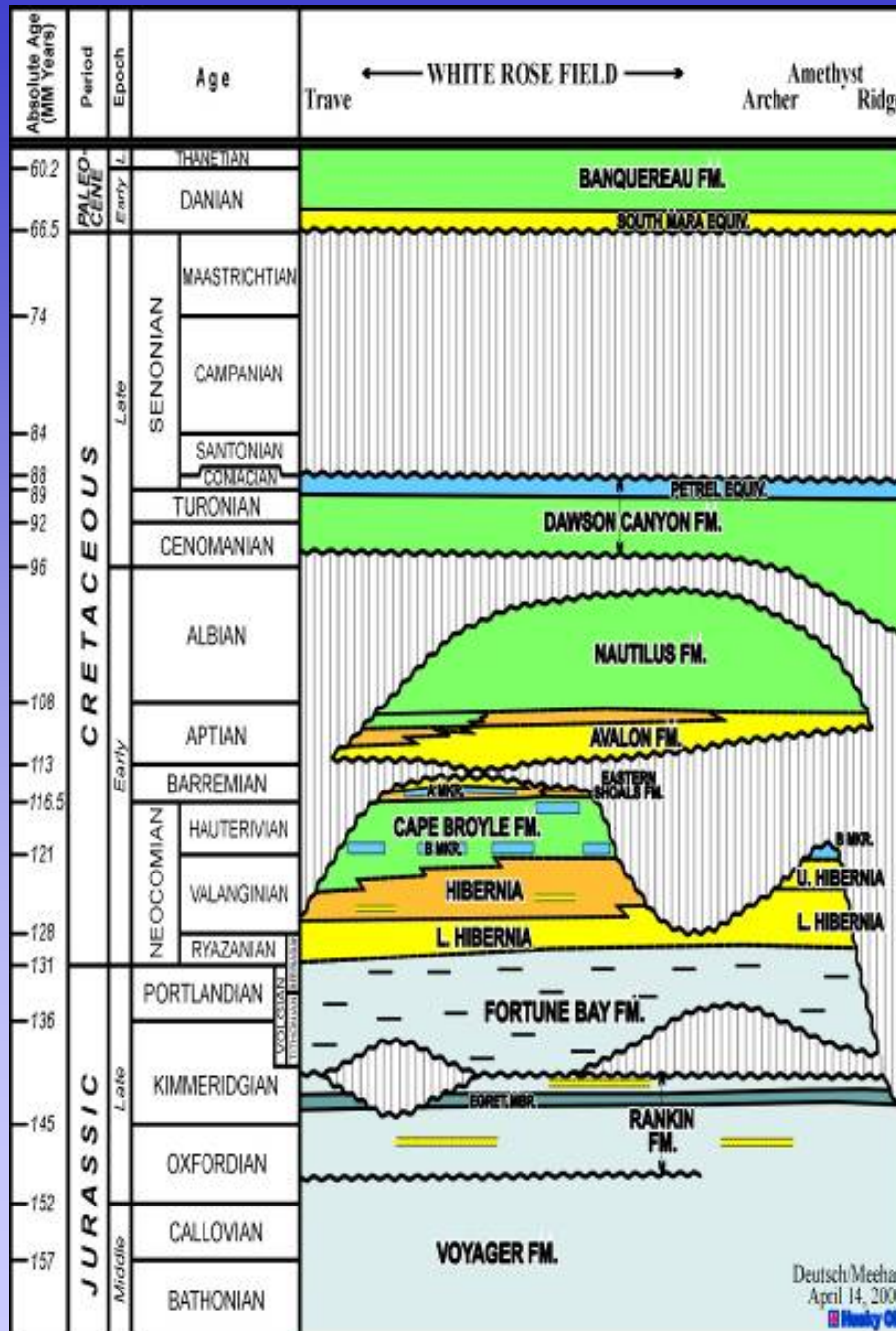




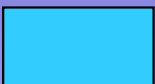


Geography Network, 2002



Modified after Husky Energy, 2000

Stratigraphy of White Rose field

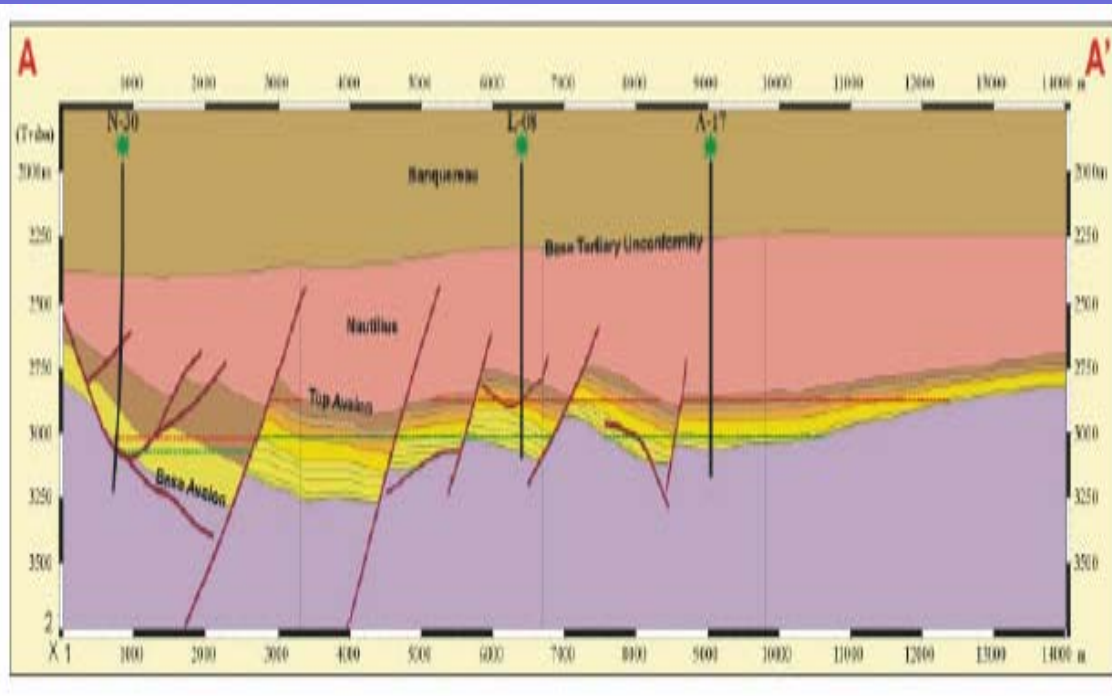


-  Sand
-  Silt
-  Carbonates
-  Shale
-  Source rock

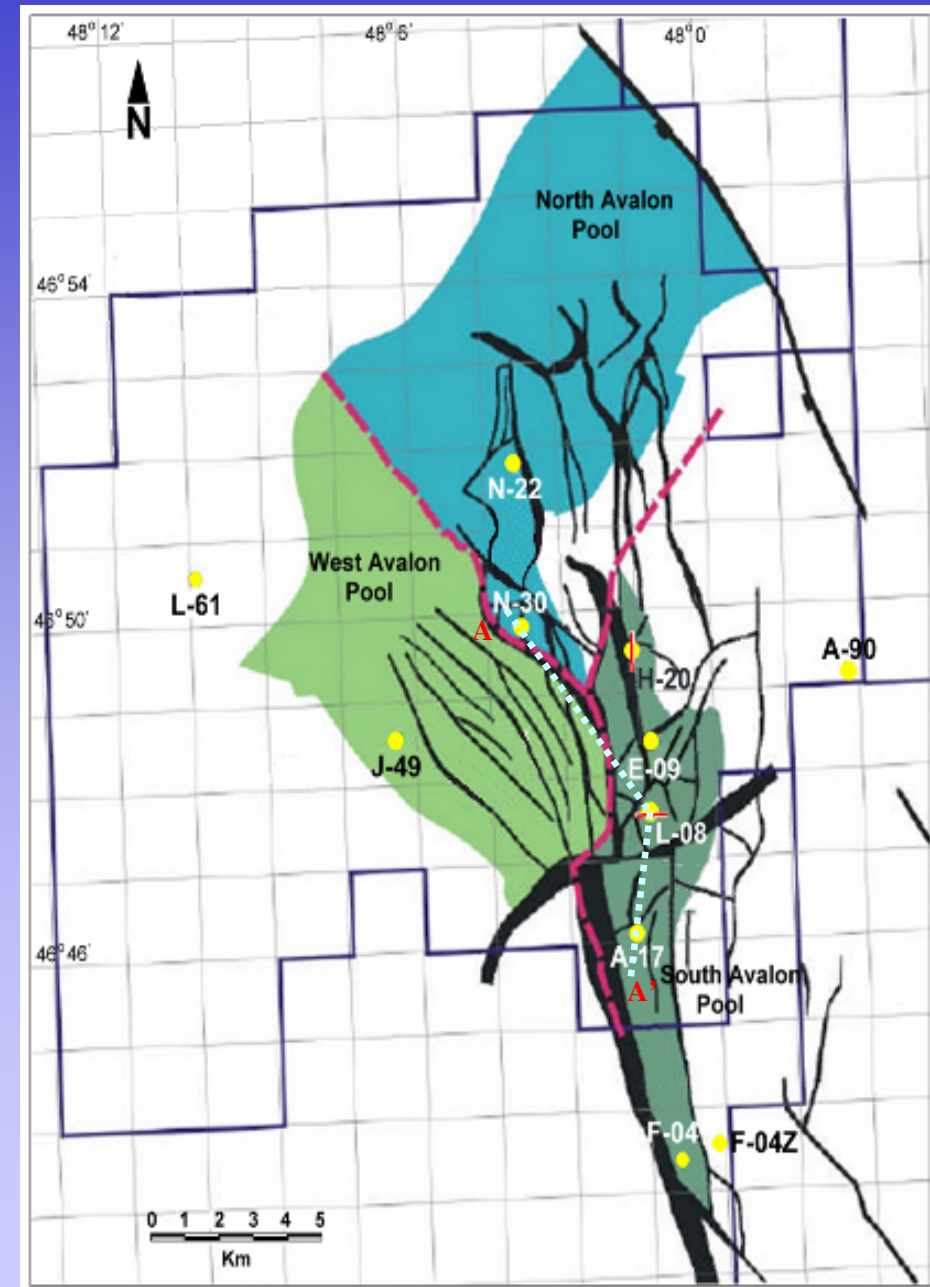
Deutsch/Meehan
April 14, 2000
Husky Oil

Modified after Emery, 2001

Structural geology of White Rose field



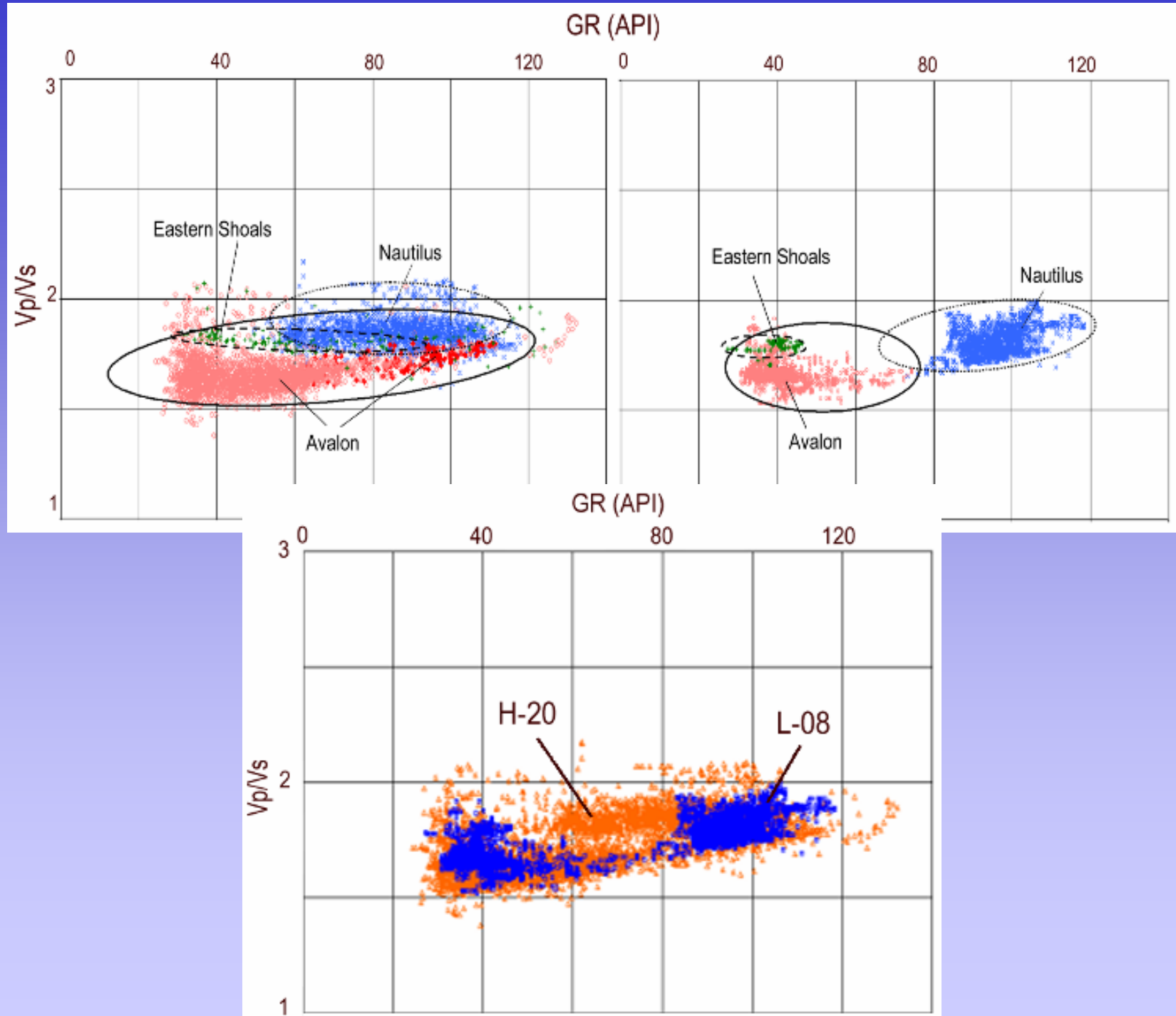
Modified after Husky Energy, 2001



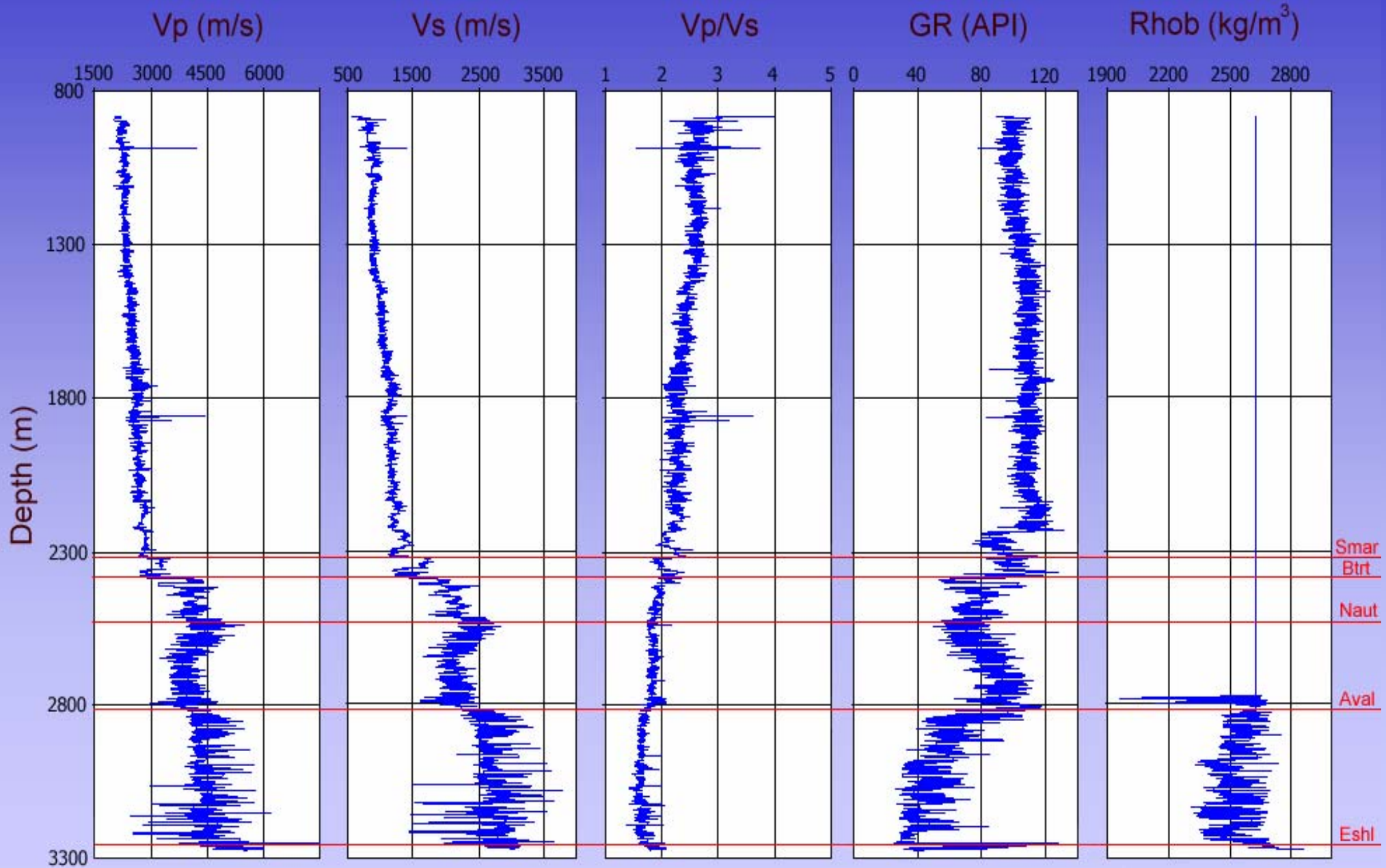
Petrophysical analysis

H-20

L-08

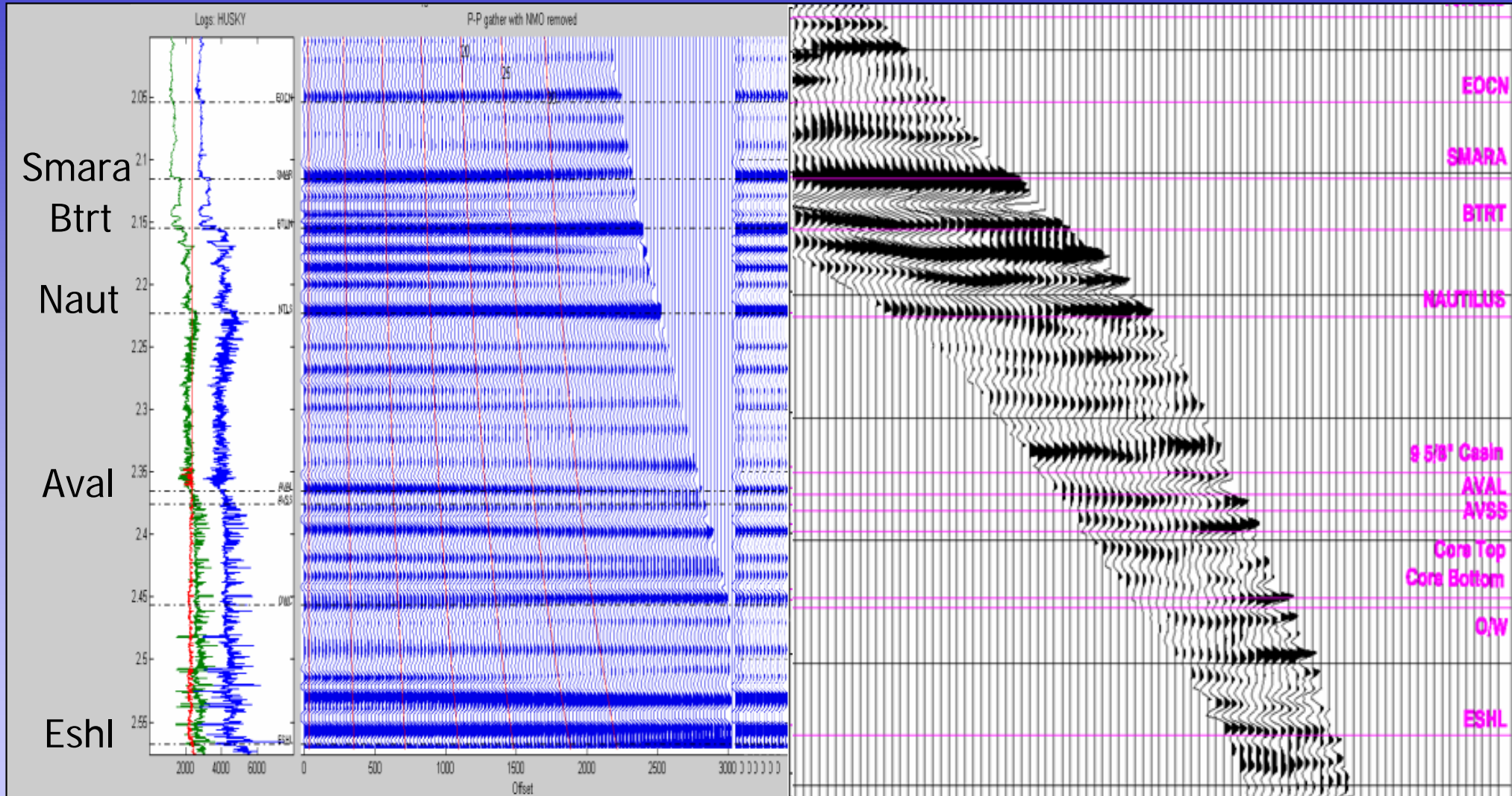


H-20 well logs



Interpretation

PP synthetic-Pwave offset VSP, well H-20

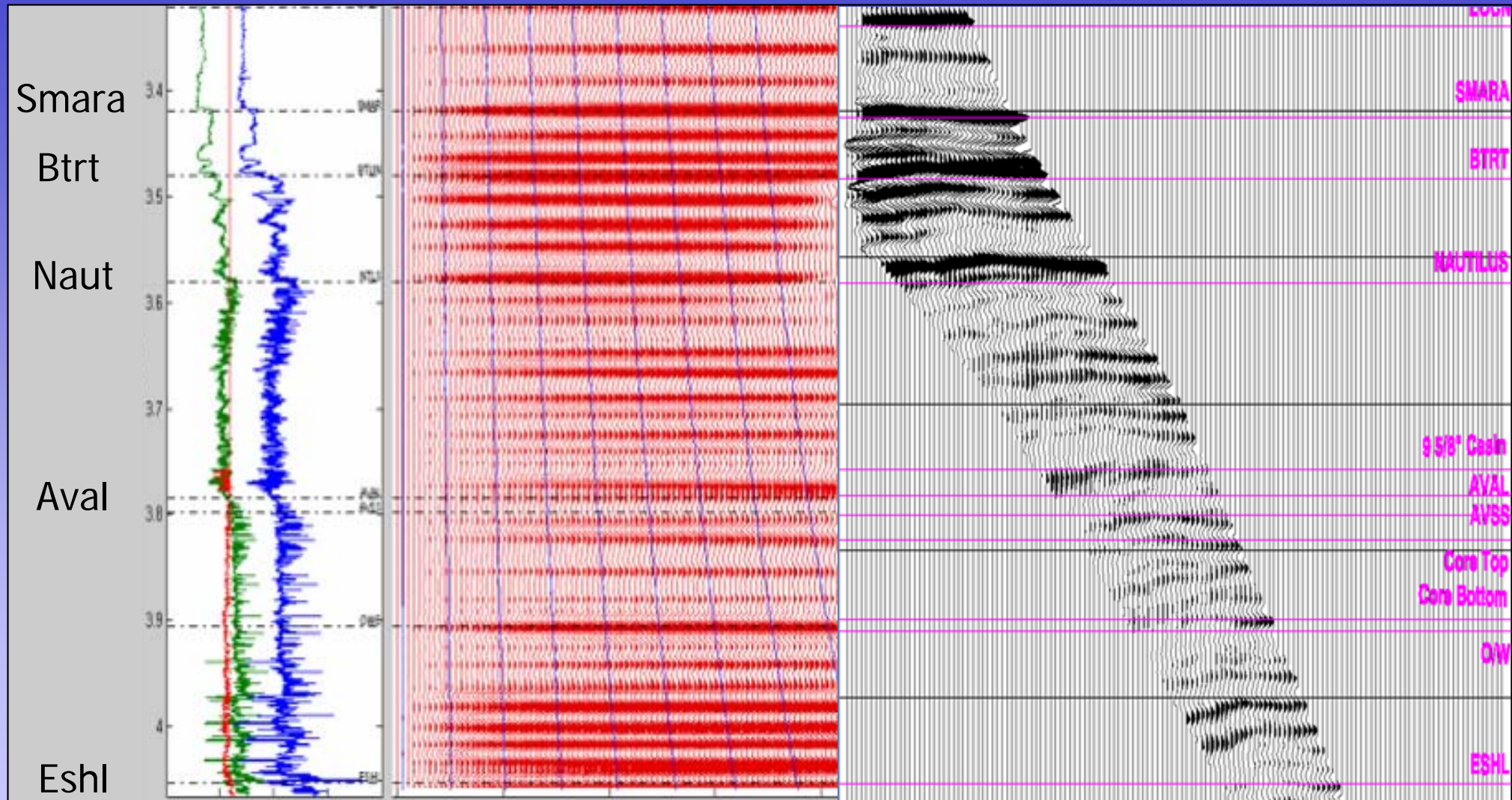


Offset from 0 to 3000 m, TWT in sec, V_p , V_s and R_{hob}
 Wavelet Ricker 45 Hz (zero phase)

Offset image of P-waves from VSP-CDP transform
 Increase in acoustic impedance is a peak

Interpretation

PS synthetic-Swave offset VSP, well H-20

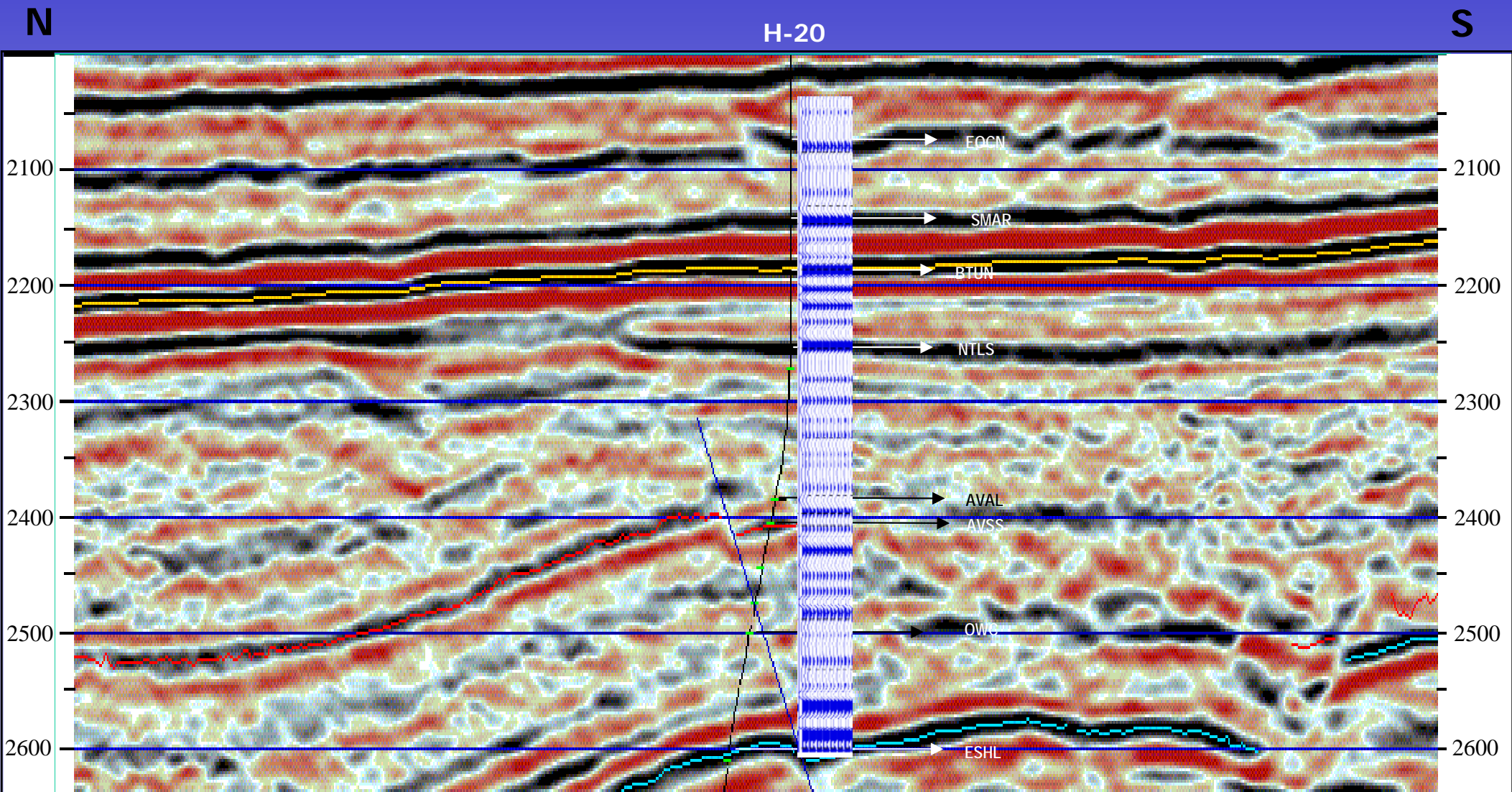


Offset from 0 to 3000 m, TWT in sec, V_p , V_s and R_{hob}
 Wavelet Ricker 45 Hz (zero phase)

Offset image of S-waves from VSP-CDP transform
 Increase in acoustic impedance is a peak

Interpretation

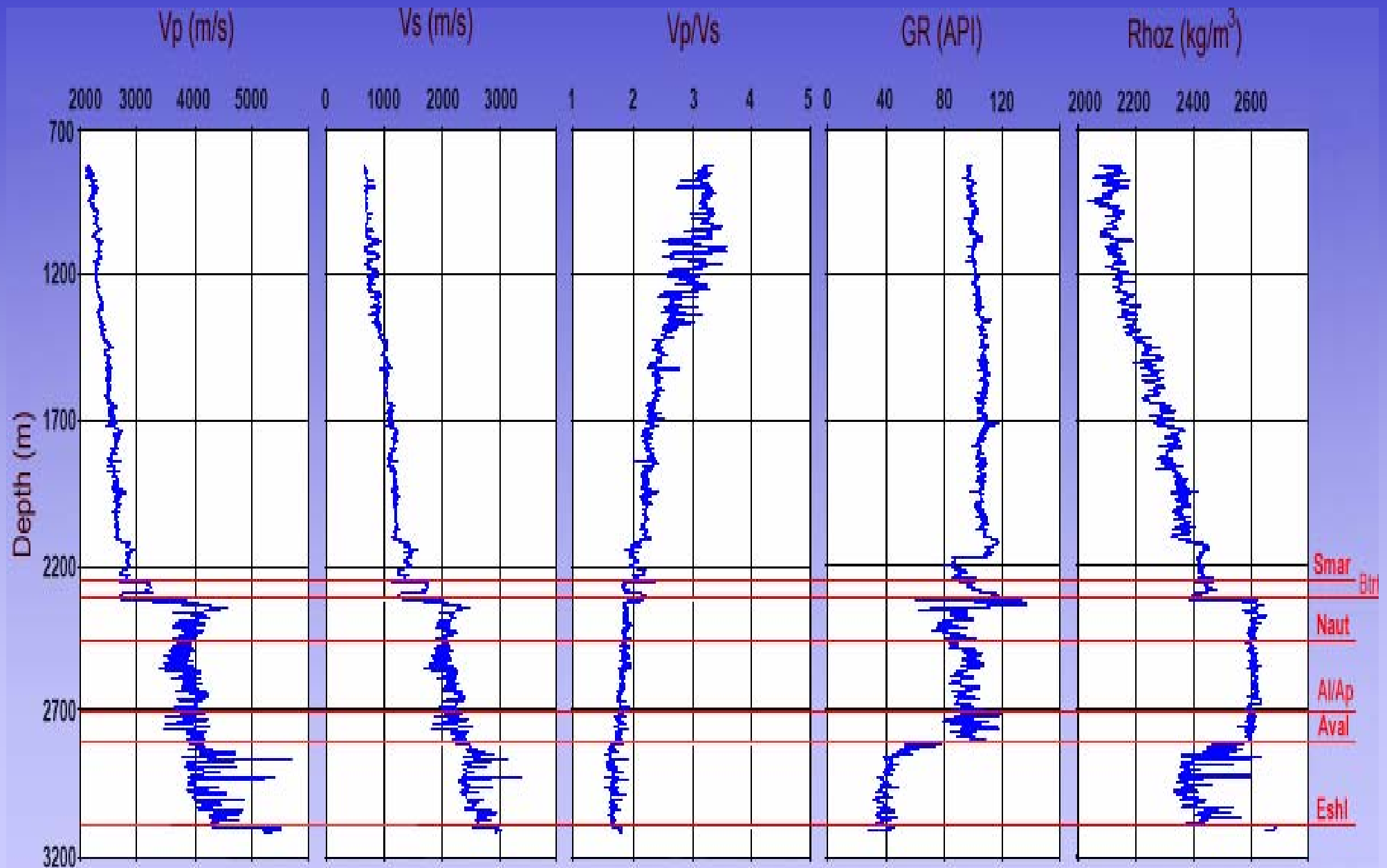
PP streamer data-PP synthetic, well H-20



North-South seismic line (1.8 to 3 seconds two-way-time (TWT)) intersecting the H-20 well (modified after Emery, 2001).

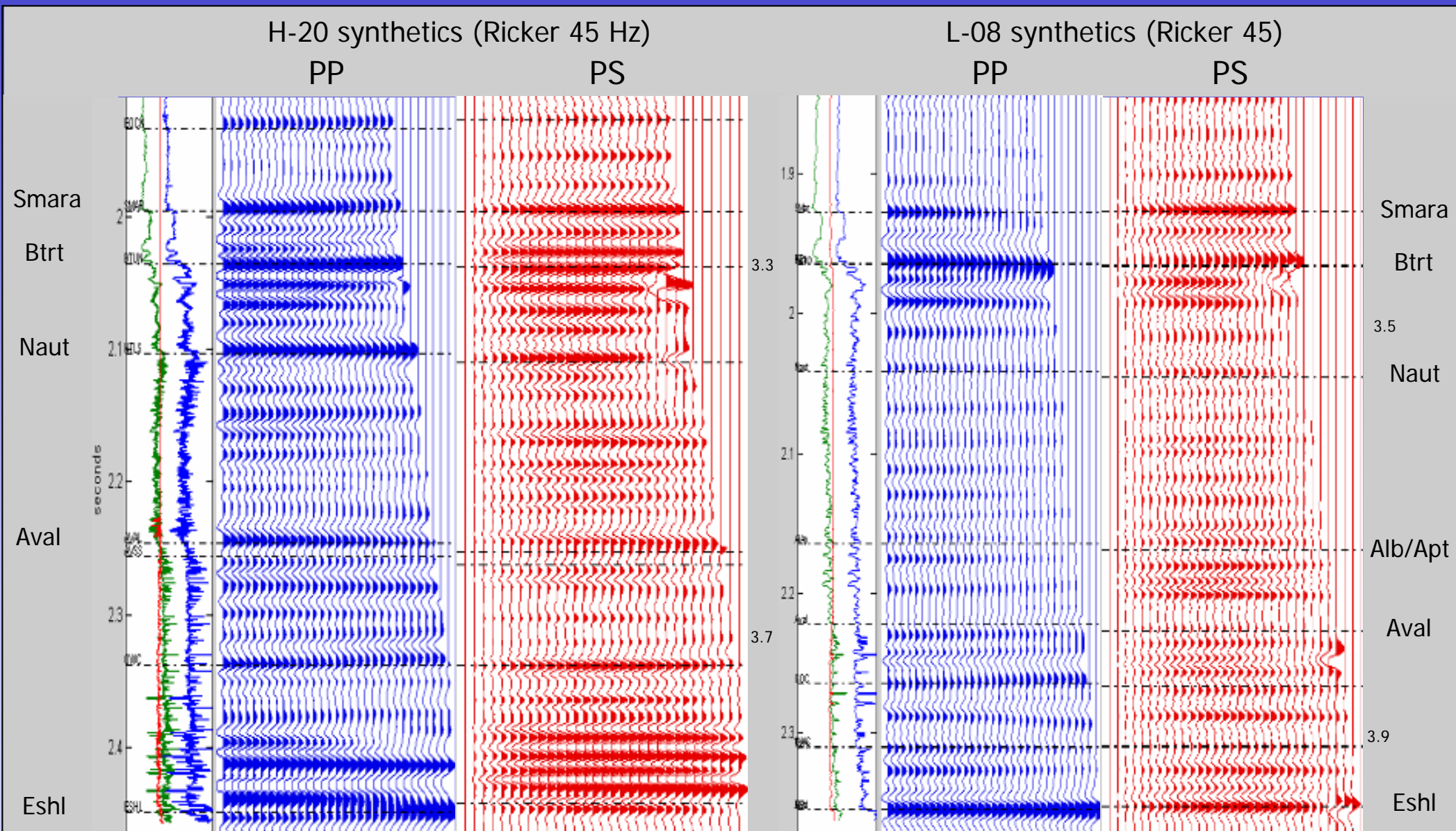
PP synthetic seismogram
Wavelet Ricker 45 Hz (zero phase)

L-08 well logs



Interpretation

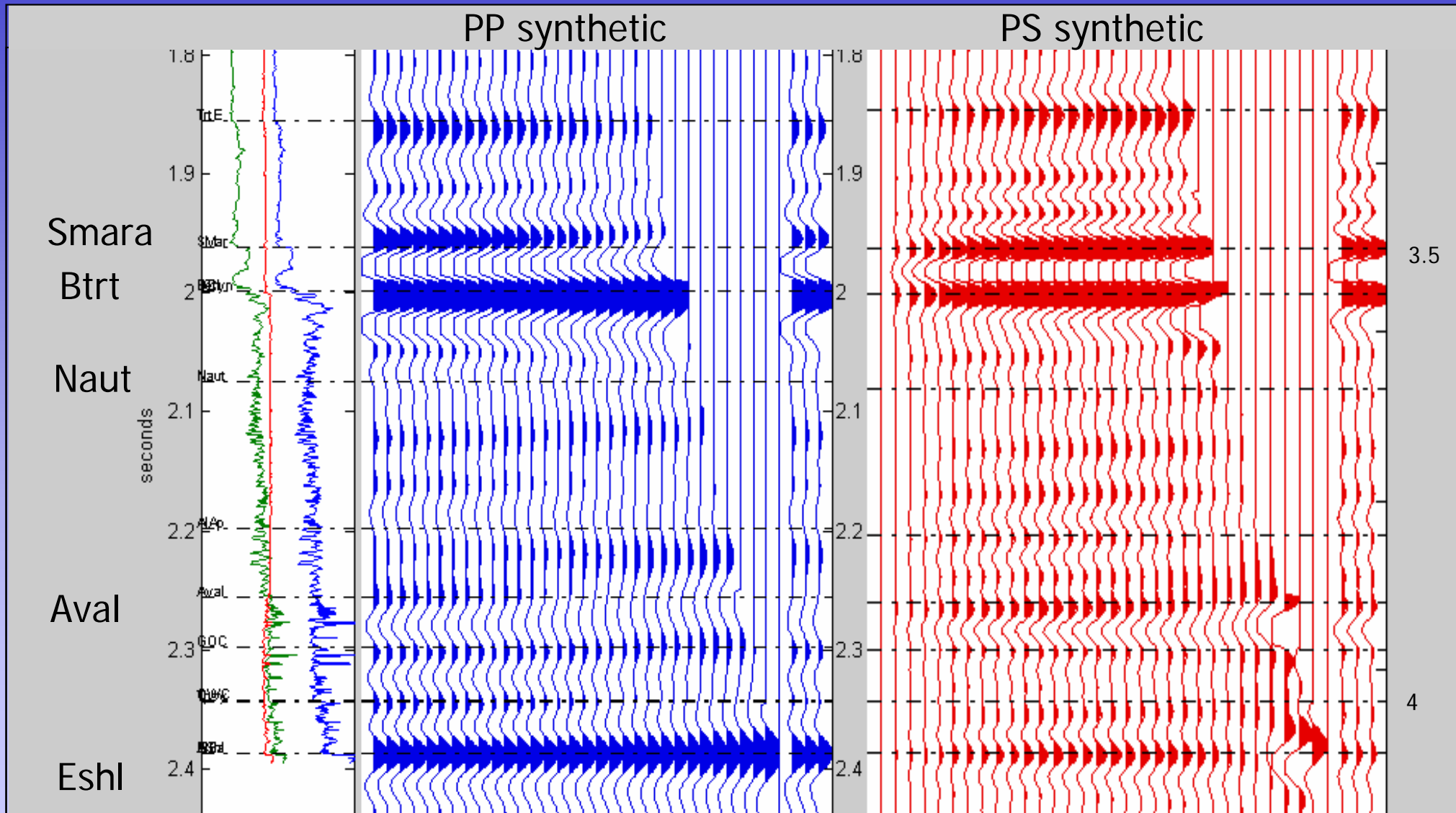
H-20 synthetics, L-08 synthetics



Offset from 0 to 3000 m, TWT in sec, V_p , V_s and R_{hob} , (zero phase wavelet)

Interpretation

P-P synthetic, P-S synthetic, well L-08



Offset from 0 to 3000 m, TWT in sec, V_p , V_s and R_{hob} , Wavelet Bandpass 4/8 25/30 Hz (zero phase)

OBS Survey Equipment



CCGS Hudson vessel (Modified from Loudon, 2002)



W2 Price air compressor. (modified from Jackson et al., 2002)



OBS (modified from www.dal.ca, 2002)

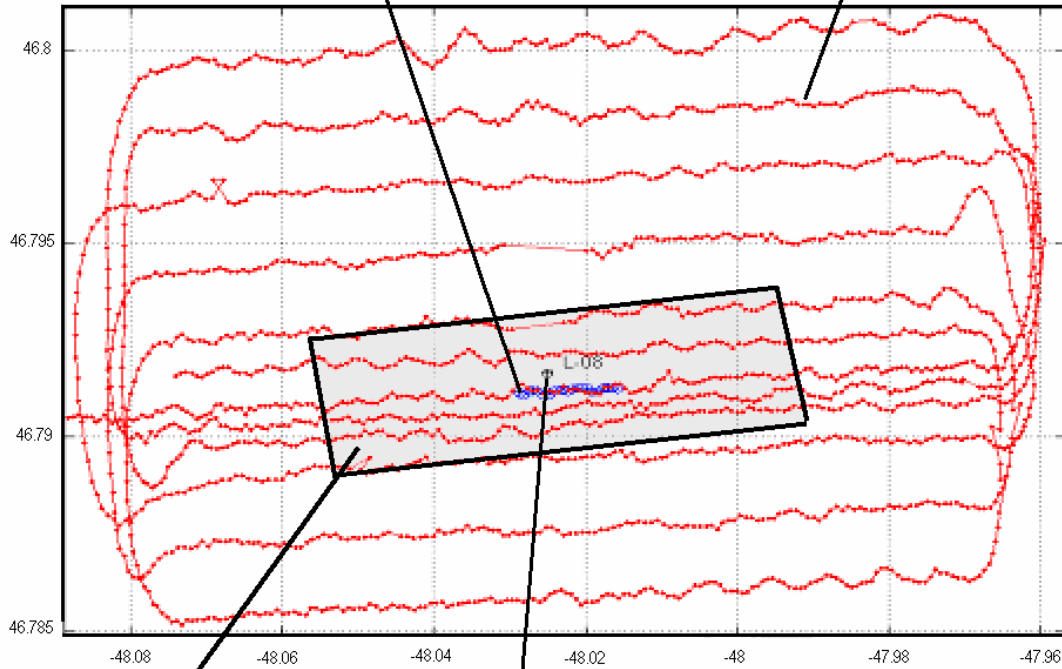


Air guns (modified from Loudon, 2002)

OBS survey Geometry

21 OBS receivers
@ 50m spacing

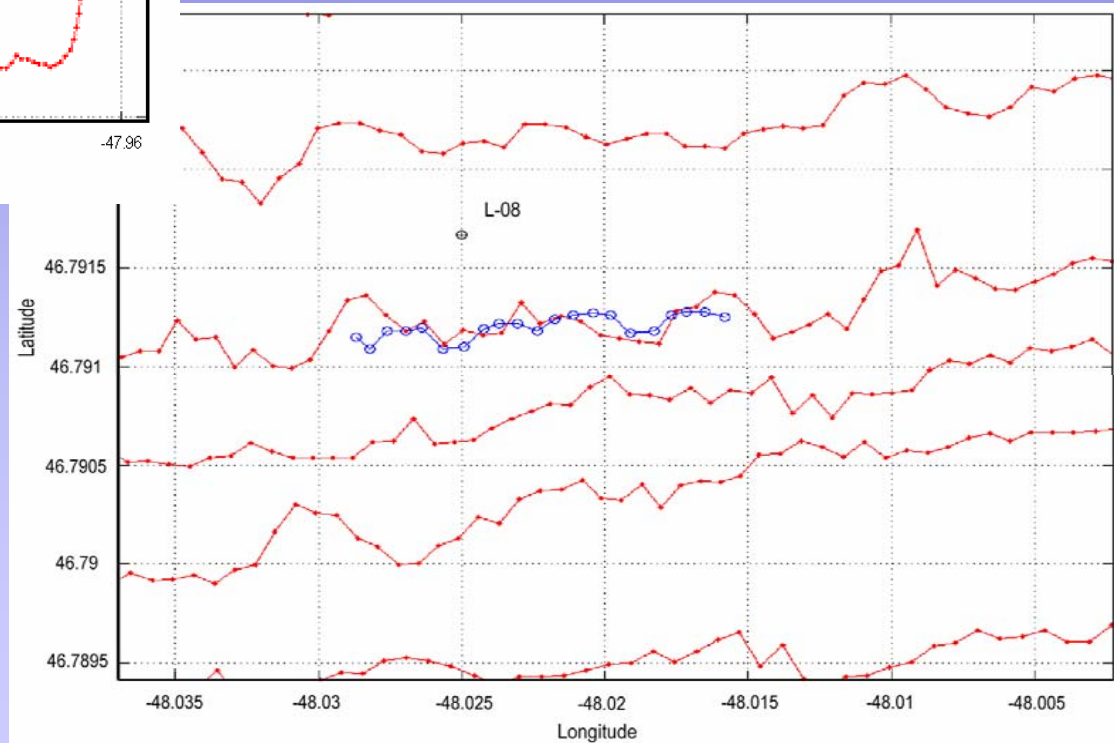
12 8km-long swath shot lines
@ 50-200m line spacing airgun



3D-4C interpreted volume

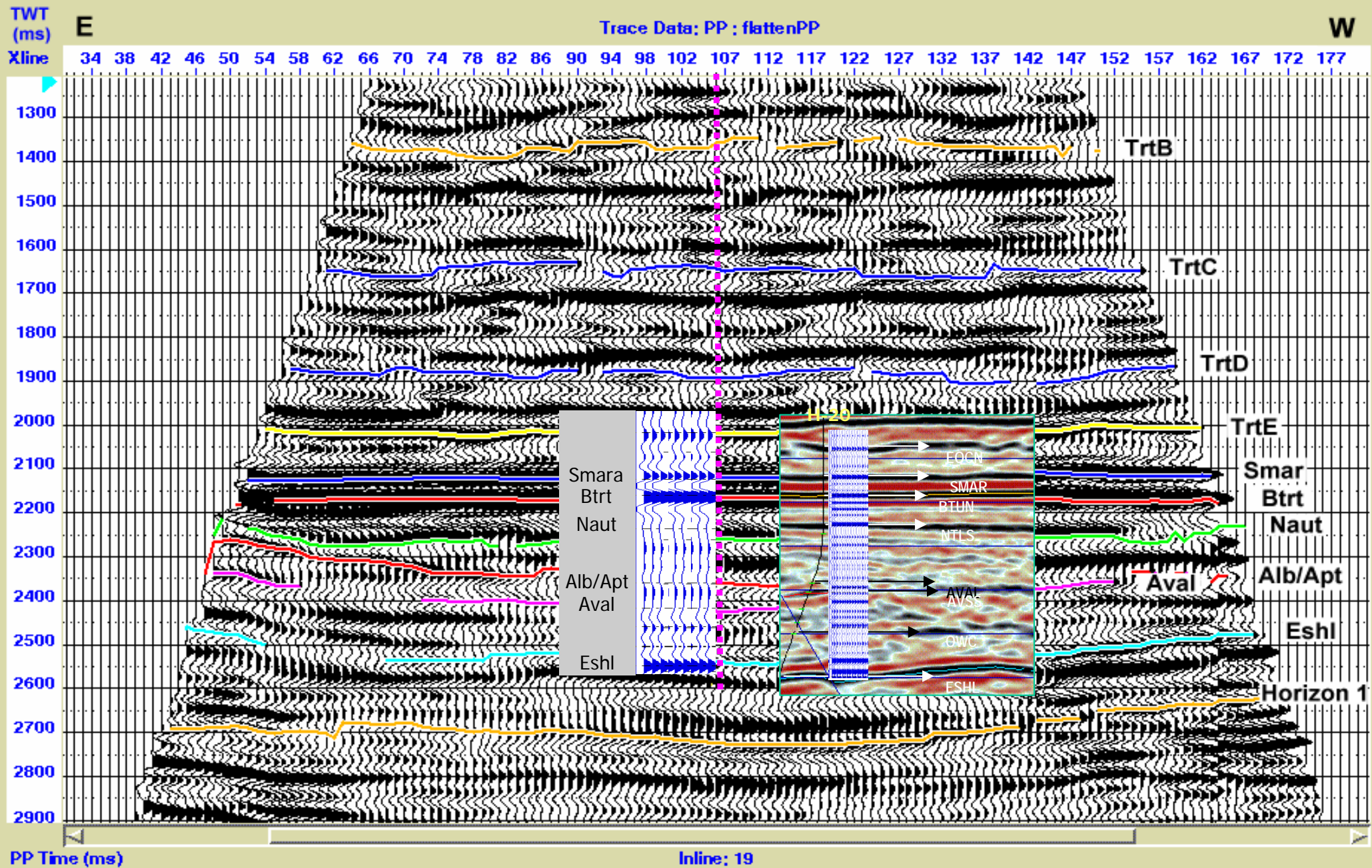
well L-08

Modified after Hall, 2002



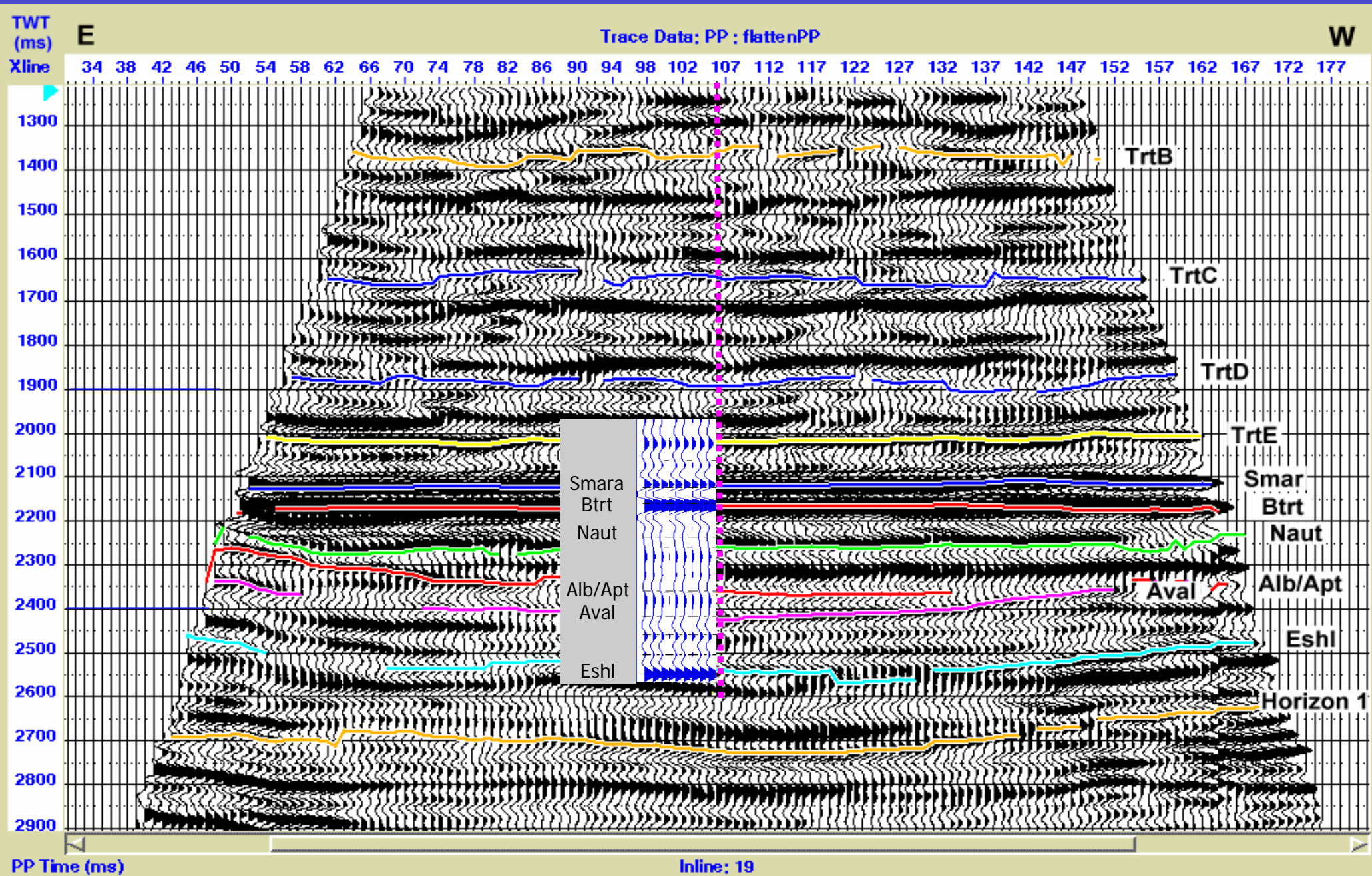
Interpretation

PP OBS, L-08 PP synth - PP streamer, H-20 PP synth



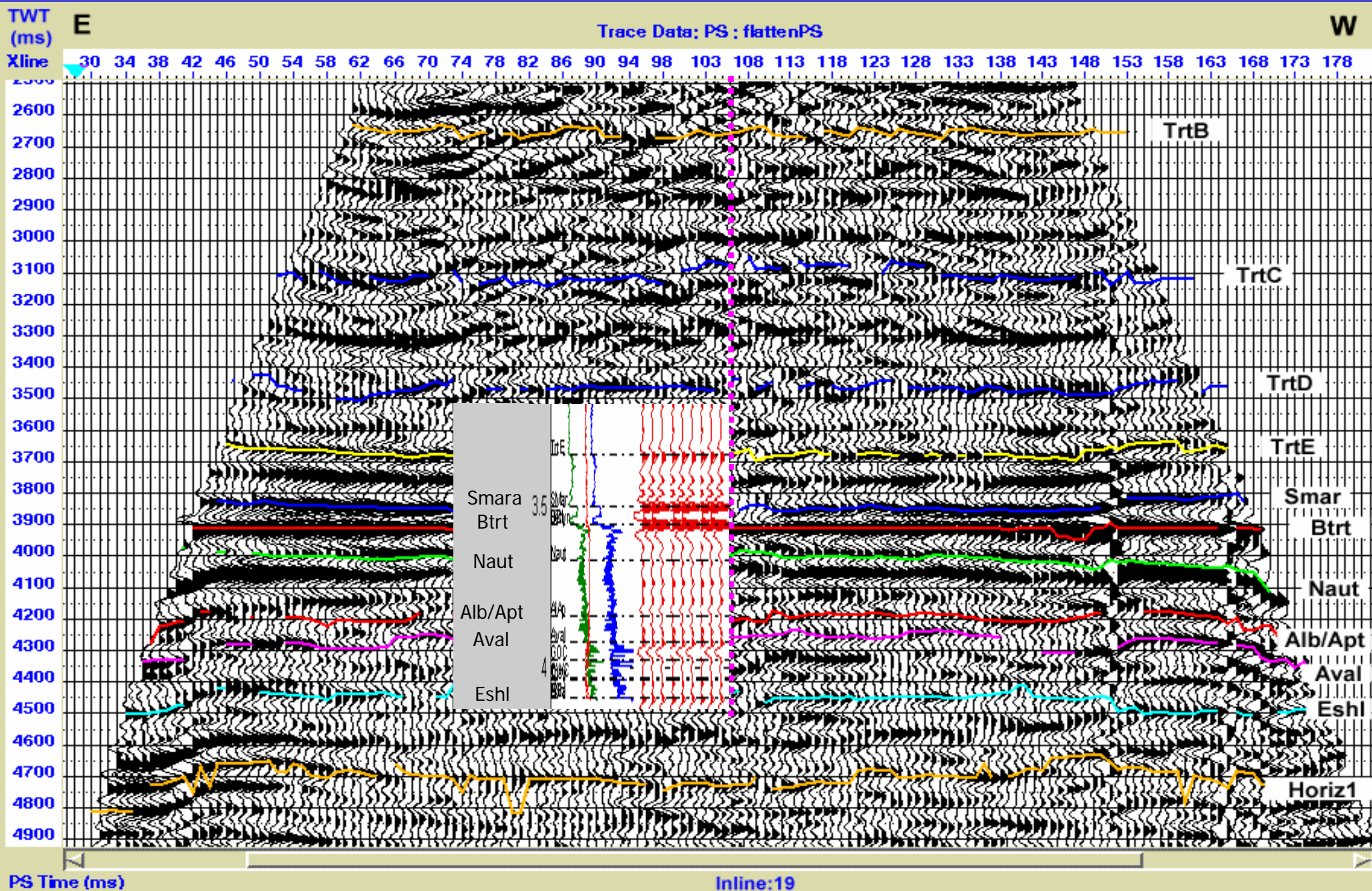
Interpretation

L-08 P-P synthetic, Vertical component



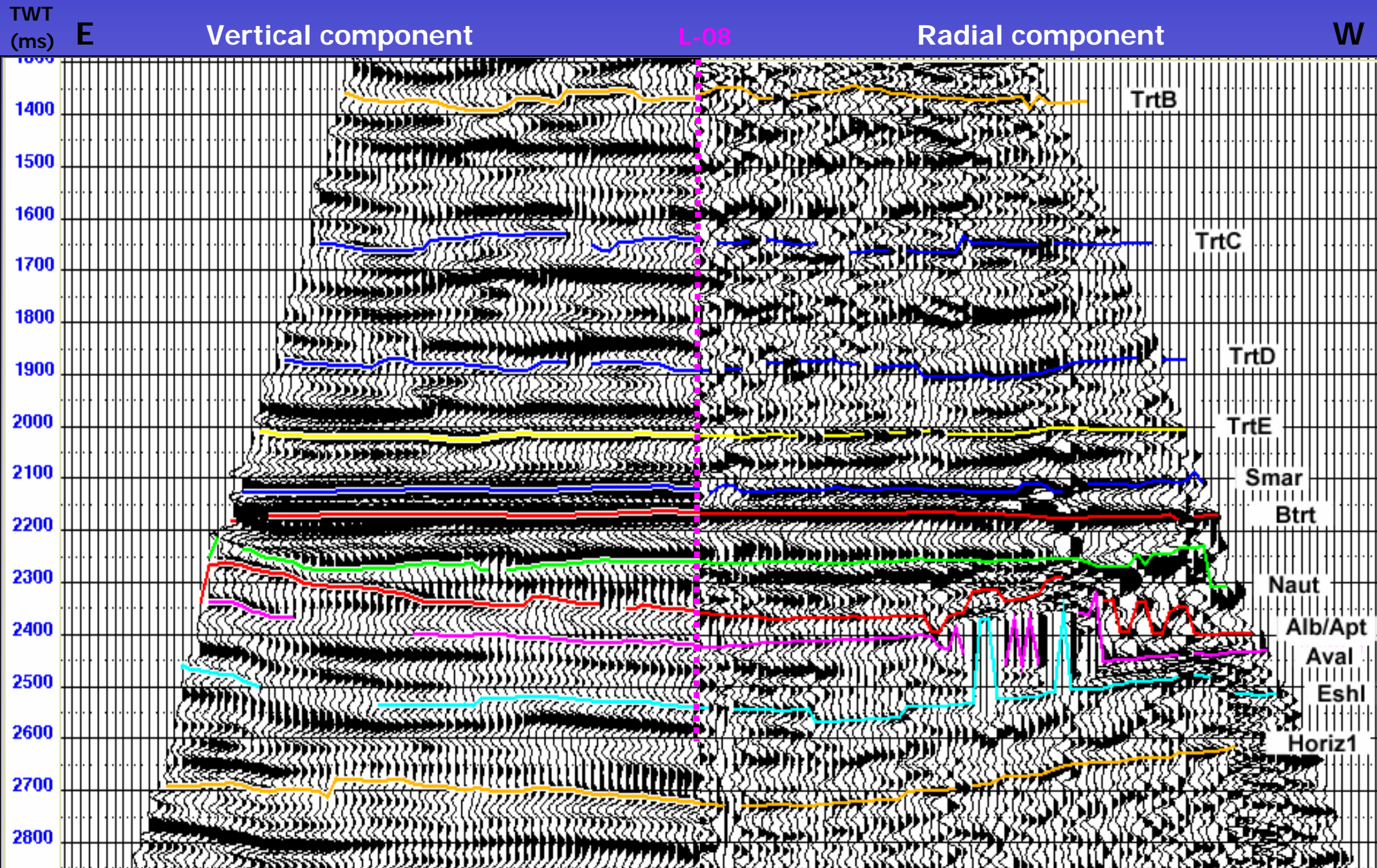
Interpretation

L-08 P-S synthetic, Radial component



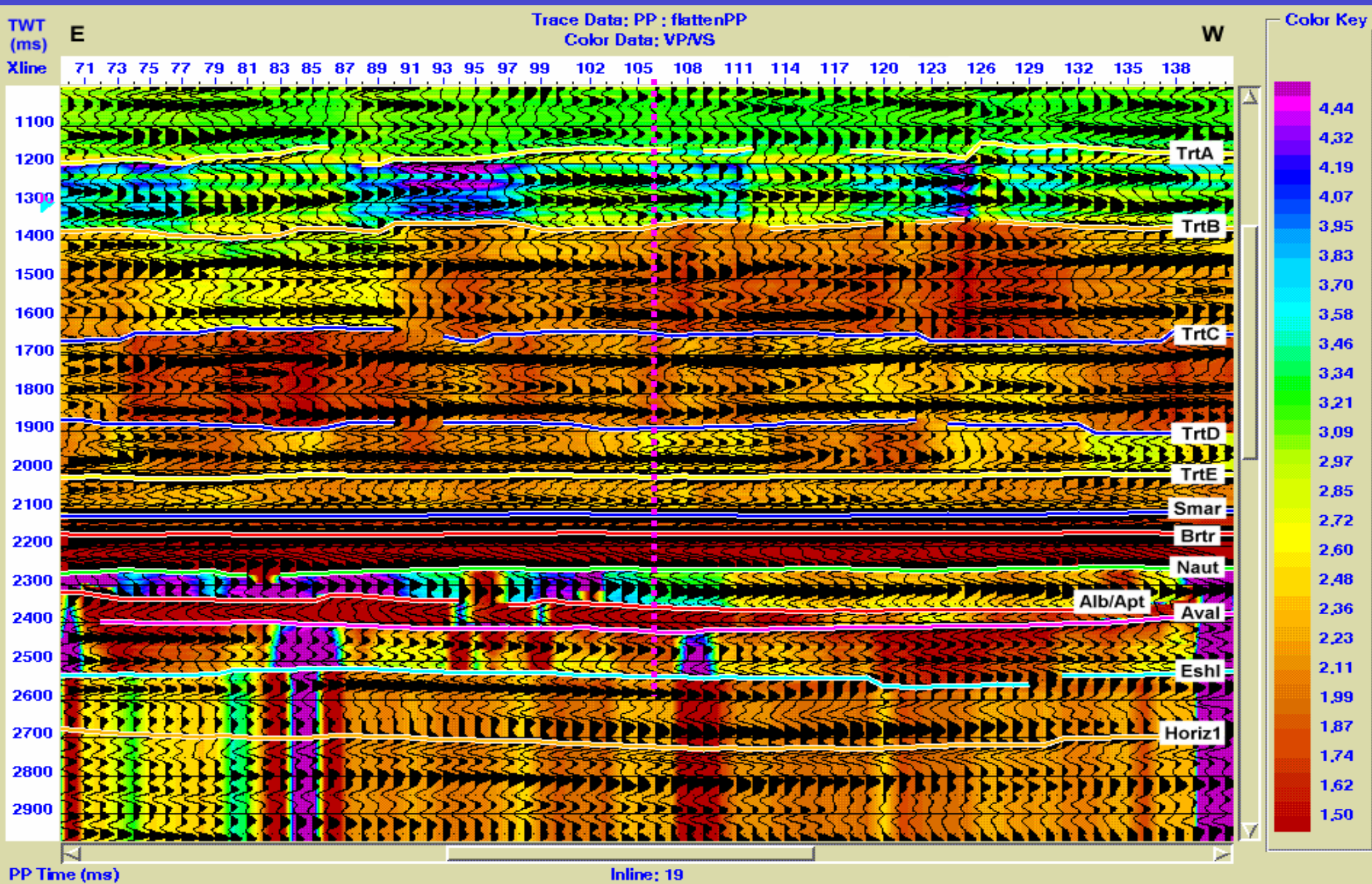
Interpretation

Vertical component, Radial component



Interpretation

Vp/Vs Vertical component



Conclusions...

- Detailed correlation information from the wells L-08 and H-20 enabled the interpretation of the low impedance contrast at the reservoir
- On well H-20, the PS seismic images showed better (higher amplitude over the surrounding signals) ability in illuminating the Avalon Fm top
- A reasonable data to model match was found for:
 - PP synthetics & PP vertical component seismic section
 - PS synthetics & PS radial component seismic section

Conclusions...

- Converted wave reflections at the high P-wave impedance contrast of the T-K unconformity indicated that the interface may not be a strong Shear reflector.
- The interpretation of the weak impedance change at the Avalon Fm/Nautilus Fm boundary can be improved through the use of converted waves.
- V_p/V_s values from the seismic and the well L-08 are related, presence of lateral V_p/V_s anomalies is evident on the seismic
- Results from the use of converted wave data, shows that the various seismic reflections of the White Rose field may be resolvable.

Acknowledgements

- Richard Xu & Kevin Hall (Crewes)
- Dr. Peter Cary (Sensor Geophysical Inc.)
- Dr. Brian Russell & Keith Hirsche (Hampson-Russell Software)
- David Emery (Husky Energy Inc.)
- CREWES sponsors