Impedance Estimation from Ross Lake PP and PS Seismic Data: Ross Lake Oilfield, Saskatchewan

Chuandong (Richard) Xu
Robert R. Stewart

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UNIVERSITY OF CALGARY

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Outline

- Introduction and review
- PP data inversion
- PS data inversion
- Vp/Vs from inversion
- Discussion
- Conclusion
- Acknowledgements

Introduction and review

- 3D migrated PP and PS-radial data

- Guided by well logs and VSP, horizons of IHACM and RushLake are picked on both PP and PS volumes

- Vp/Vs map calculated from PP time thickness map and PS time thickness map

- Vp/Vs map verified by the horizontal well log

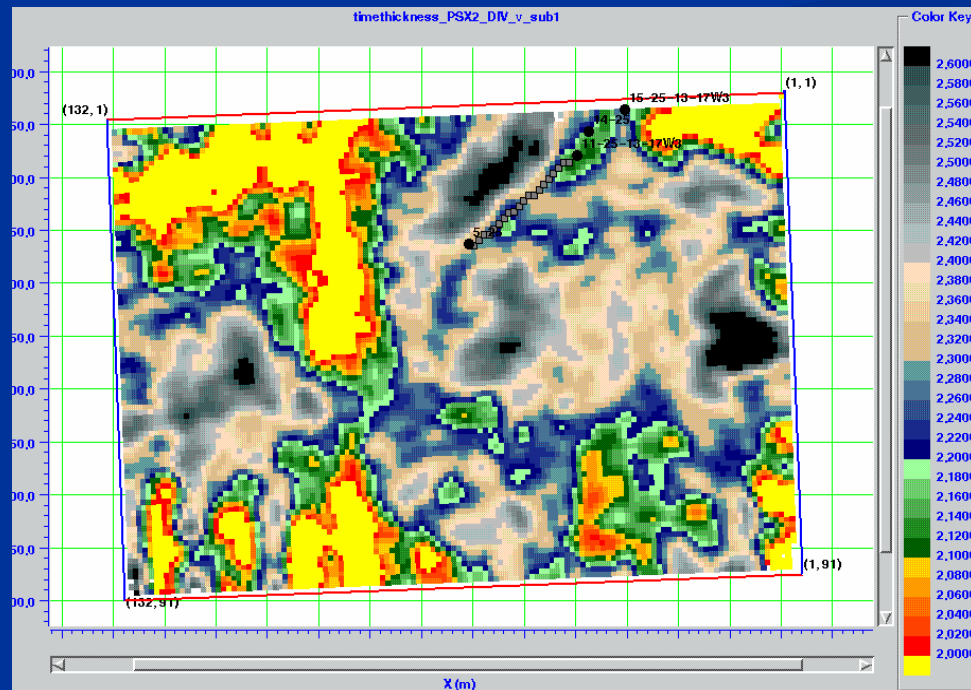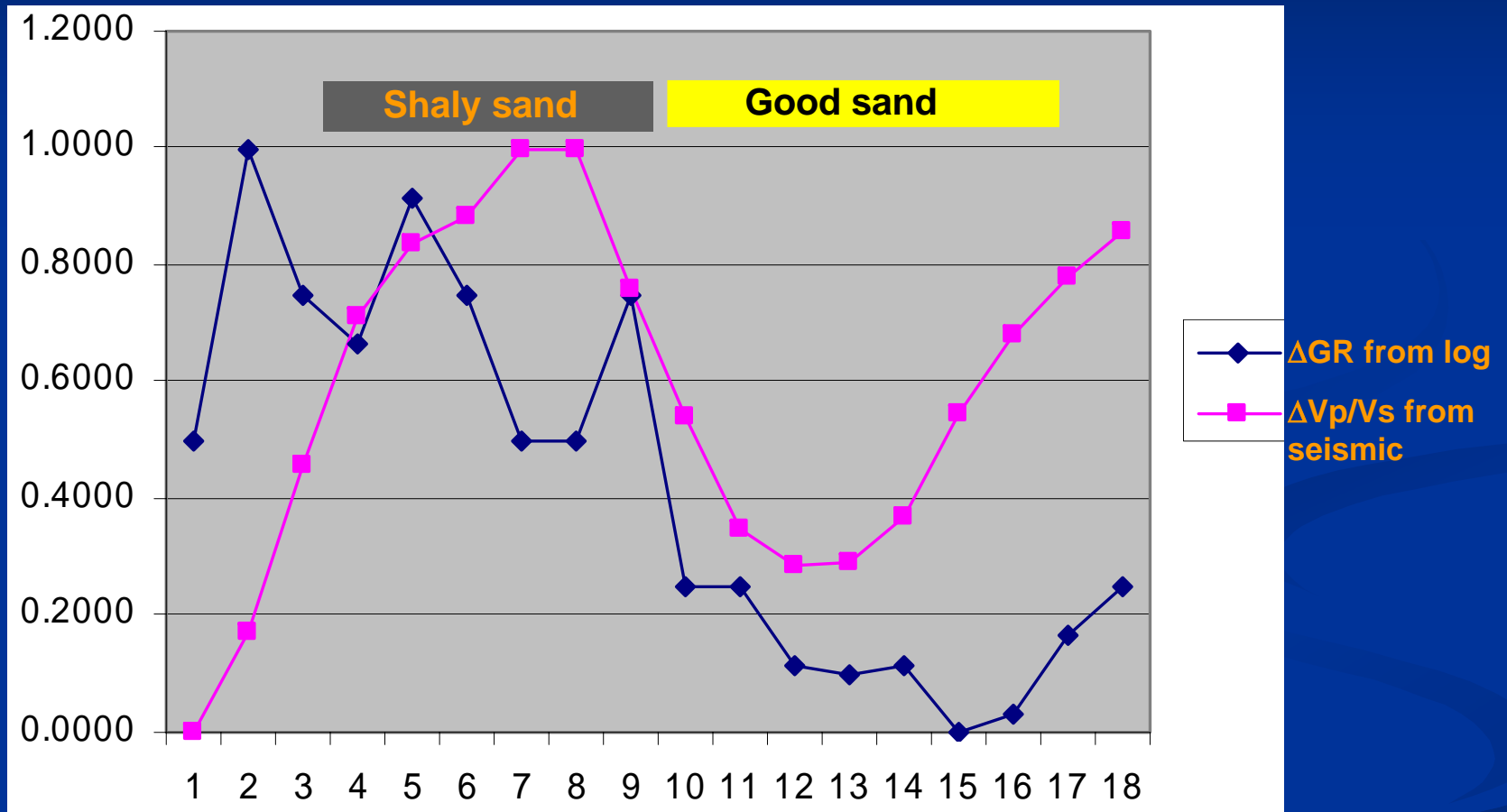# PP time thickness RushLake-IHACM   PS time thickness RushLake-IHACM
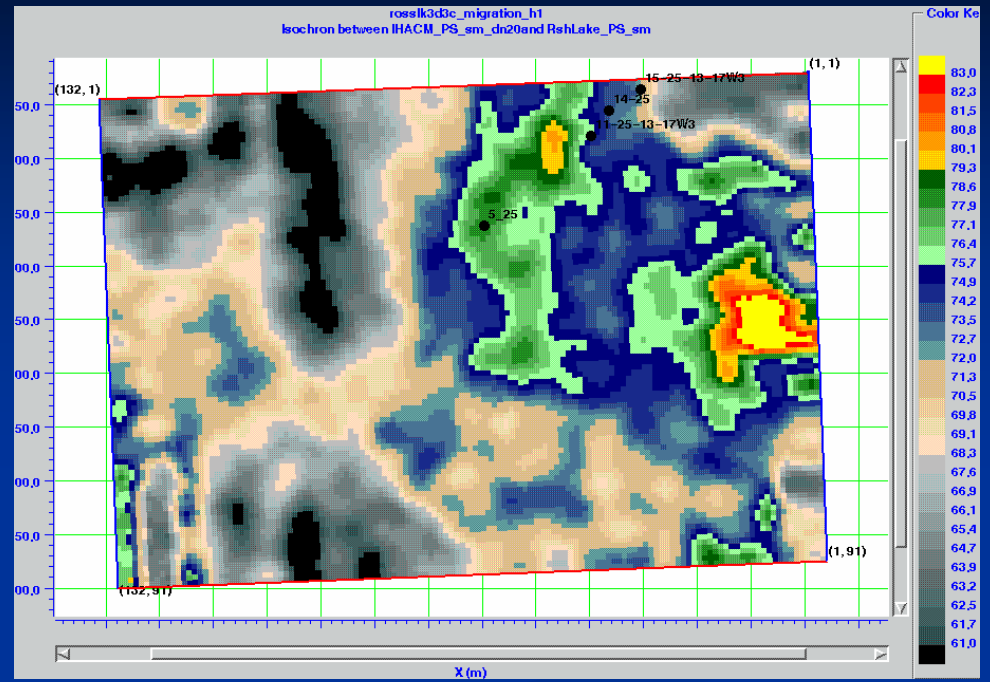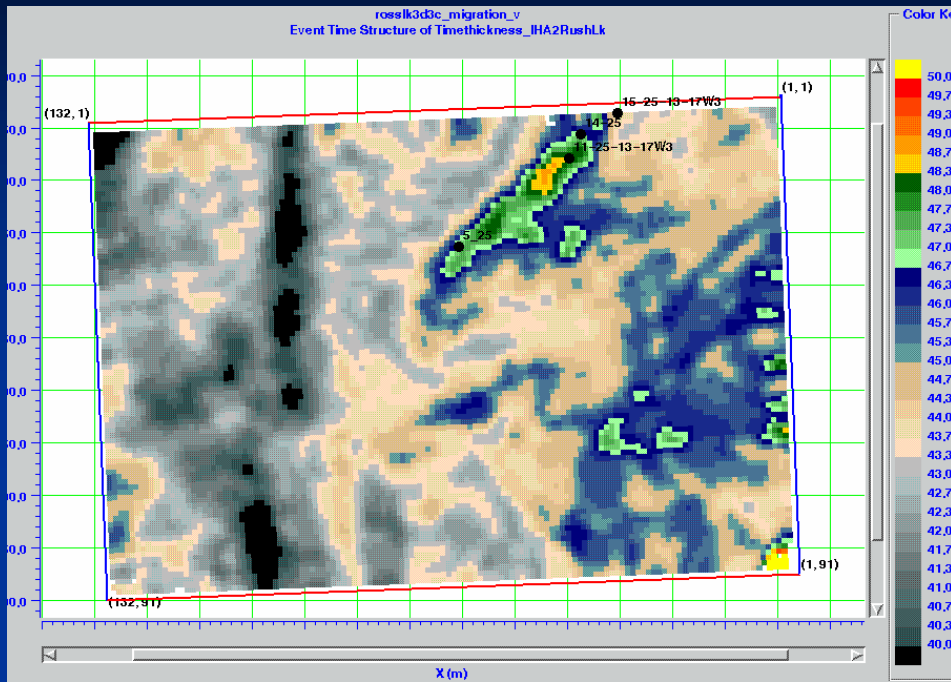
Map of average Vp/Vs between RushLake and IHACM

$$Vp/Vs = \frac{2 * \Delta Tps}{\Delta Tpp} - 1$$

Normalized local variation of GR from MWD and Vp/Vs from 3C seismic travel time

Horizontal trajectory of well 5-25, start from MD 1270m to MD 1830m, ~33 m/bin
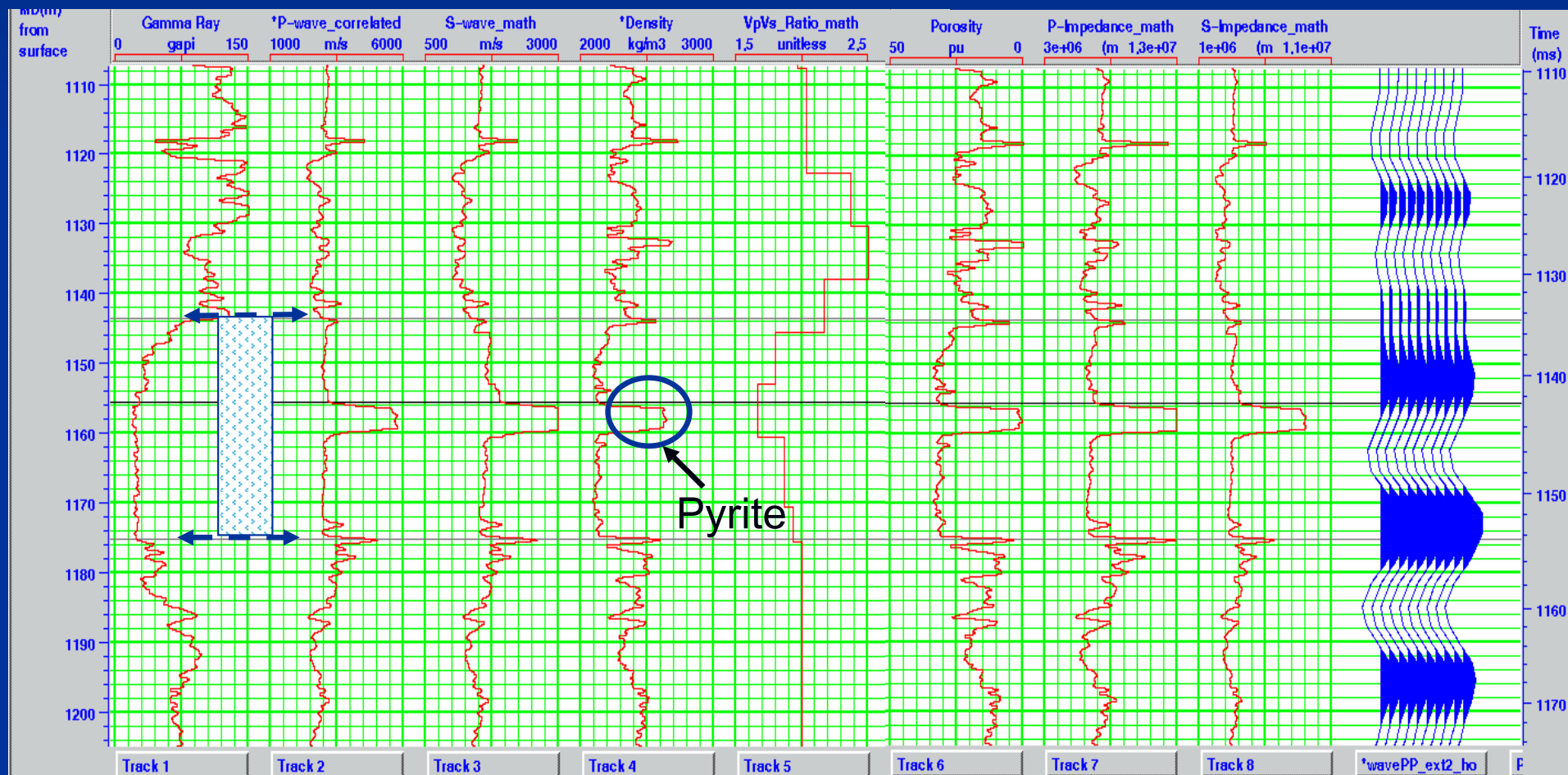
PP data inversion

- Build the initial model using well 11-25 and 4 horizons

- Low-pass filtering the model

- Extract wavelet from PP seismic traces

- Model-base inversion

Well 11-25 logs

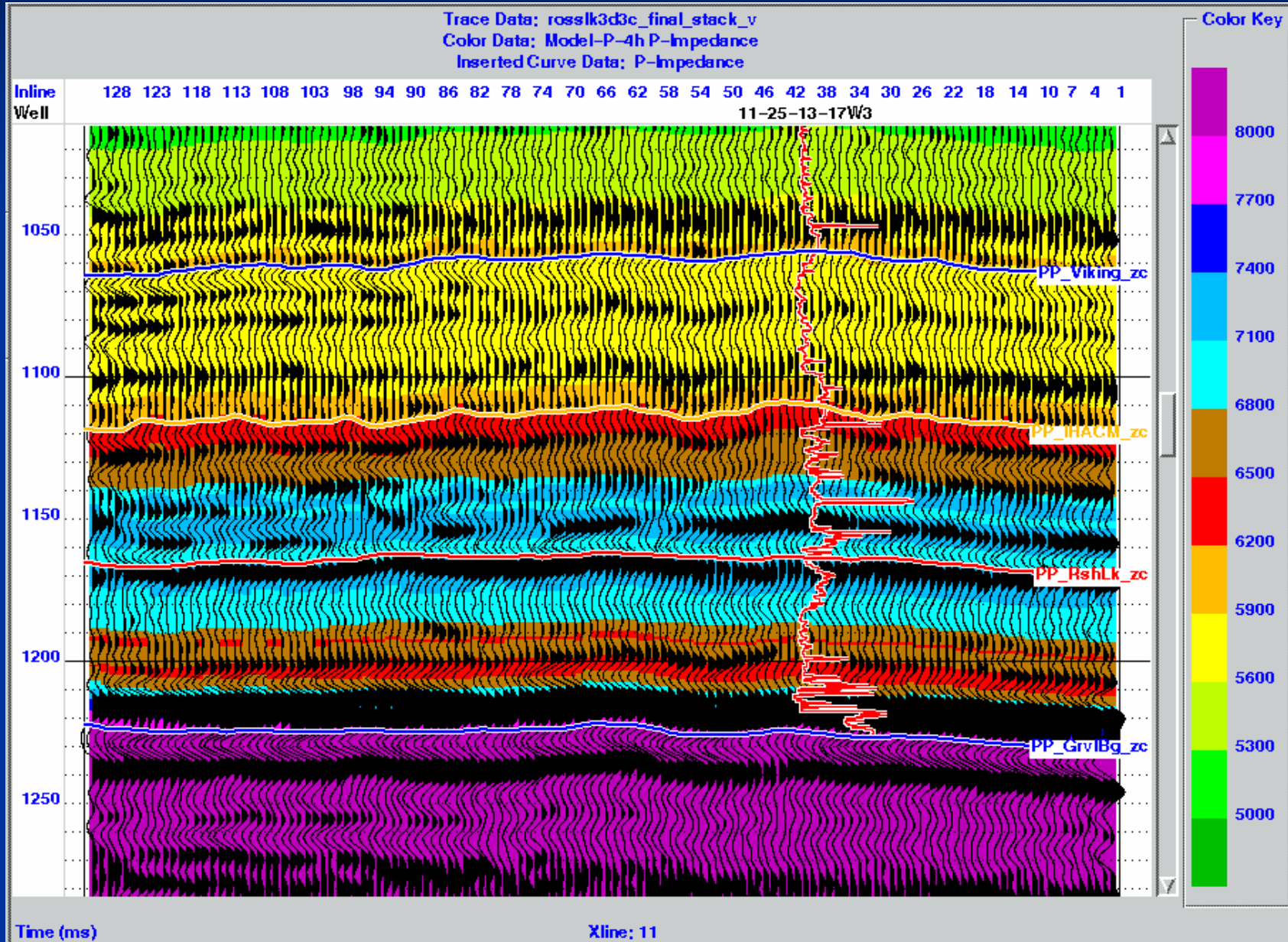P-imp: nearly same as above shale, lower than beneath layer

S-imp: a little higher than above shale, lower than beneath layer
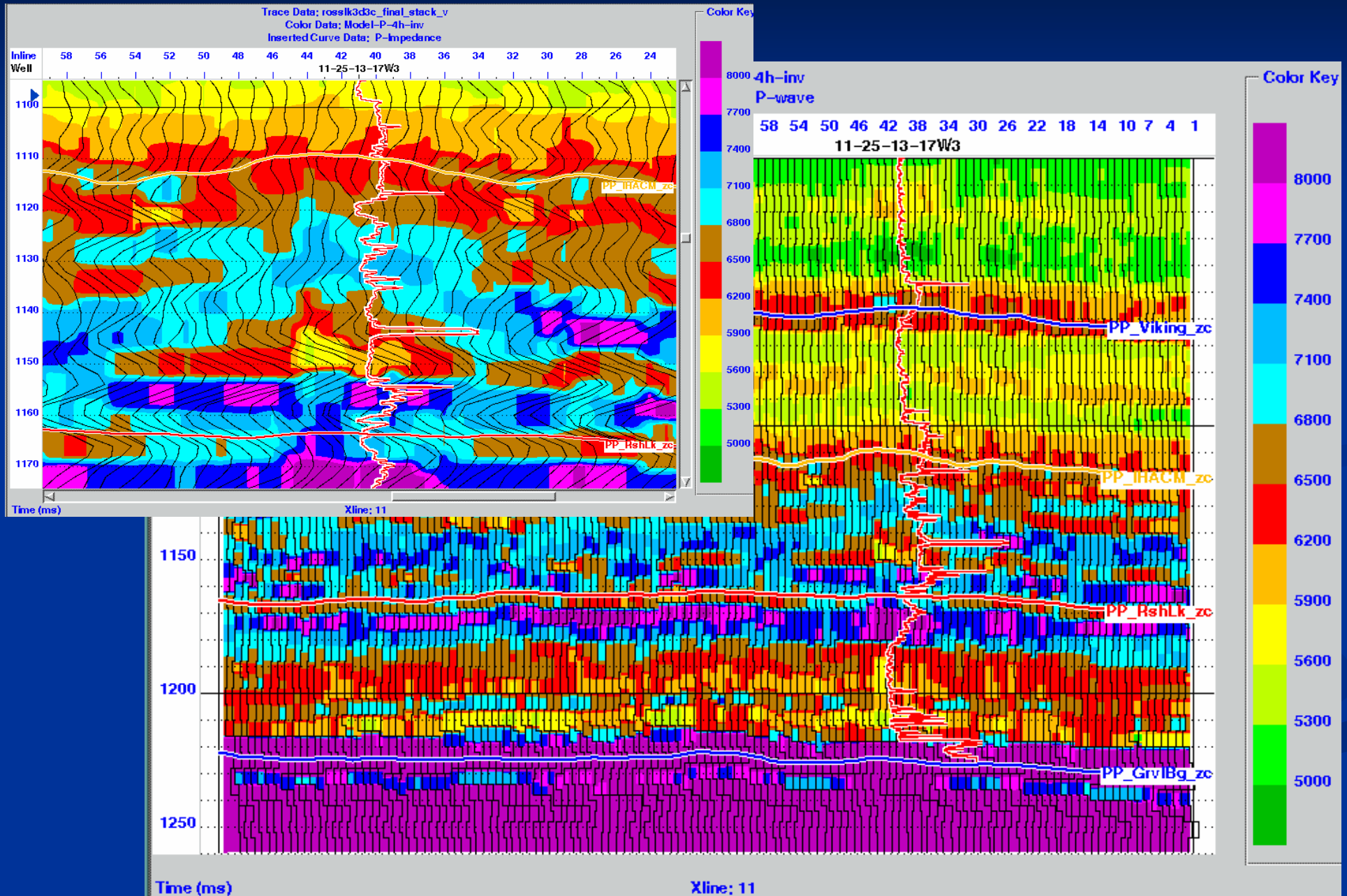
GR Vp Vs DEN Vp/Vs POR P-imp S-imp PP-syn
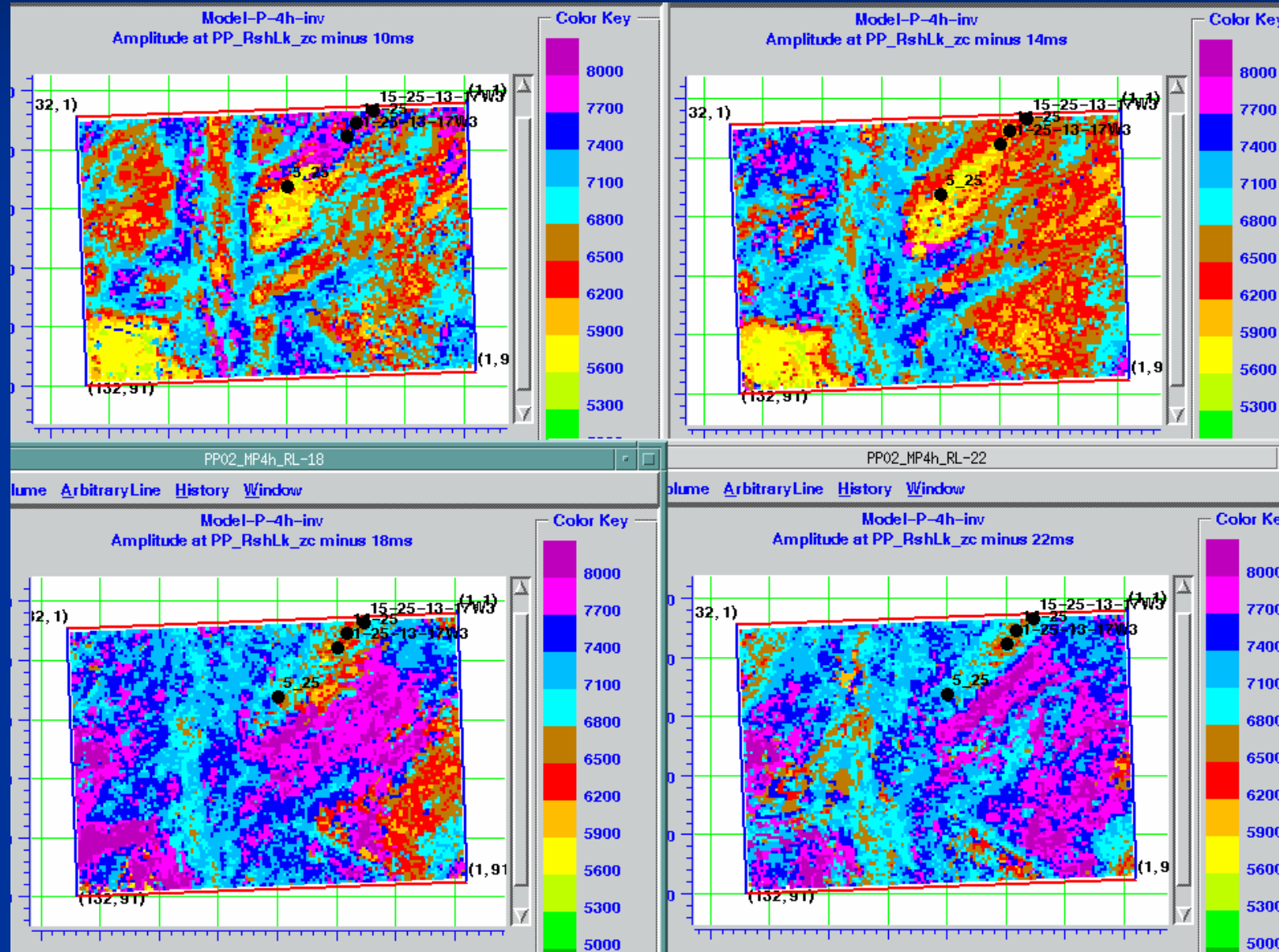
The initial P-impedance model (in color)
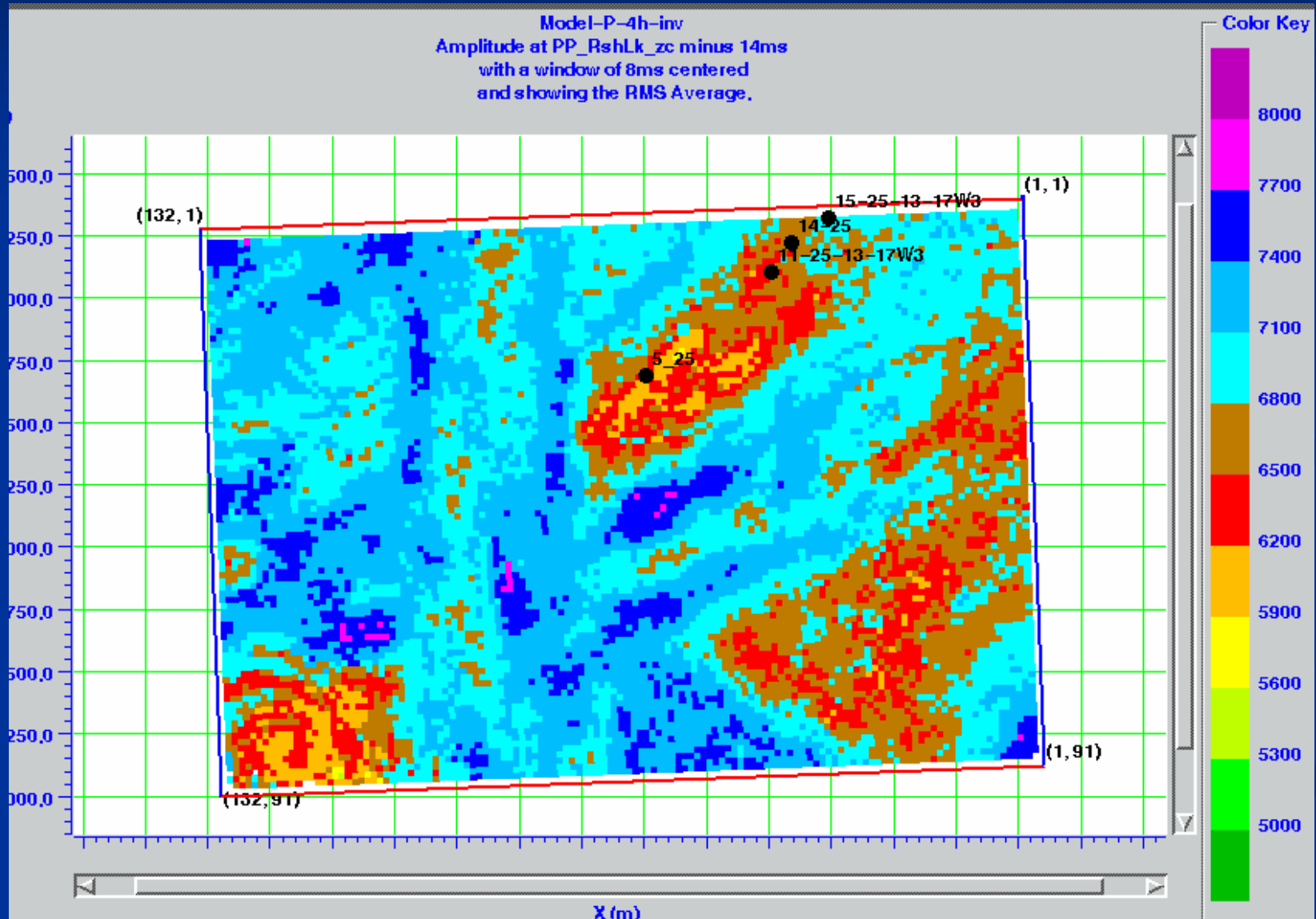
PP inversion result

Horizon slices of inverted P-impedance:

10ms, 14ms, 18ms and 22ms above the horizon of RushLake

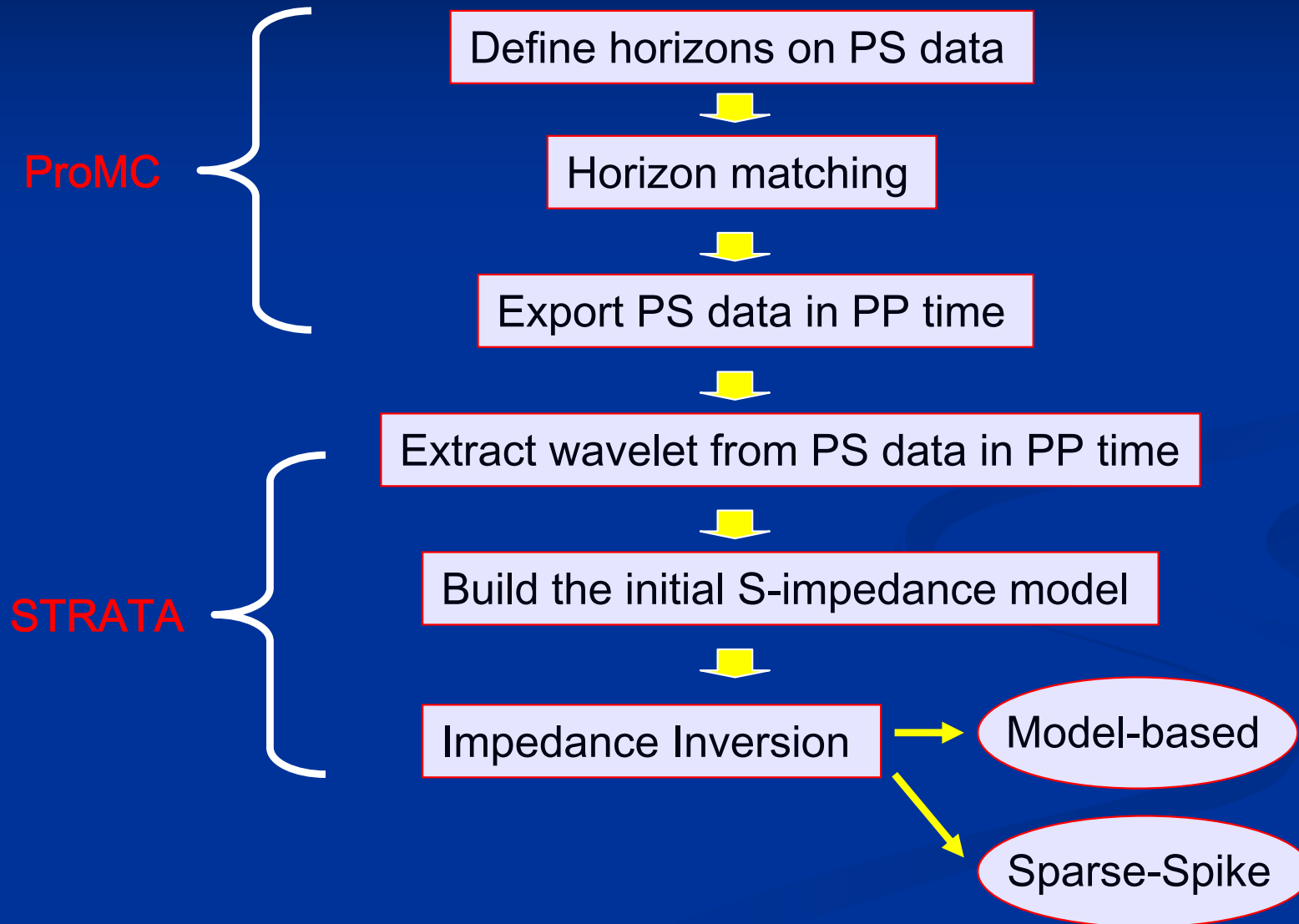Horizon slices of inverted P-impedance:

RMS average of a 8ms window centered at the 14ms above Rush Lake horizon
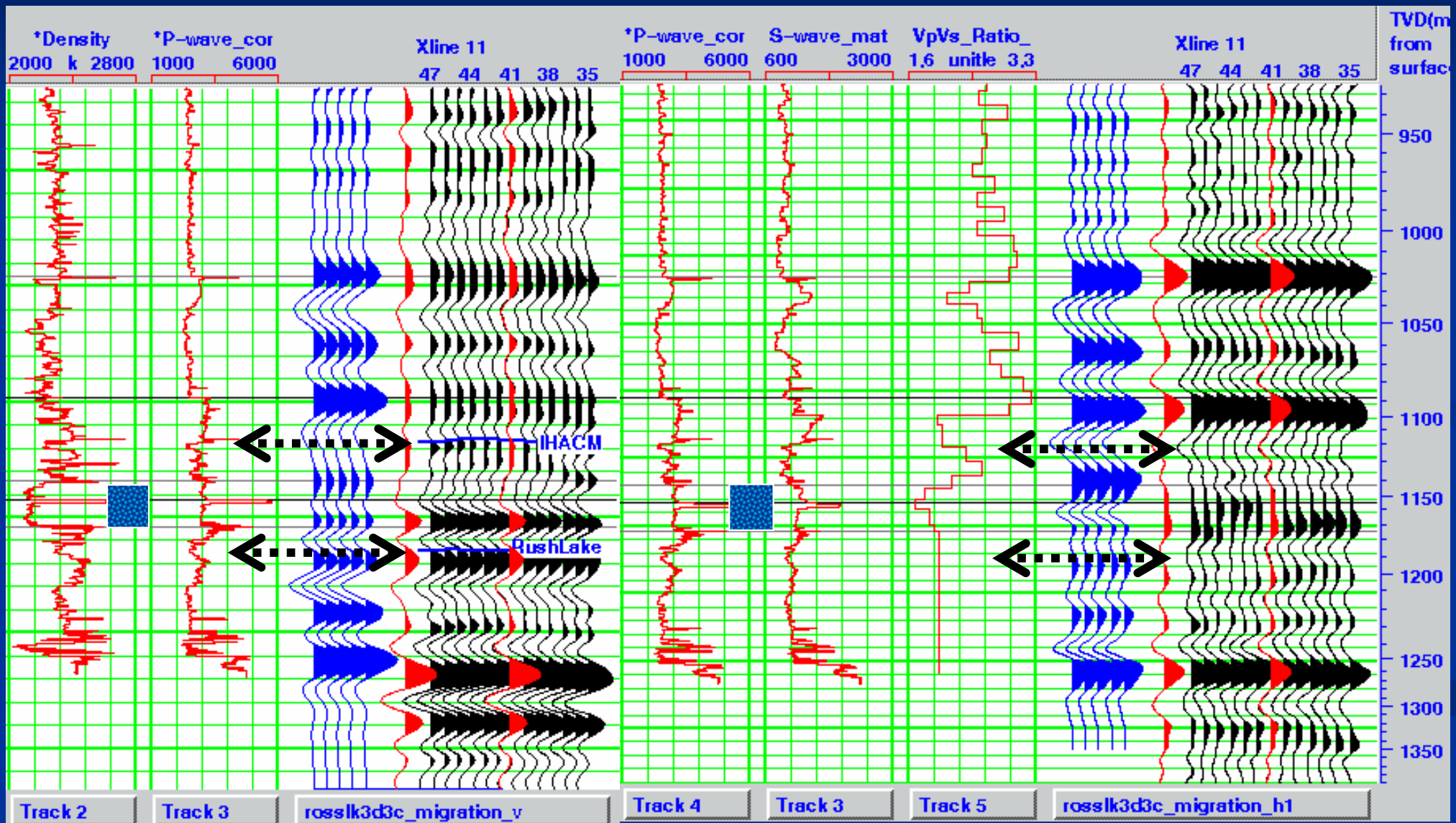
PS data inversion

- Assume: PS reflectivity is linearly proportional to the SS reflectivity.

- In reality: more complicated,

    depends on trace offsets as well as time-dependent incidence angle.

- Relative change of PS reflectivity over small depth may be highlighted by the inversion
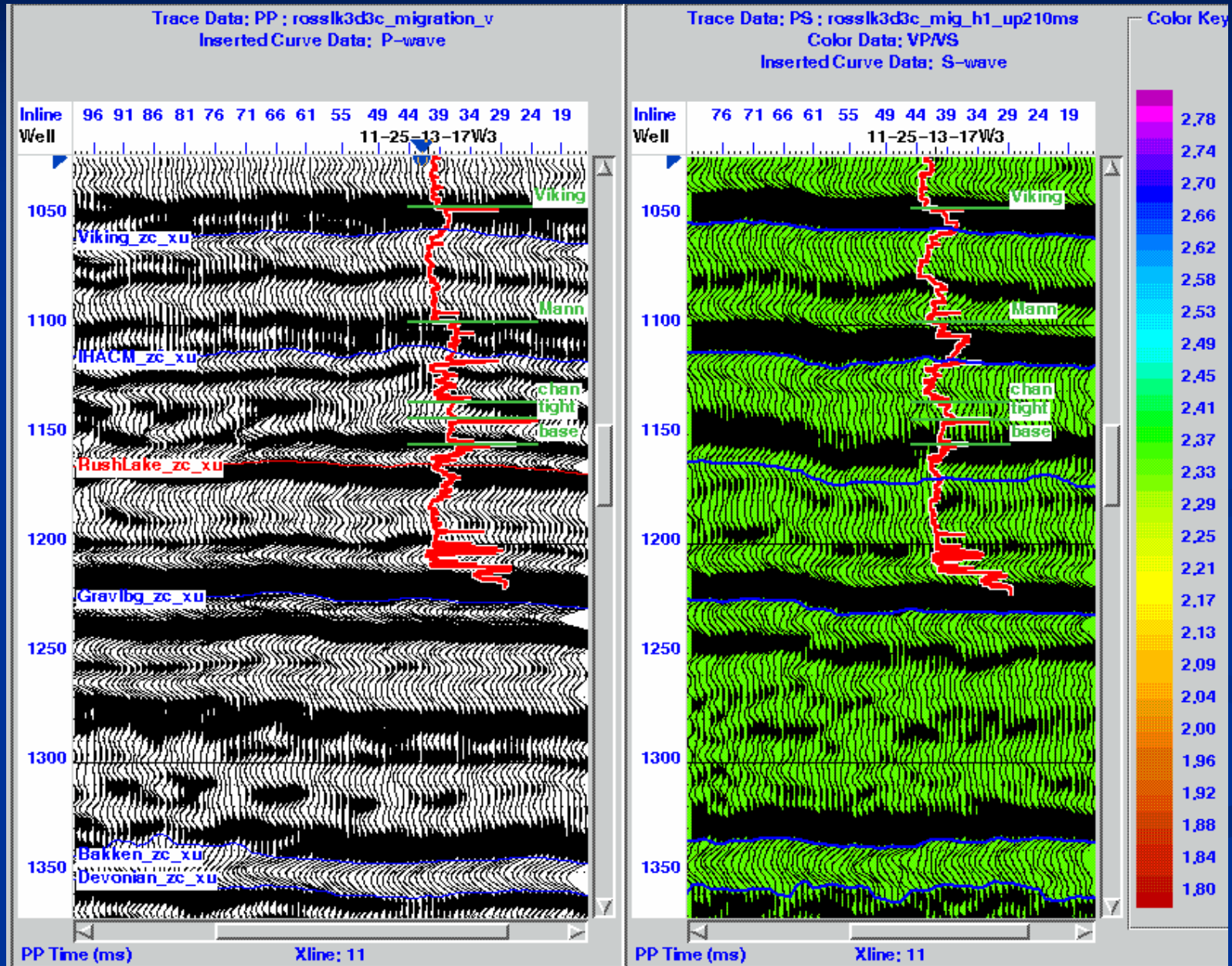
PS data inversion

ProMC
- Define horizons on PS data
- Horizon matching
- Export PS data in PP time

STRATA
- Extract wavelet from PS data in PP time
- Build the initial S-impedance model
- Impedance Inversion → Model-based
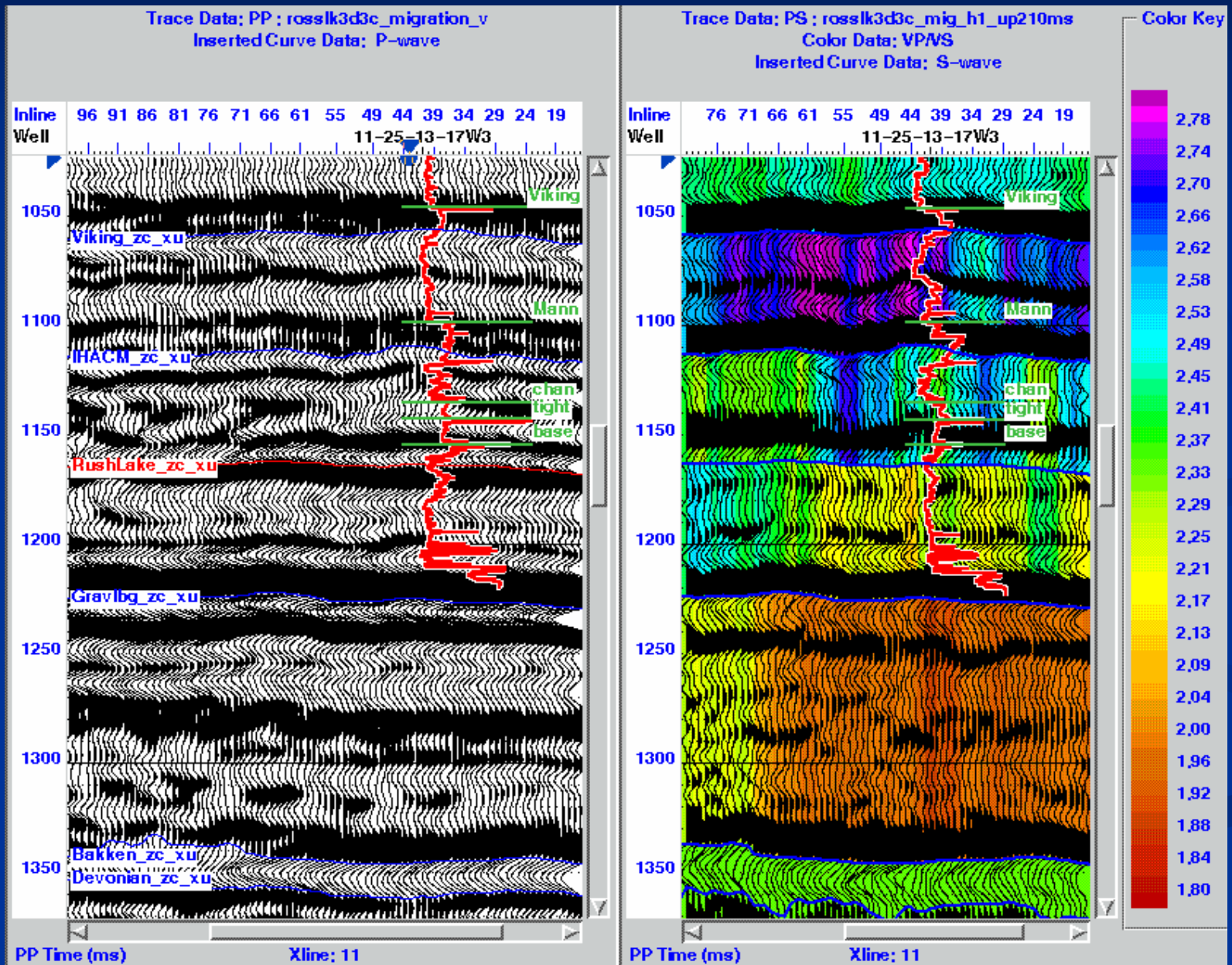- Impedance Inversion → Sparse-Spike

PP synthetic

PS synthetic

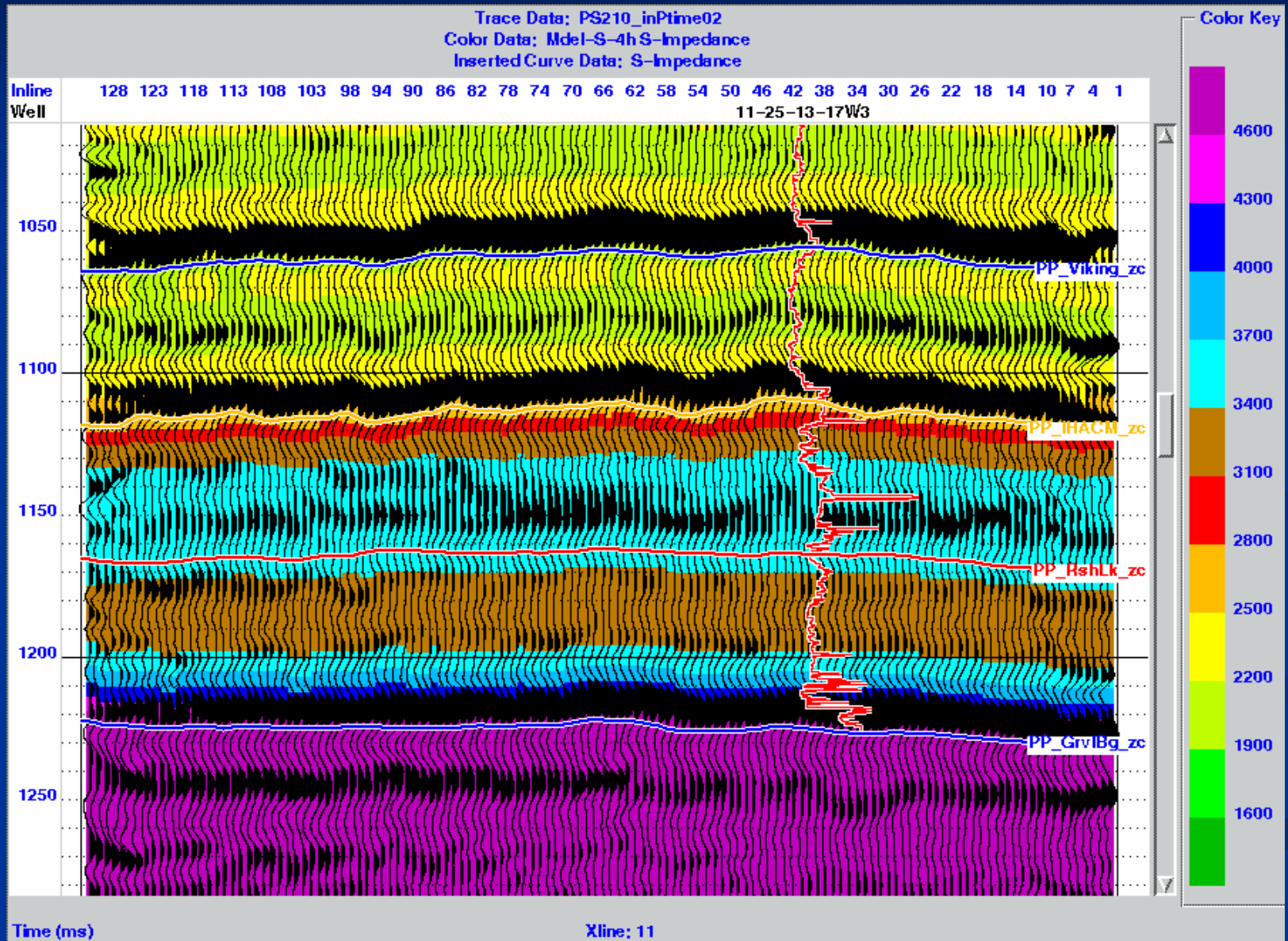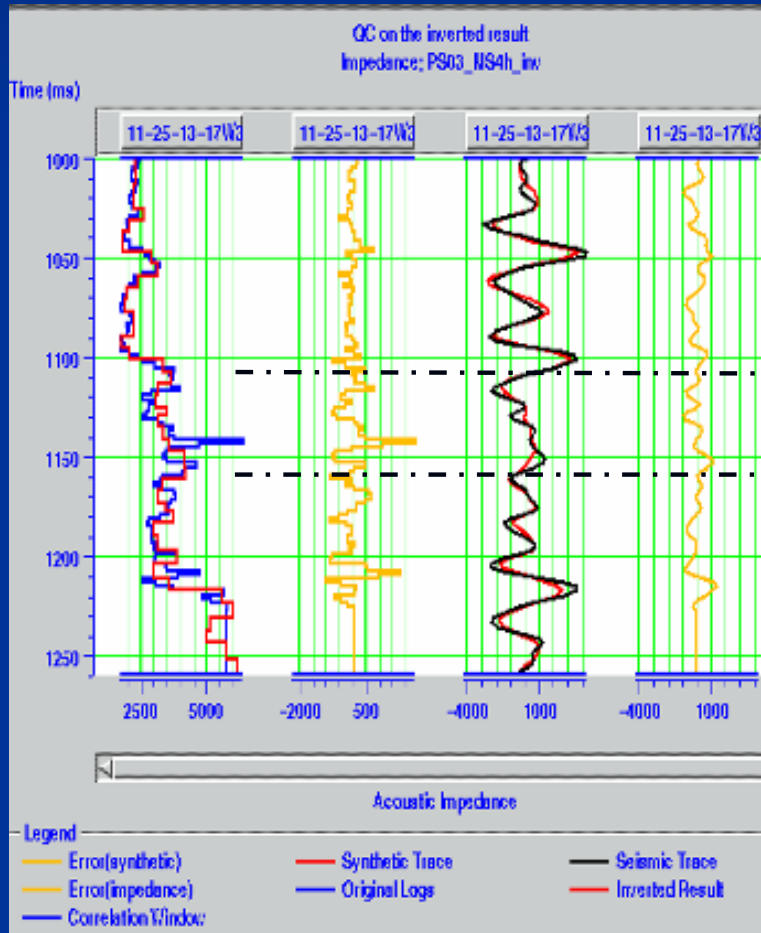# PP data (left) and PS data (right) in PP time, using constant Vp/Vs=2.35
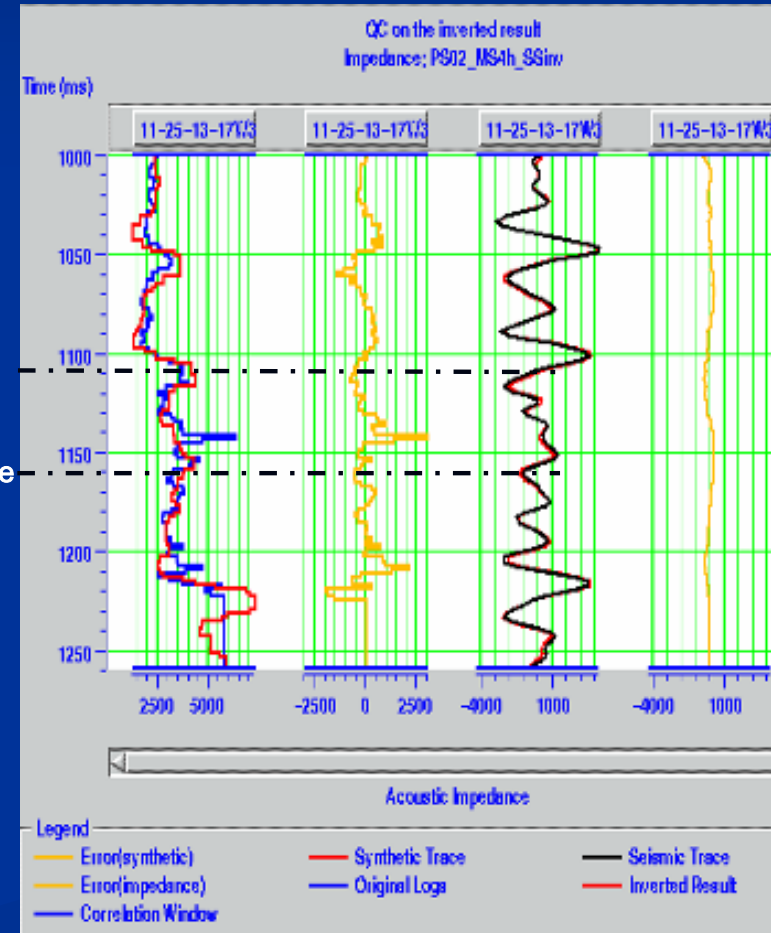
After horizon matching

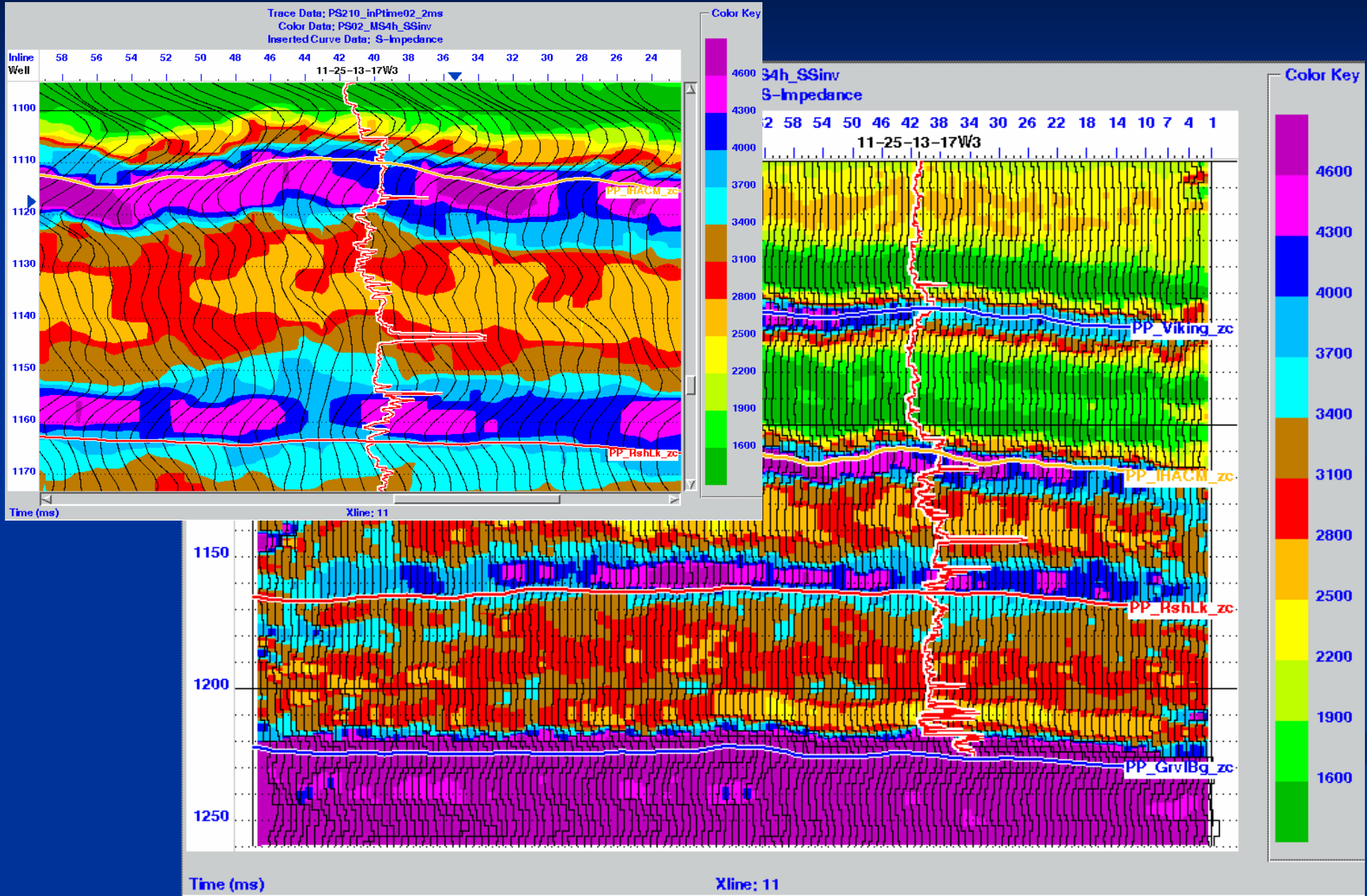# The initial S-impedance model
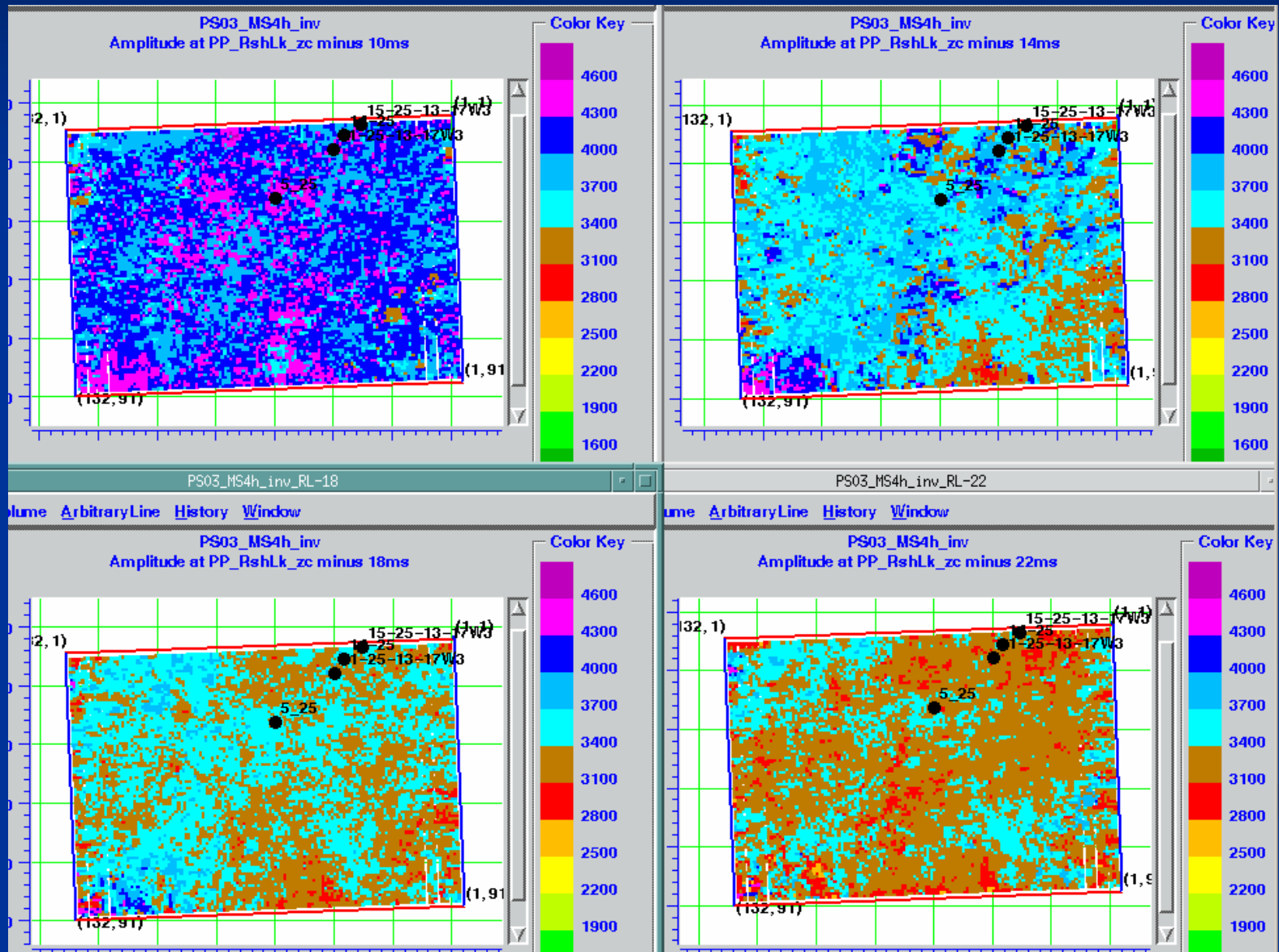
Two inversion methods: Model-based and Sparse-spike
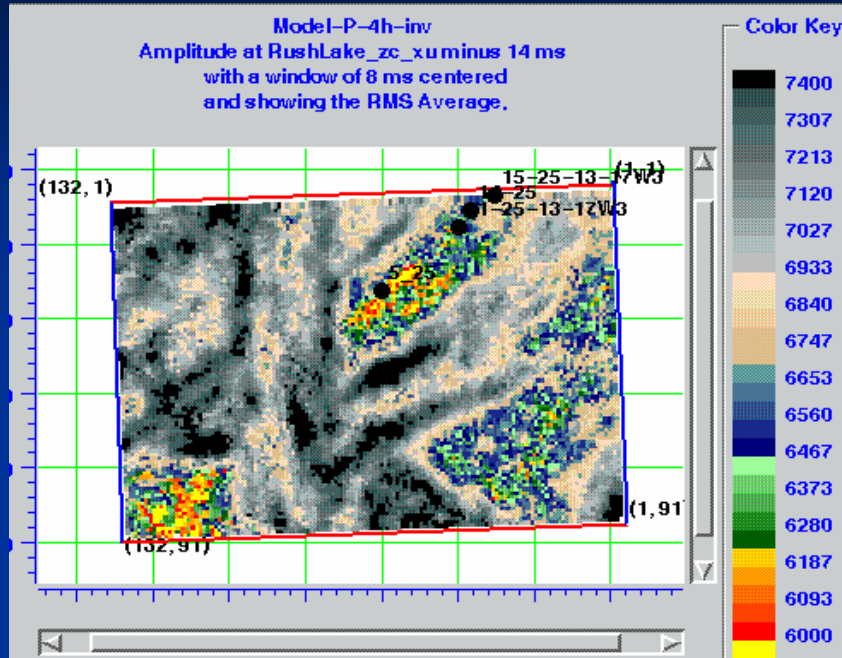
Choose: inverted S-impedance, Sparse-spike

Horizon slices of inverted S-impedance:
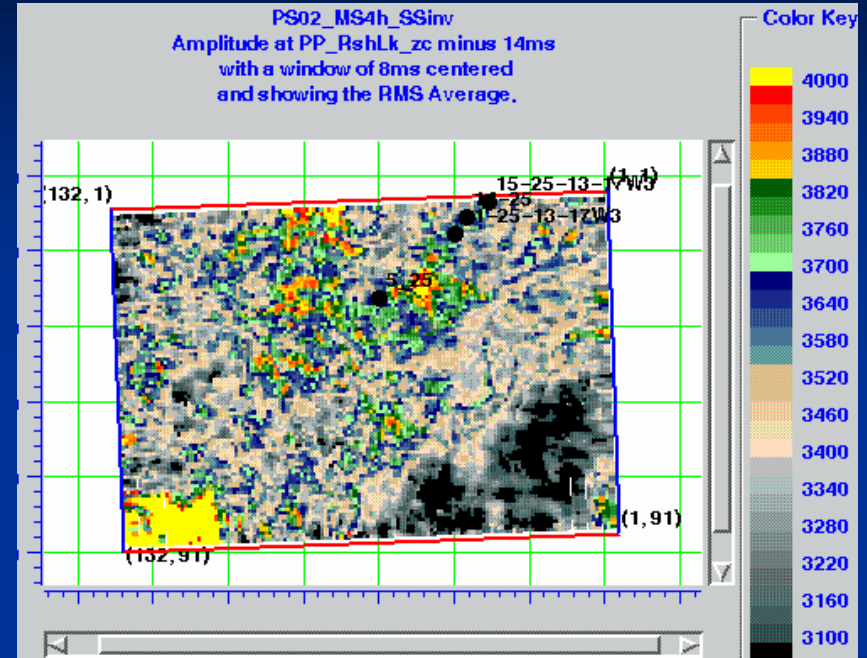
10ms, 14ms, 18ms and 22ms above the horizon of RushLake

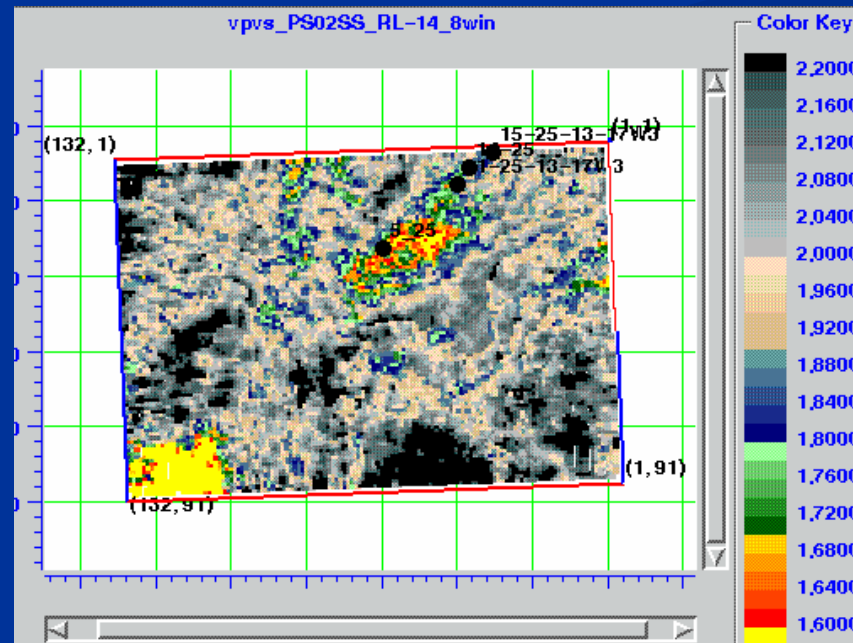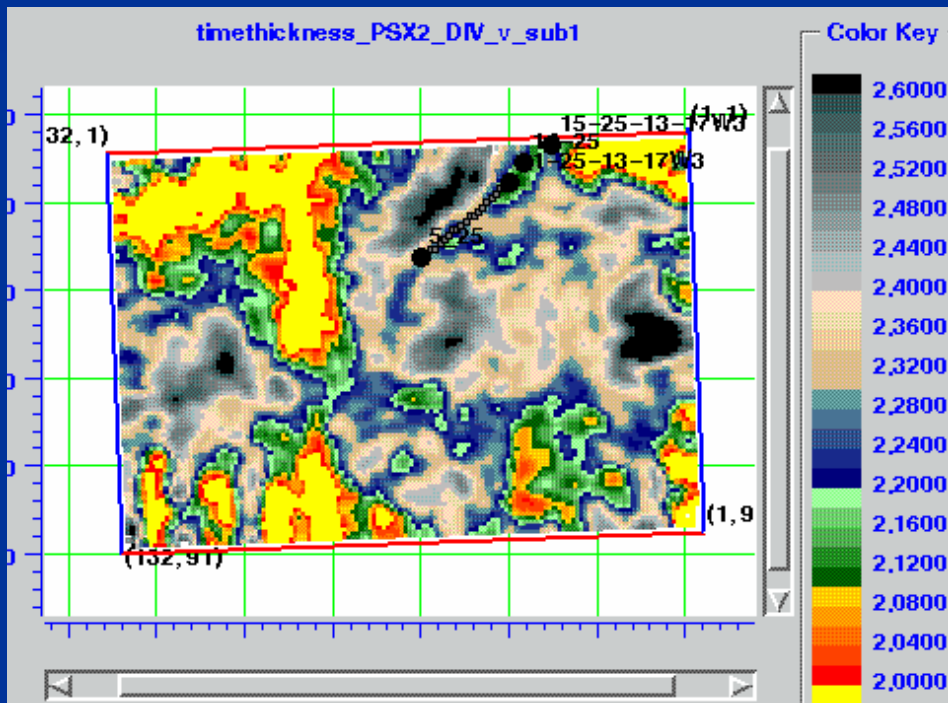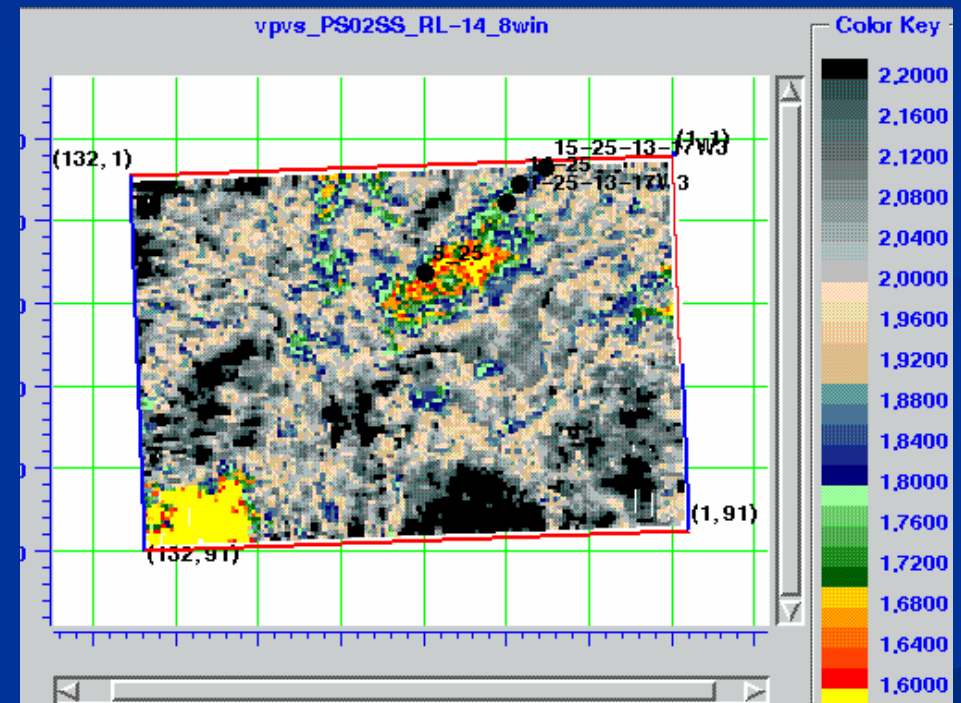P-impedance, 8ms window

S-impedance, 8ms window

Vp/Vs, 8ms window

Comparison: travel-time-derived Vp/Vs and impedance-derived Vp/Vs

Vp/Vs from travel-time

Vp/Vs from impedance

Discussion

- To get SS reflectivity from post-stack PS data …

- Vp/Vs: result from PP and PS travel time combination appears comparable with that from post-stack PP & PS inversion

- Go pre-stack

Conclusion

- PP and PS inversions show that the oil-bearing sand has a relative low P-impedance and a bit high S-impedance

- Both travel time Vp/Vs and impedance Vp/Vs show promising anomalies

- The reservoir sand has a eastern direction extension

Acknowledgement

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