Inversion and interpretation of multicomponent seismic data: Willesden Green Alberta

Roxana M. Varga, Robert R. Stewart
and John C. Bancroft

University of Calgary
December 1, 2006
CREWES

Outline

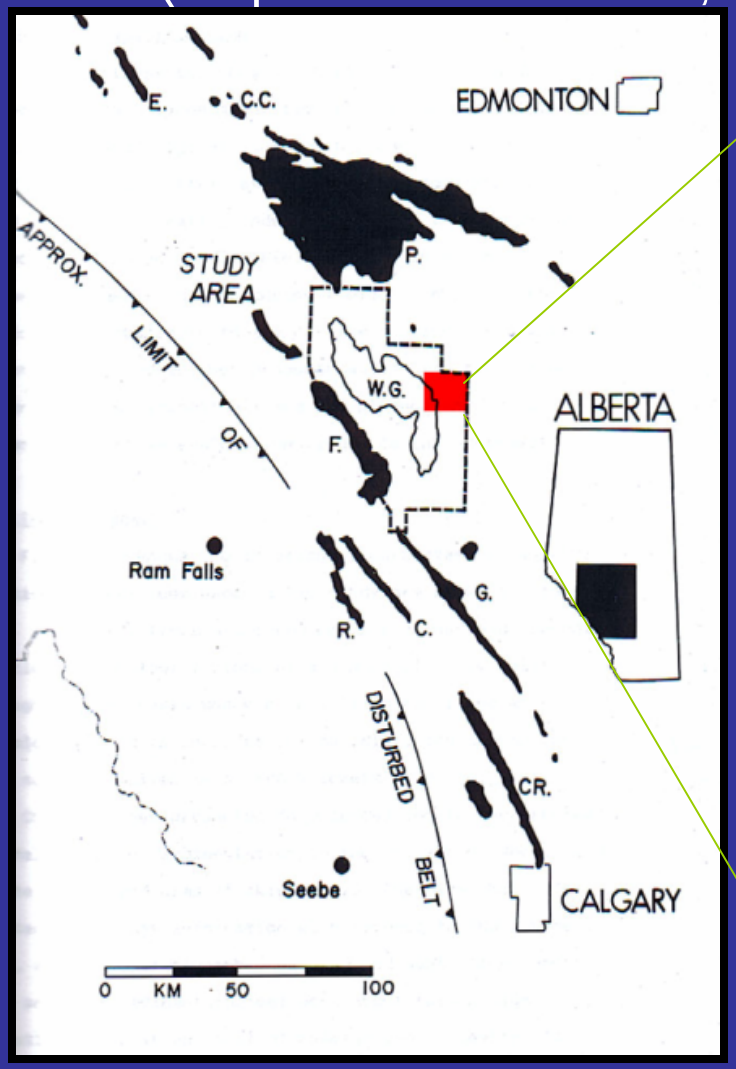
- Location and Geology
- PP Interpretation and PP Inversion
- PS Interpretation
- PP and PS interpretation and PS Inversion
- Results - Imaging of anomalous zones
- Conclusions, Future work

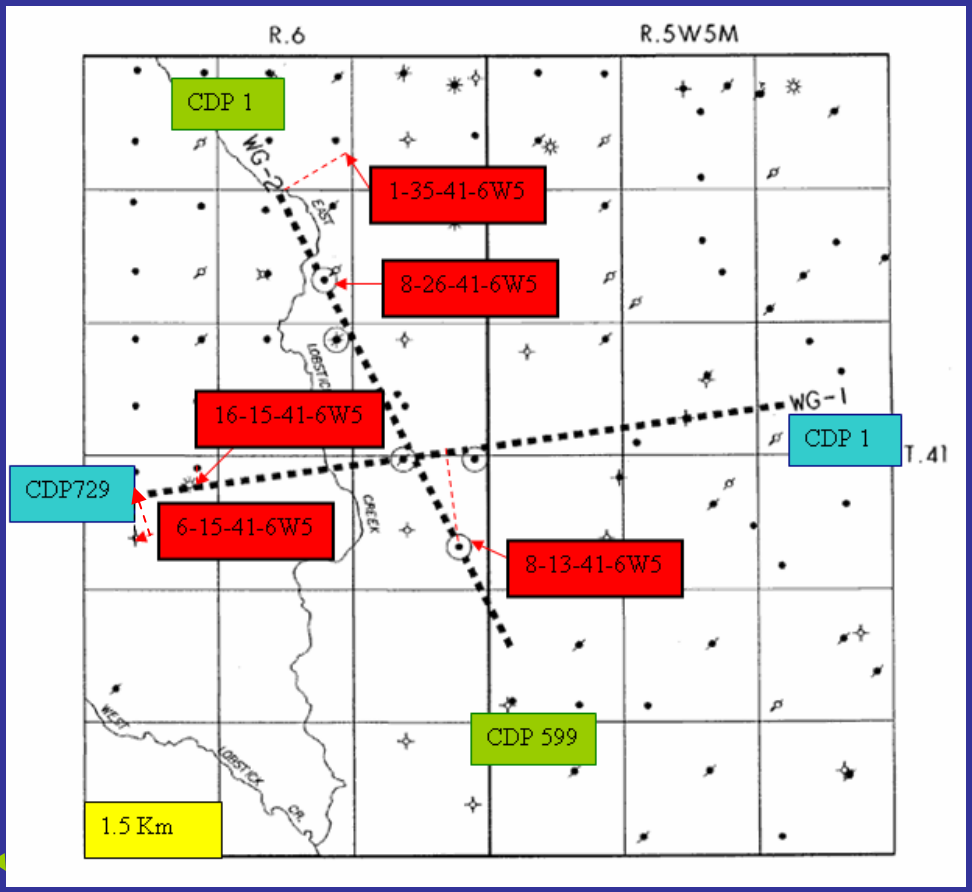
What are we really trying to do?

- **Find oil-saturated 2nd white speckled shales (2WSPK)**
- **Geologic model: 2WS shale mixed with sand, limestone, gas & oil gives low Vp/Vs**
- **Get PP and PS sections & find Vp/Vs anomalies**

Location of Willesden Green Alberta

(maps from Keith 1985, and Response Seismic Surveys Ltd.)



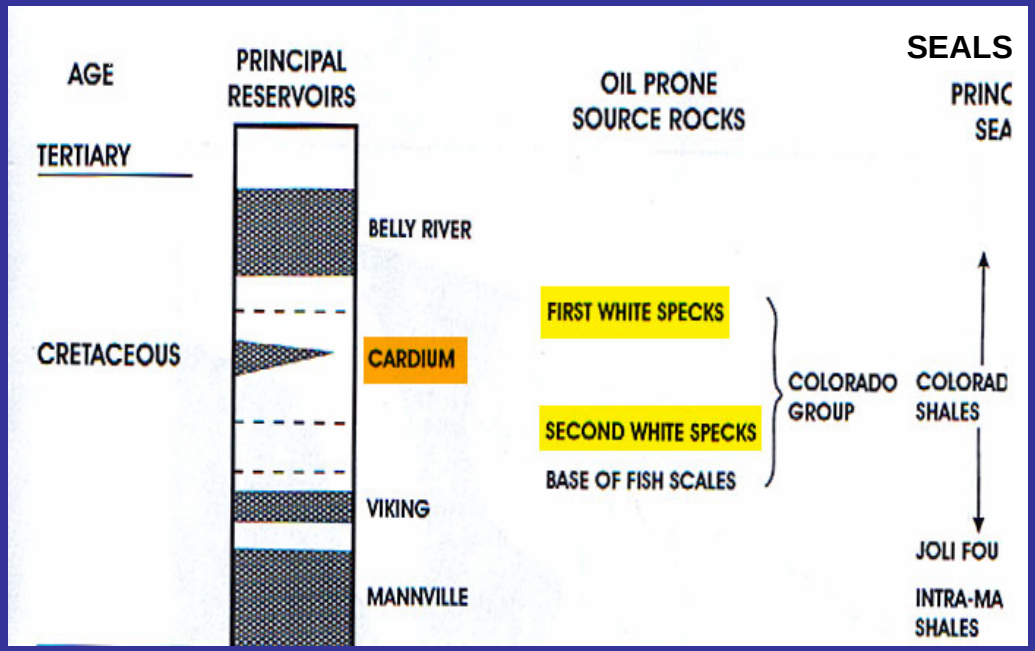


Generalized stratigraphy of Western Canada sedimentary basin

- **1WSPK and 2WSPK: good stratigraphic markers**

- **2WSPK:**
- **calcareous shale - occurrences of sandstone and siltstone**
- **a source and a reservoir rock**
- **Thickness: 45m-70m**

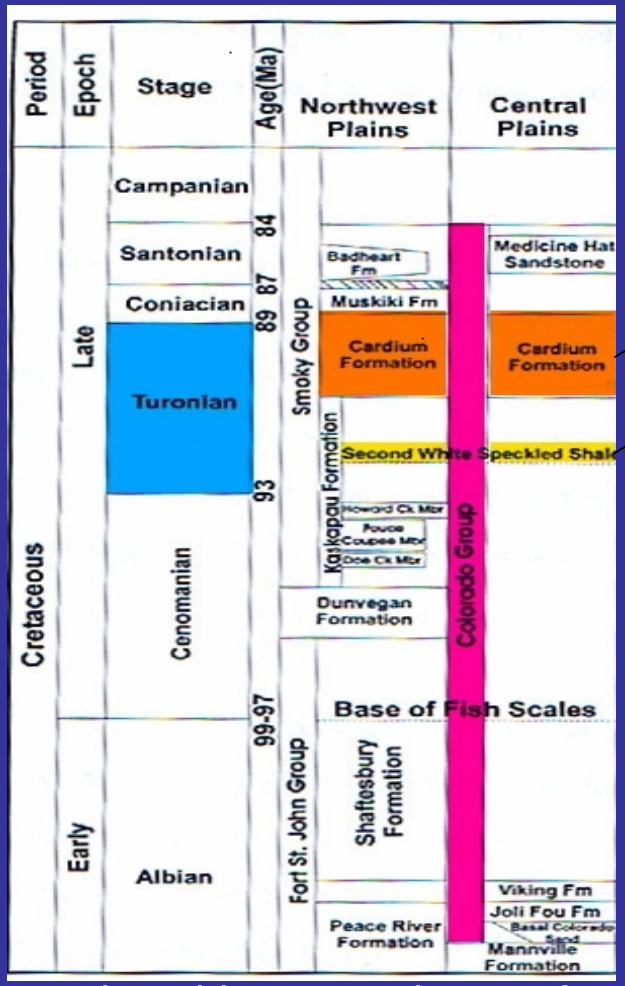
- **Cardium**
- **main sandstone unit**
- **interbedded sandstones and shales**
- **Thickness about 100m**



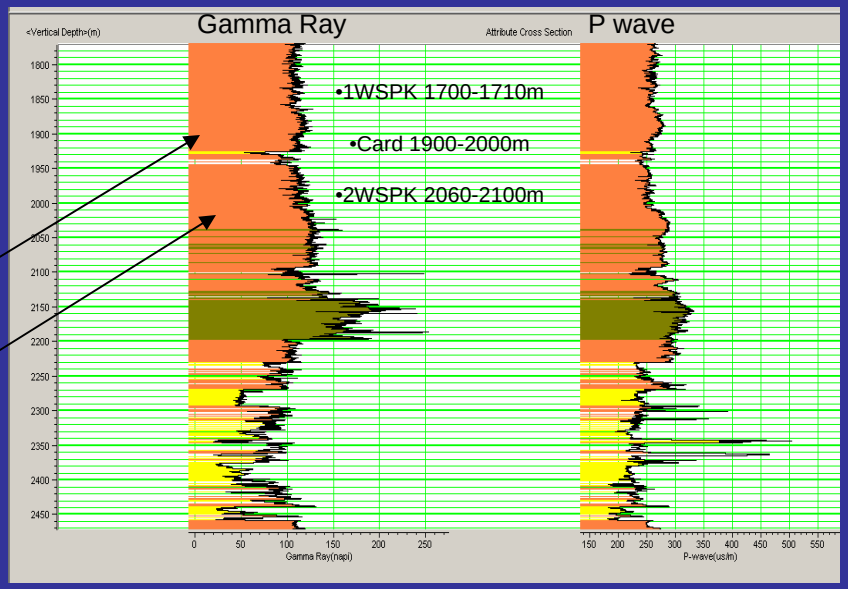
(Creancy et al. 1992)

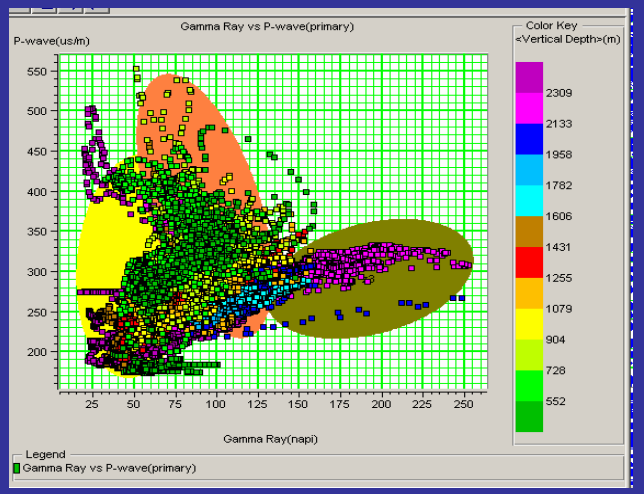
Lithology differentiation

well 1-35-41-6W5



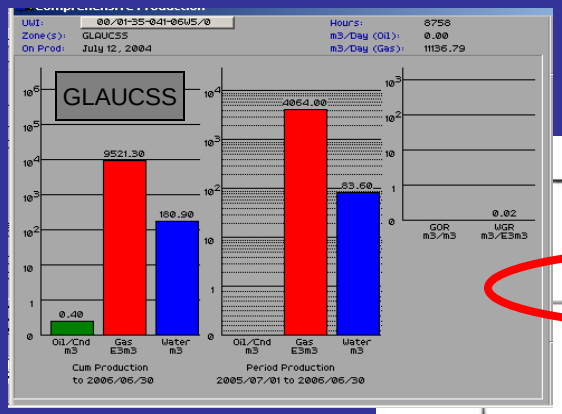
Stratigraphic nomenclature of Western Central Alberta

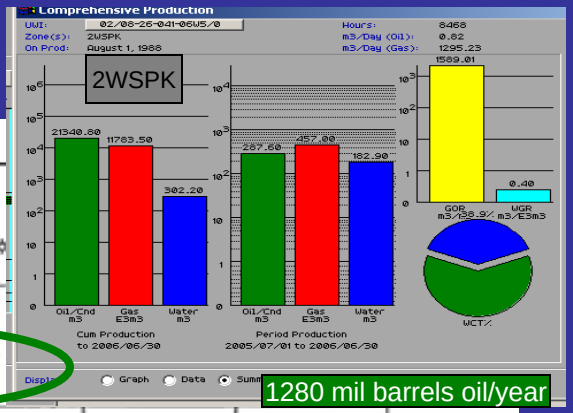


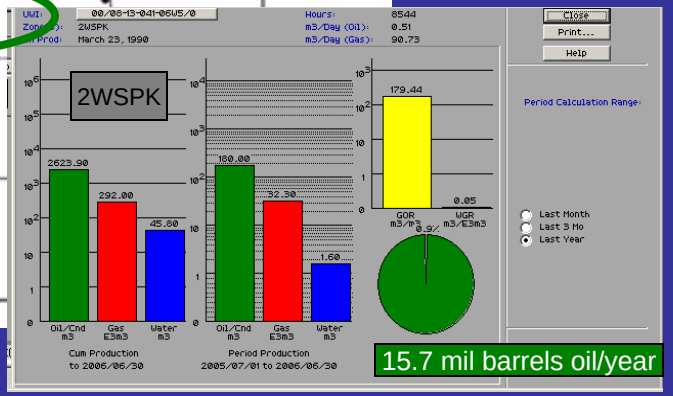


Wells from Accumap:

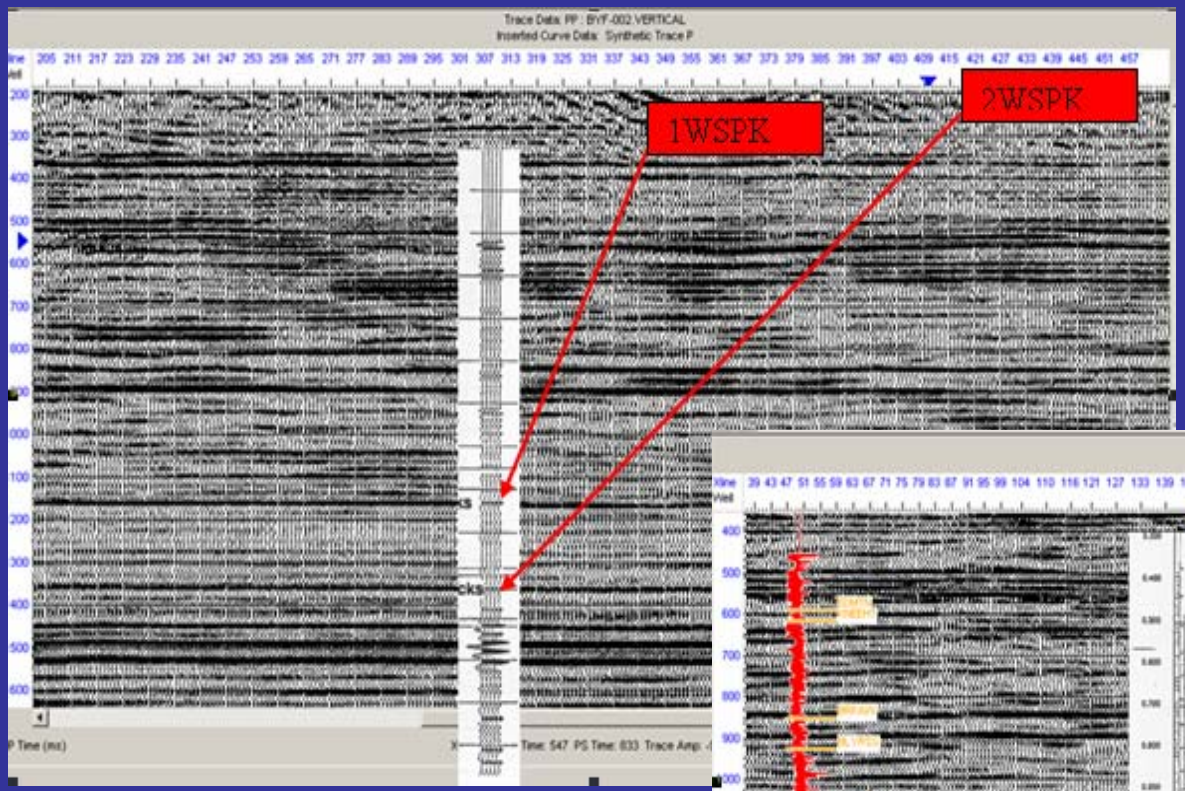
Cumulative oil and gas production in last year (2WSPK)



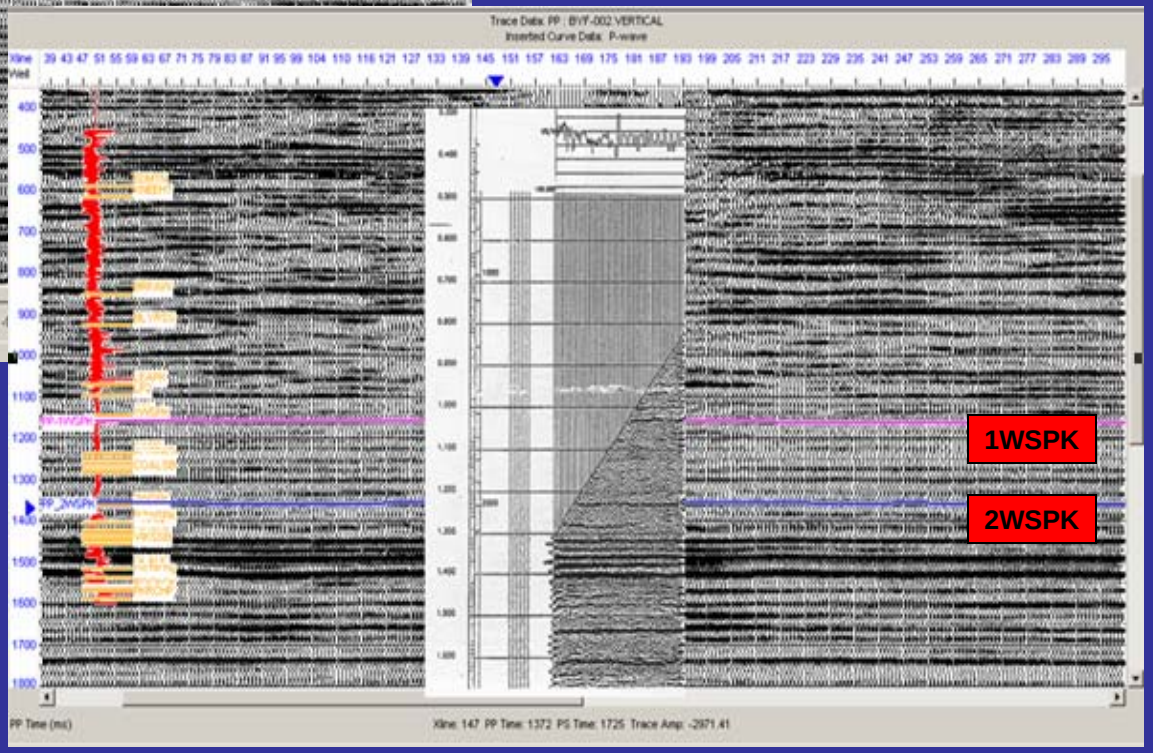




PP Interpretation

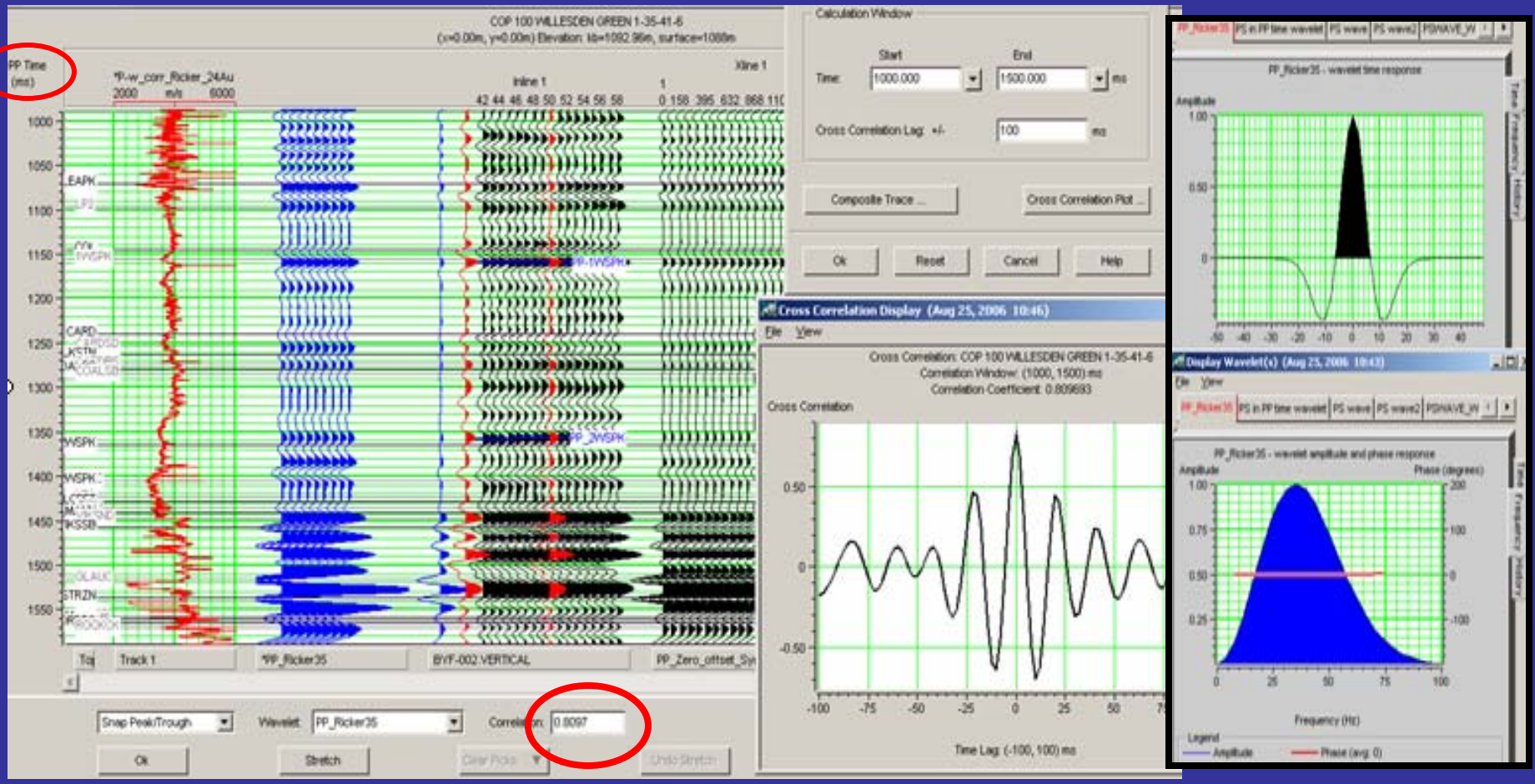


WG2: line correlated with the corridor stack (VSP) at well 8-13-41-6 (PP time)



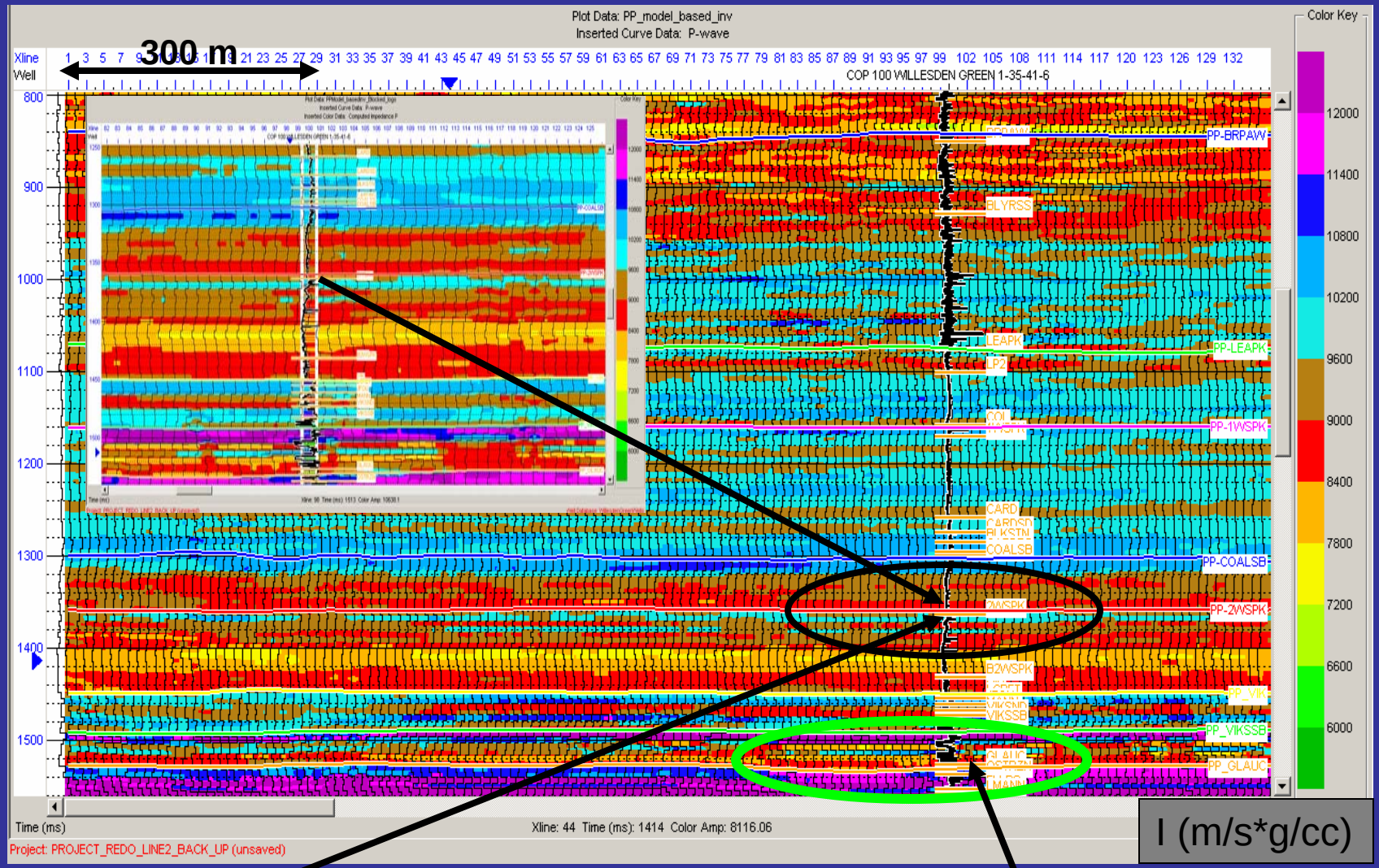
WG2 line: correlated with the zero offset VSP stretched two way time at well 8-13-41-6 (PP time)

Line WG2: Synthetic, Seismic and well log correlation - PP time



Well 1-35-41-6W5

Line WG2: PP inversion **Model Based**

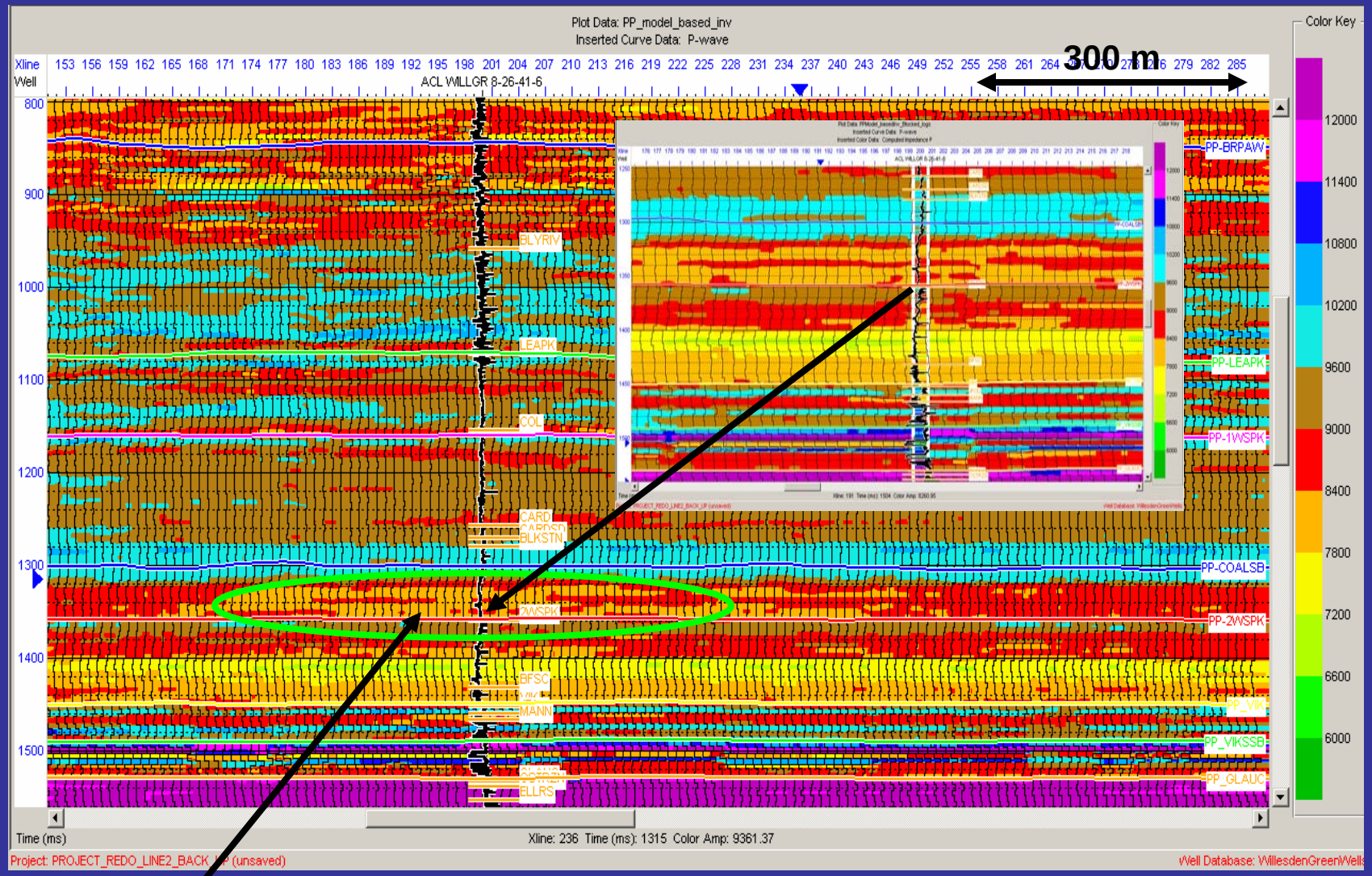


Not producing from 2WSPK

Well 1-35-41-6W5

Producing from GLAUCSS

Line WG2: Inversion - PP Model Based



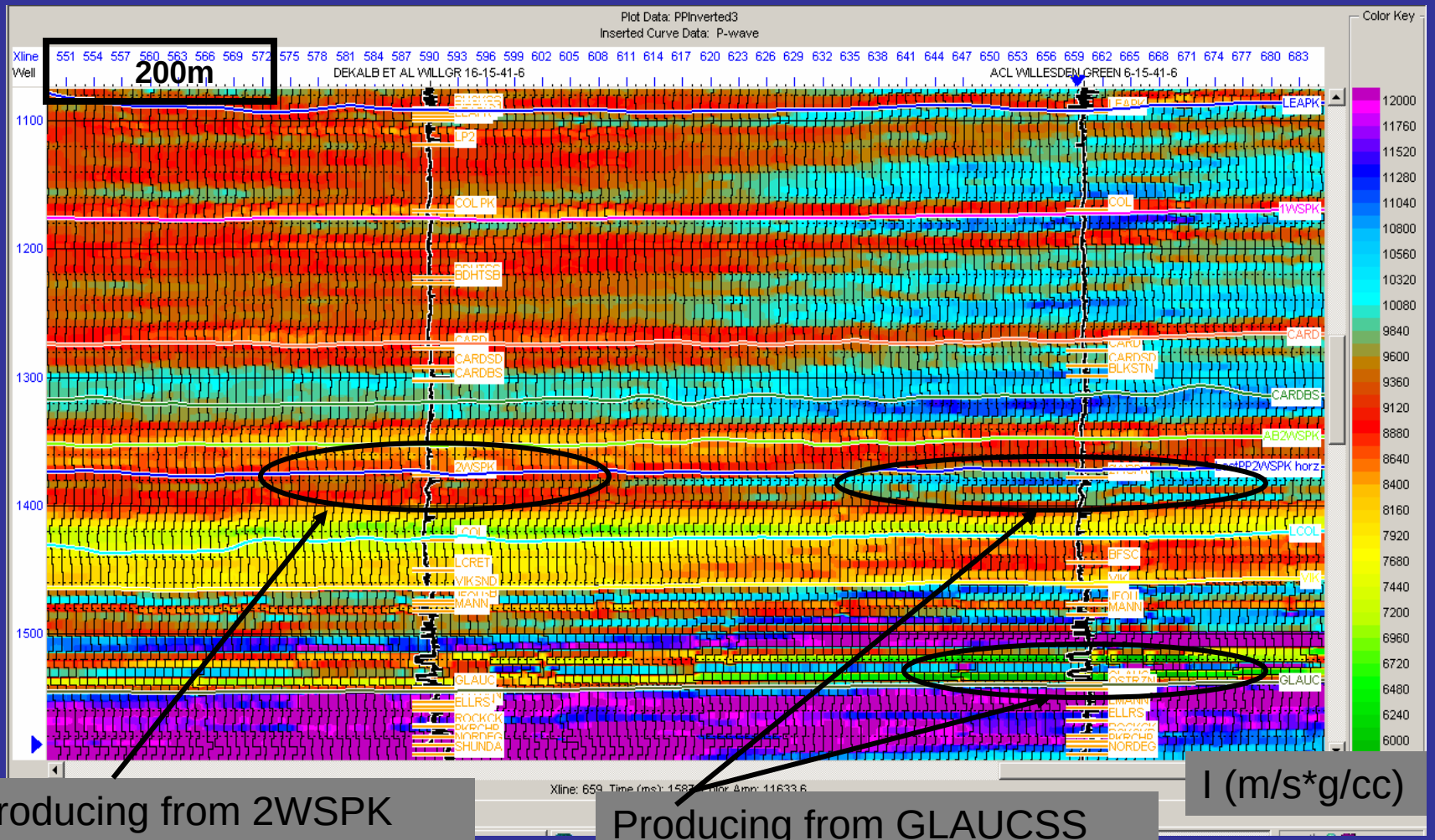
Producing from 2WSPK

Well 8-26-41-6W5

Line WG1: Inversion - PP Model Based

Well 16-15-41-6W5

Well 6-15-41-6-W5

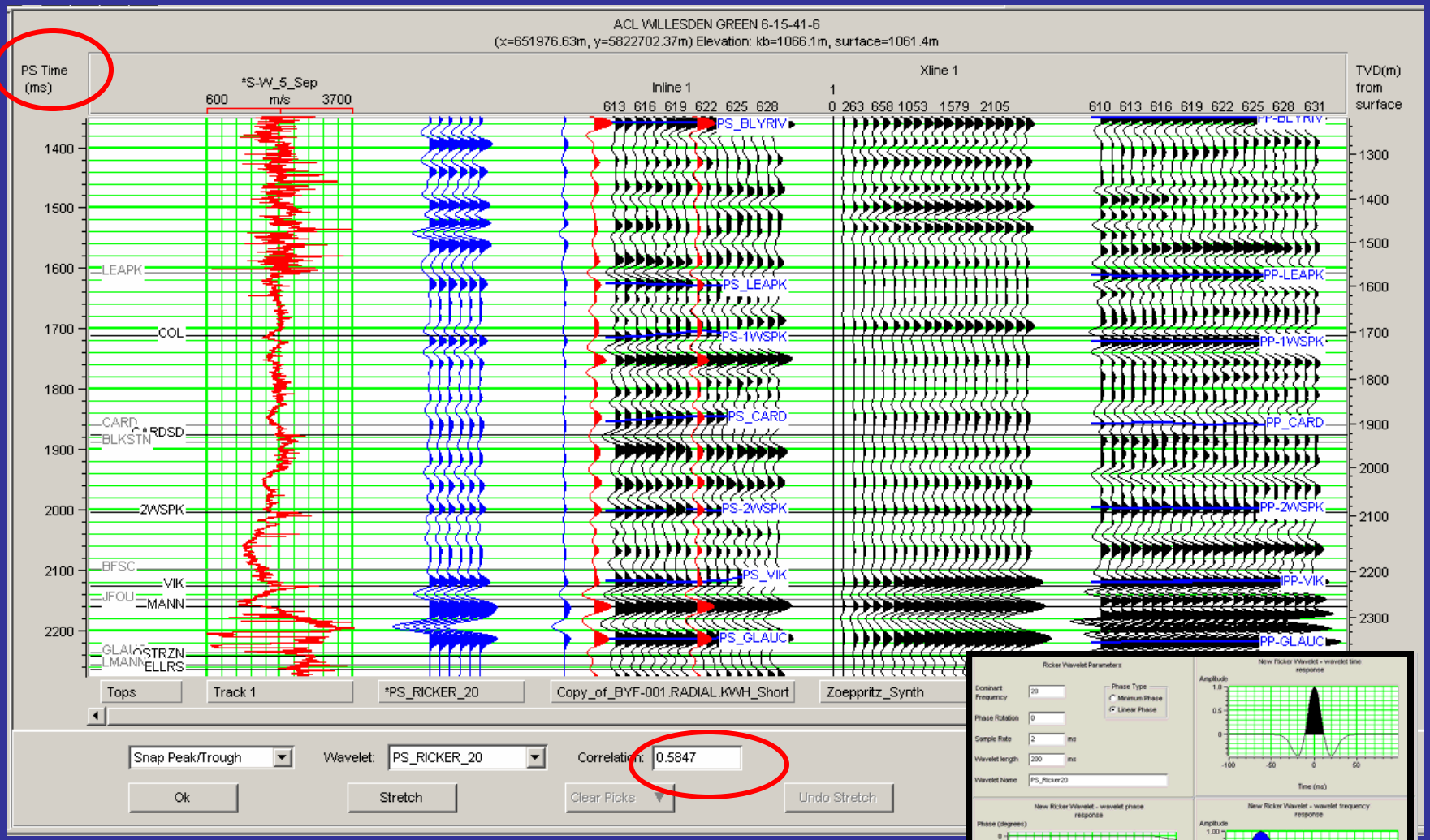


Producing from 2WSPK

Producing from GLAUCSS
Was producing from 2WSPK

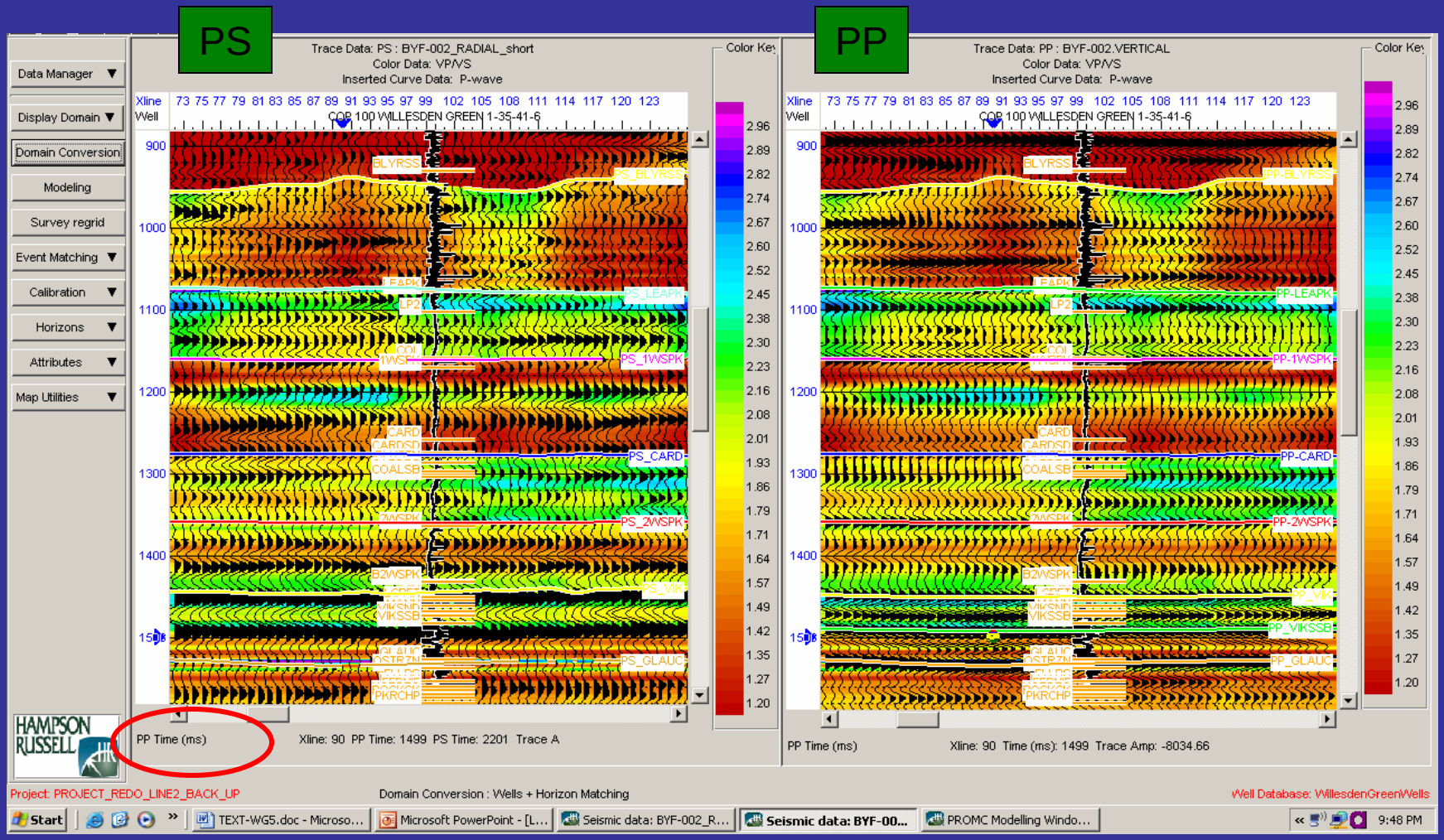
PS Interpretation

Line WG1: Synthetic, Seismic and well log correlation-PS time



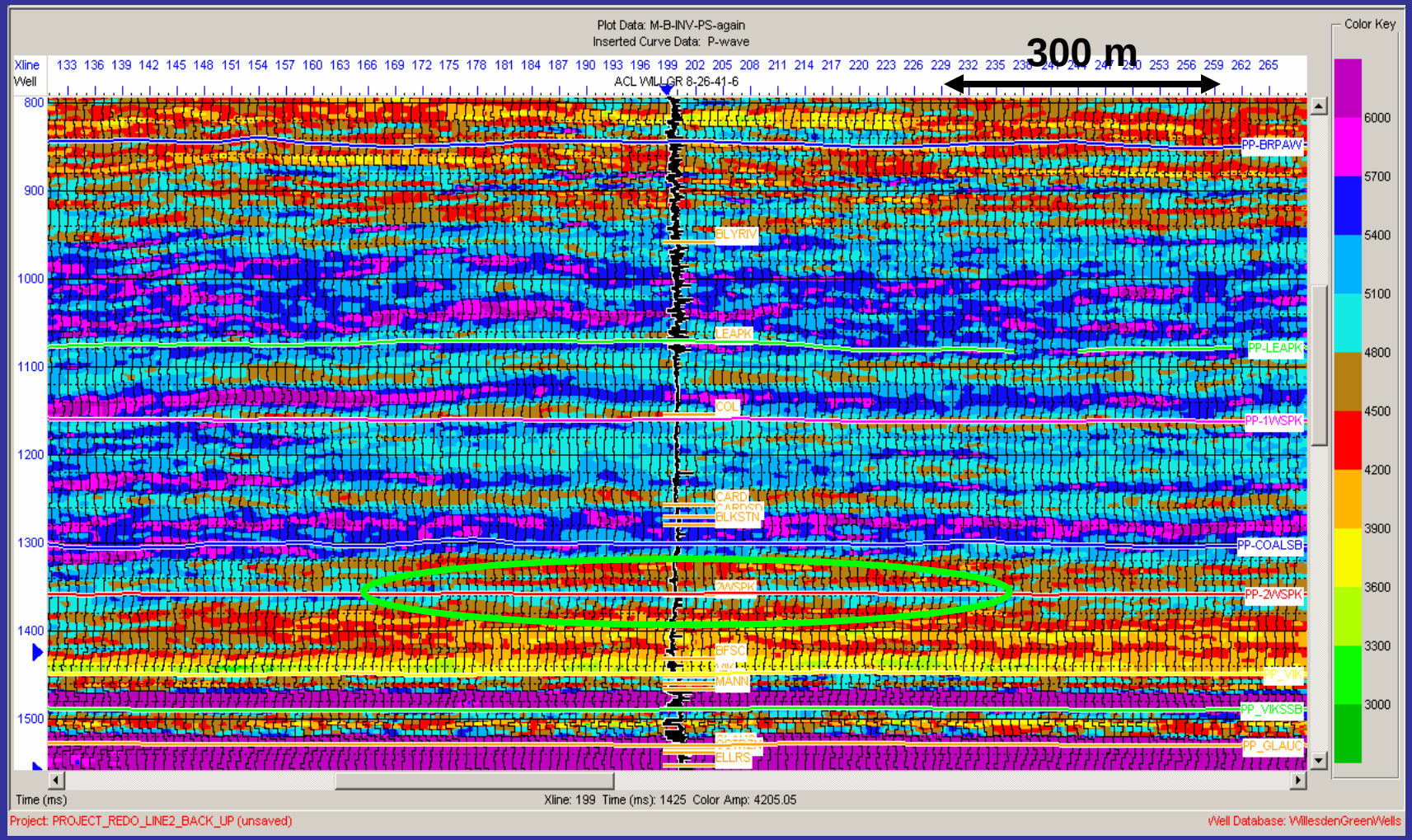
20 Hz Ricker wavelet

PP and PS Interpretation



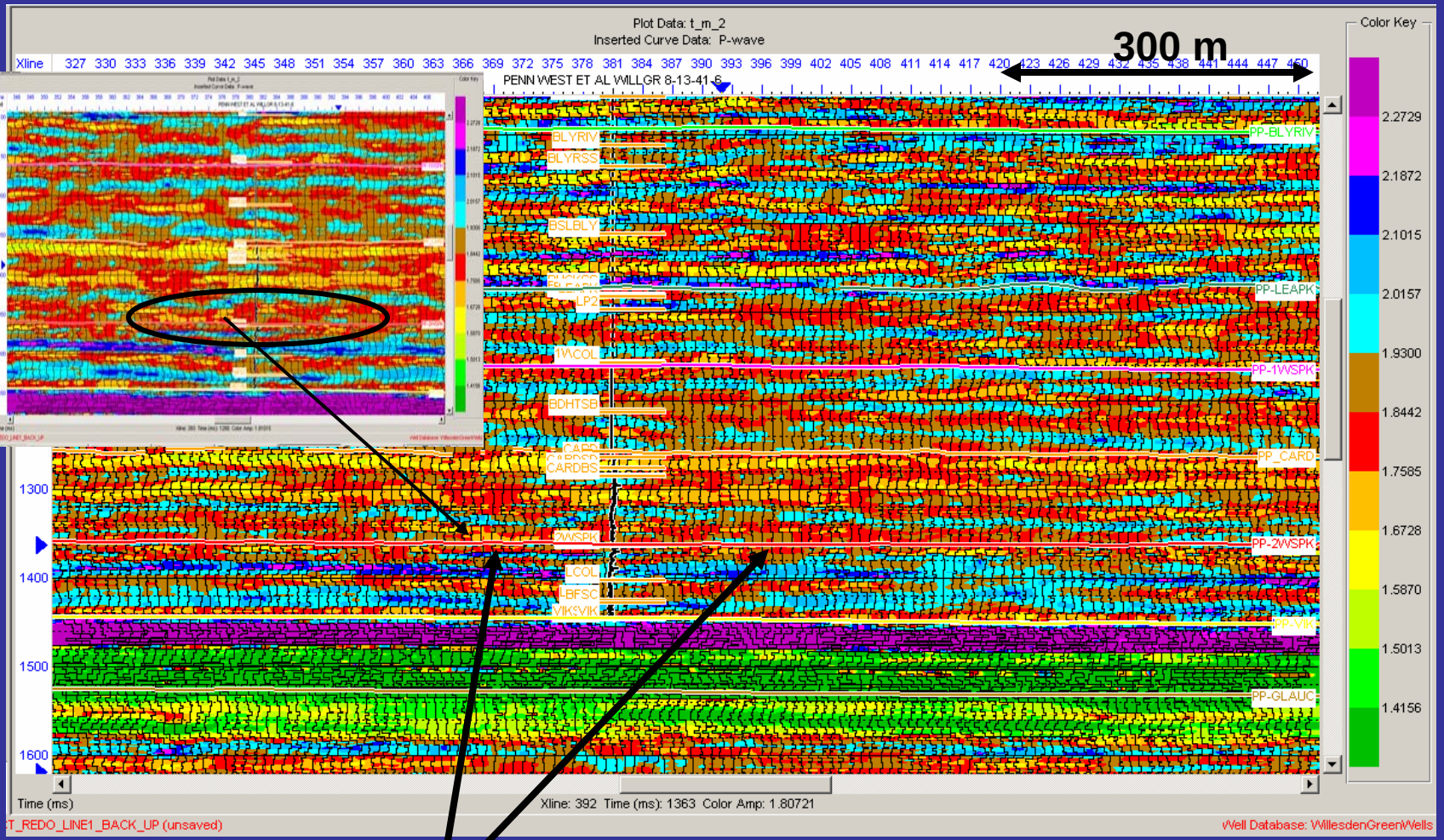
Line WG1: After registration / horizon match

PS Inversion
Line WG2: – Model Based PS in PP time



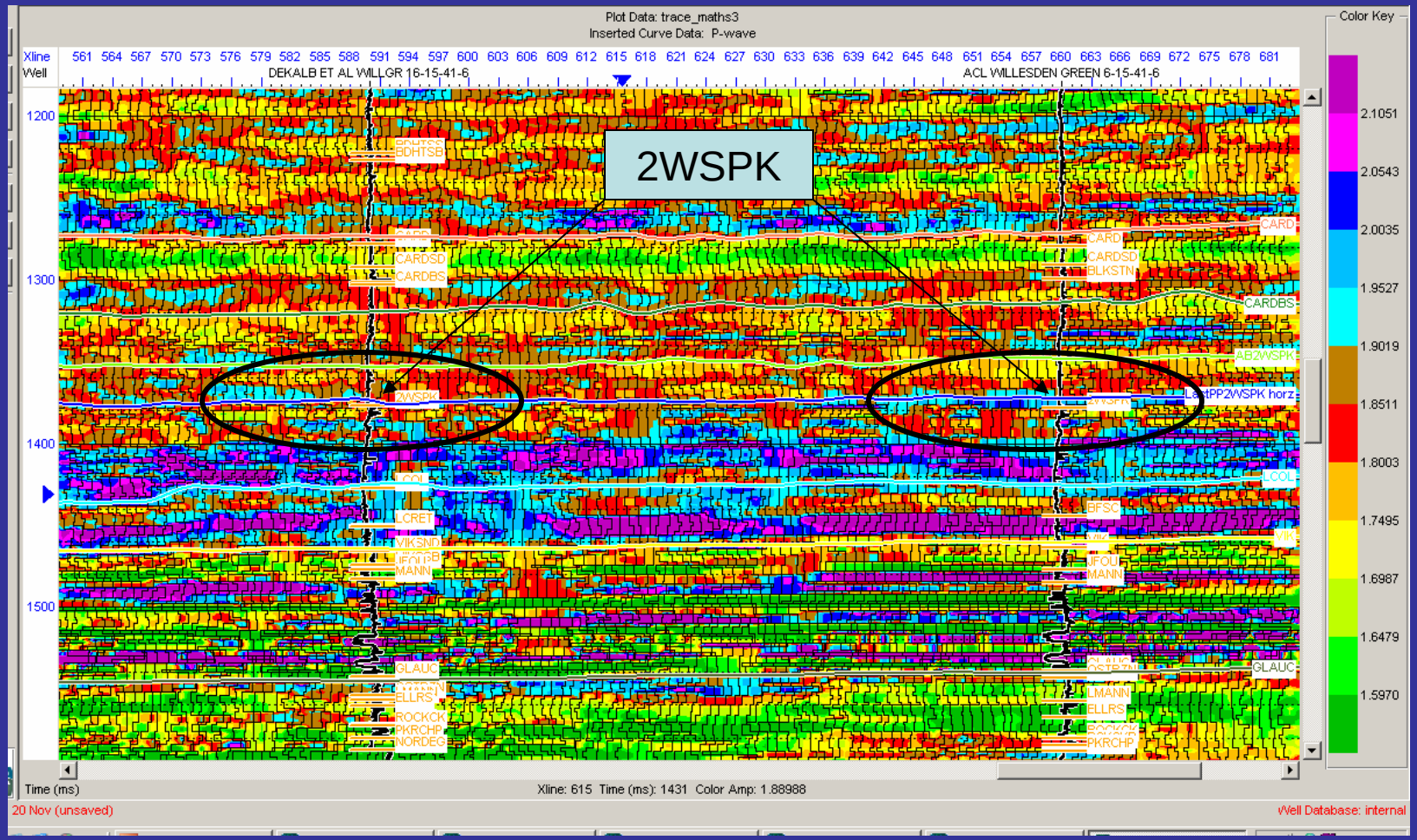
Well 8-26-41-6W5 – producing from 2WSPK

The ratio of PP inversion to PS inversion



Line WG1: Well 8-13-41-6 – producing from 2WSPK – well is 1 km away

The ratio of PP inversion to PS inversion

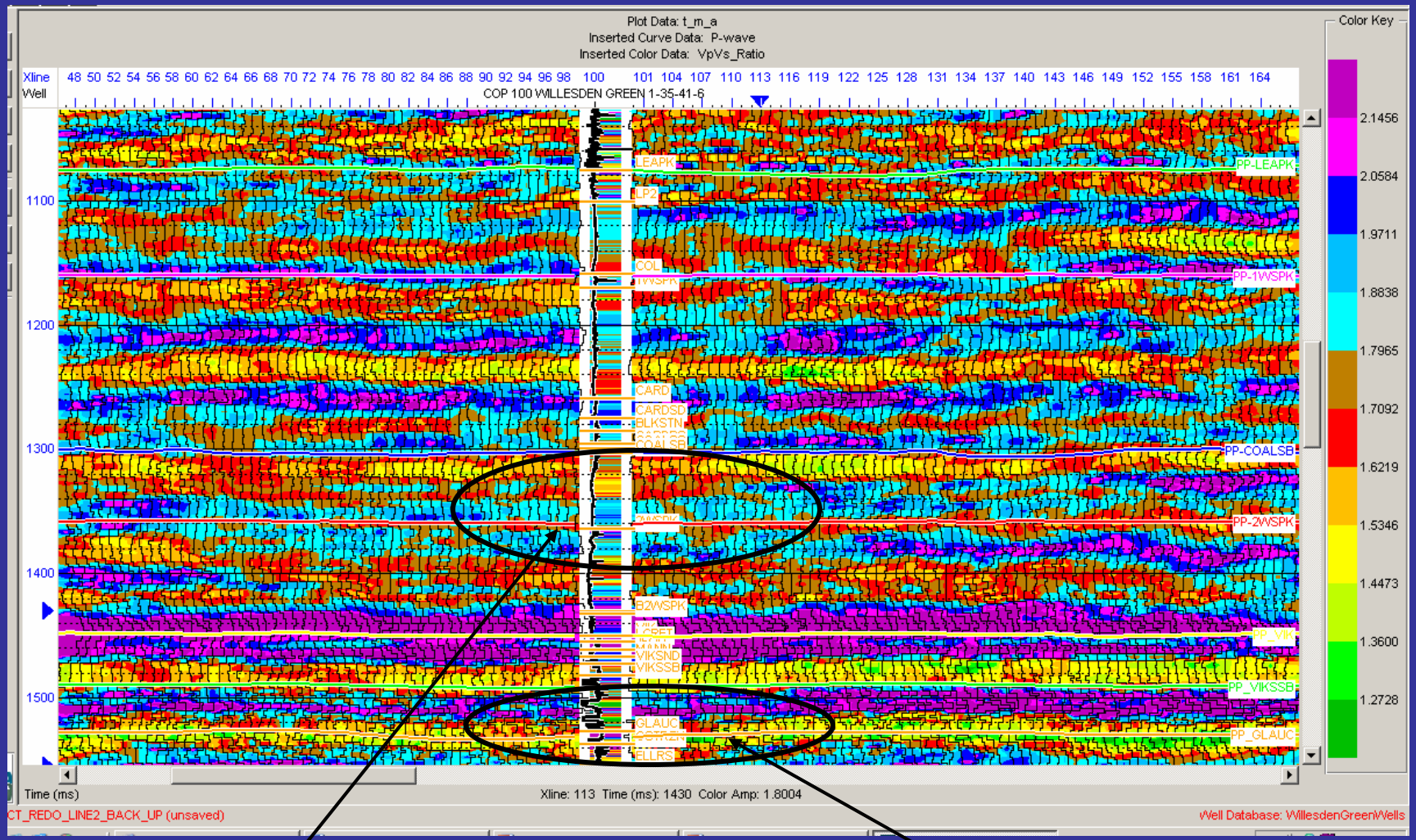


Line WG1: - Well 16-15-41-6 – producing from 2WSPK

- Well 6-15-41-6 – not producing from 2WSPK

The ratio of PP inversion to PS inversion

Line WG2: well 1-35-41-6 is not producing from the 2WSPK, producing from the GLAUCSS

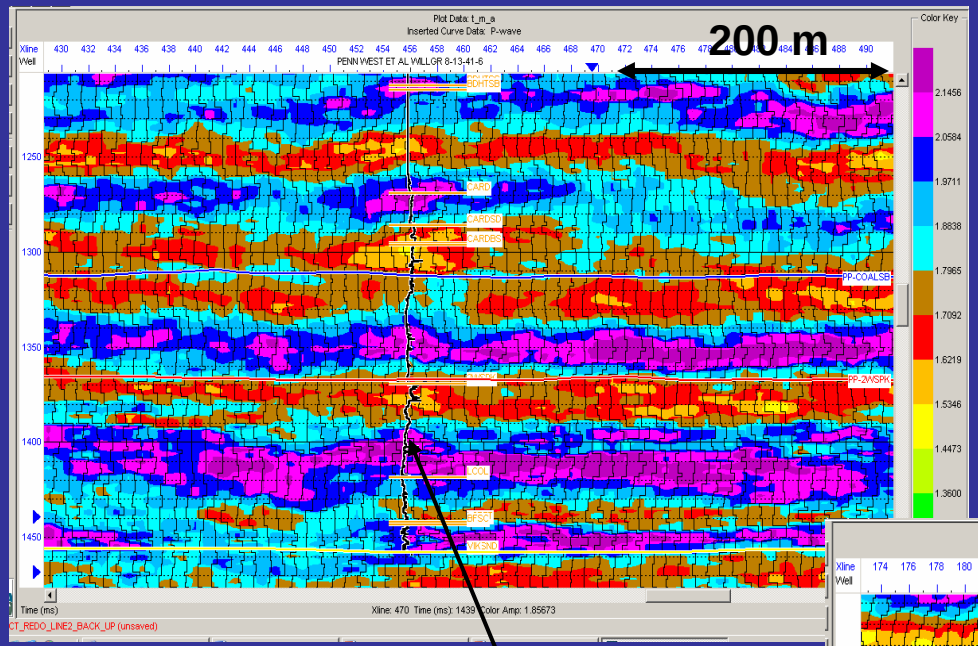


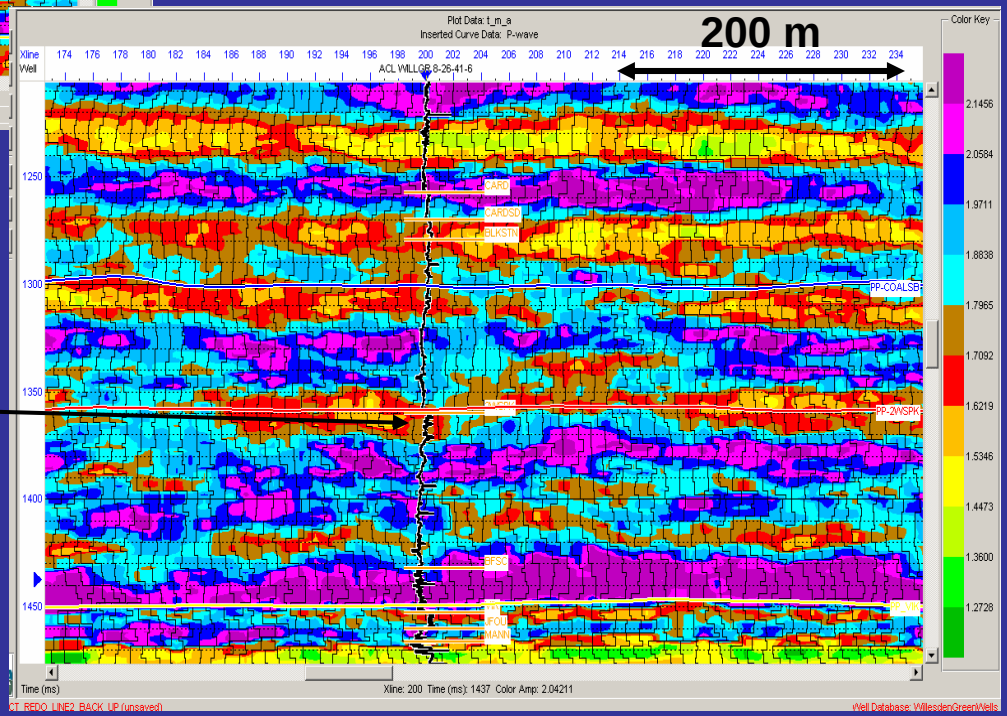
2WSPK

GLAUCSS

Results-Imaging of anomalous zones: **Line**

WG2 - the two producing wells on the line: 8-13-41-6W5(up) and 8-26-41-6W5(down)





Producing from 2WSPK

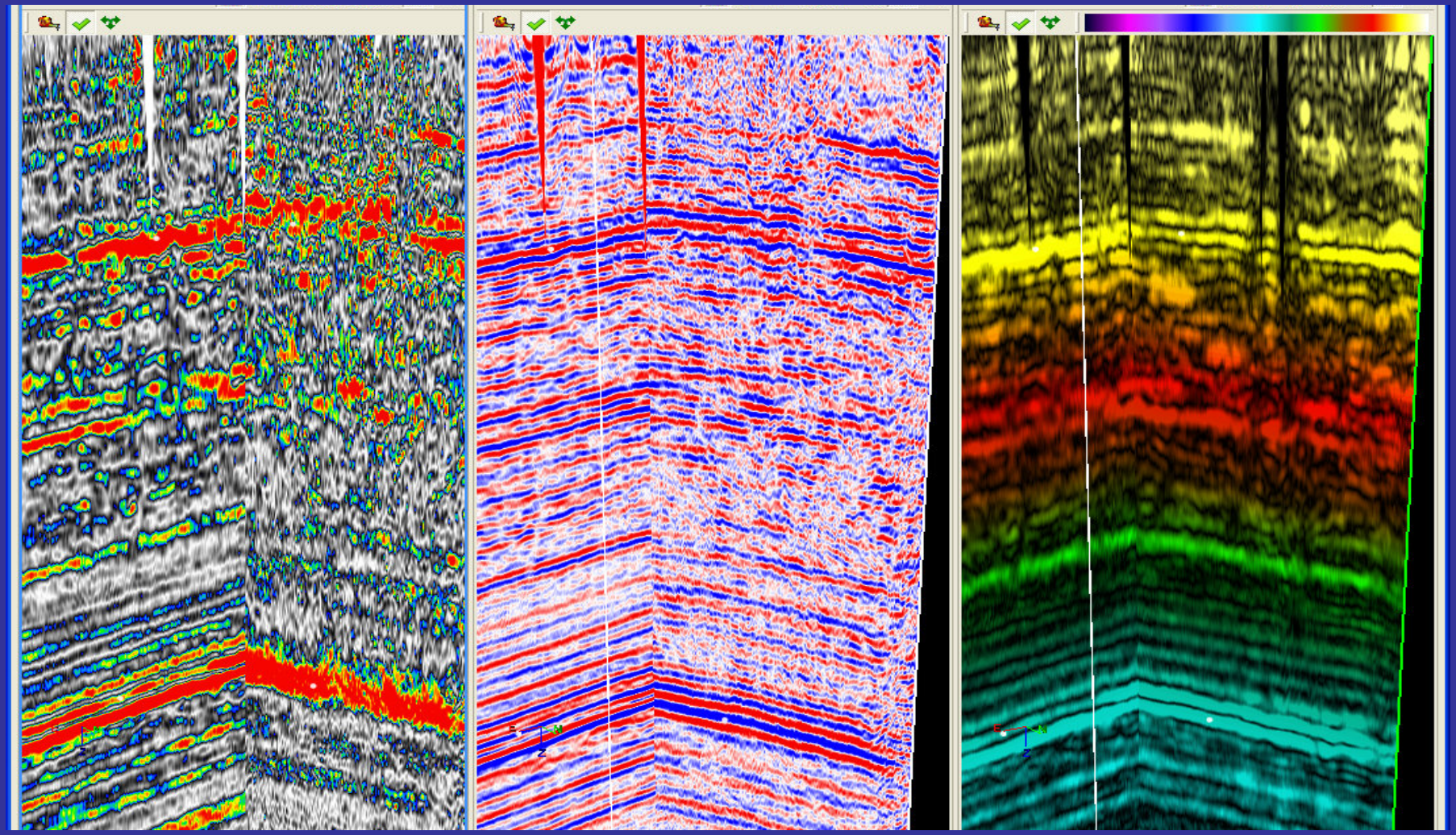
Conclusions

- The main impedance changes correspond to the major lithologic boundaries
- The productive interval is interpreted as a PP impedance drop and a PS increase
- Vp/Vs values were helpful for sand/shale discrimination
- The ratio of PP inversion to PS inversion in PP time is useful to delineate the reservoir

Future work

Explore new 2D and 3D registration techniques

Amplitude envelope PP and PS registration in PP time Gamma values



Acknowledgement

- Peter Cary and Carmen Dumitrescu (Sensor Geophysical Ltd)
- Ianusz Peron (Hampson-Russell)
- Murray Roth (Transform Software)
- Kevin Hall
- CREWES sponsors