Reservoir Characterization of the High-Impedance Tight Gas Sands in the Ada Field, North Louisiana*

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Abstract

Objectives: The Upper Cotton Valley formation in the Ada field, North Louisiana comprises multiple sandstone reservoir zones that vary significantly in lateral extent and thickness. These reservoirs are situated in an anticline compartmentalized by a number of faults in multiple directions. Therefore, the primary objective of this study was to build a model with improved definition of the Cotton Valley sand pay zones facilitating well-to-well correlation and thickness estimation of the tight gas sands to aid optimization of location of the future infill and step-out wells.

Procedure: The Upper Cotton Valley sandstones are fine to medium grained, well sorted and highly compacted. Due to compaction and quartz cementation, these sandstones are tight with relatively low porosity and permeability. The Cotton Valley pay zones in this field are stimulated by hydraulic fracturing for completion.

The high-resolution impedance model was built using model-based seismic inversion technique. The prestack seismic data and the near-angle and far-angle stacks were used for AVO analysis to identify and predict the tight-gas pay zones in the Upper Cotton Valley formation. An AVO model was constructed for Well D using the P-wave, S-wave and density logs. The impedance and the ratio of the P-wave and S-wave velocities were cross plotted to characterize the pay zones.

Results: The impedance data aided in improving definition of the Cotton Valley sand pay zones facilitating well-to-well sand correlation and thickness estimation of the gas sands. The horizon slice of the pay zone provided the lateral distribution of the reservoir and non-reservoir facies and the faults. The impedance model was validated by the results of the test well E, drilled post

seismic inversion which is currently producing gas. The analysis of the AVO model and the pre-stack data in Well D was used in characterizing the Cotton Valley sands as Class I gas sand.

Conclusions: The improvement in definition, continuity and thickness estimate in the impedance model facilitated tracking the tight gas sands in the Upper Cotton Valley formation, both vertically and laterally, aiding optimization of location of the future infill/stepout wells. The AVO modeling and analysis and the rock property analysis assisted in identification and prediction of the high impedance, tight gas sand pay zones in the Ada field.

References

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Outline

- *Objectives*
- *Geologic Setting*
- *Seismic Inversion*
- *AVO Modeling / Analysis*
- *Conclusions*

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Objectives

- Improve the definition, continuity and thickness estimate
- Facilitate sand correlation well-to-well and away from wells
- Provide a better understanding of the distribution of the reservoir and seal rocks
- Predict high-impedance gas sands
- Optimize location of the future in-fill wells
- Find new opportunities for infill drilling

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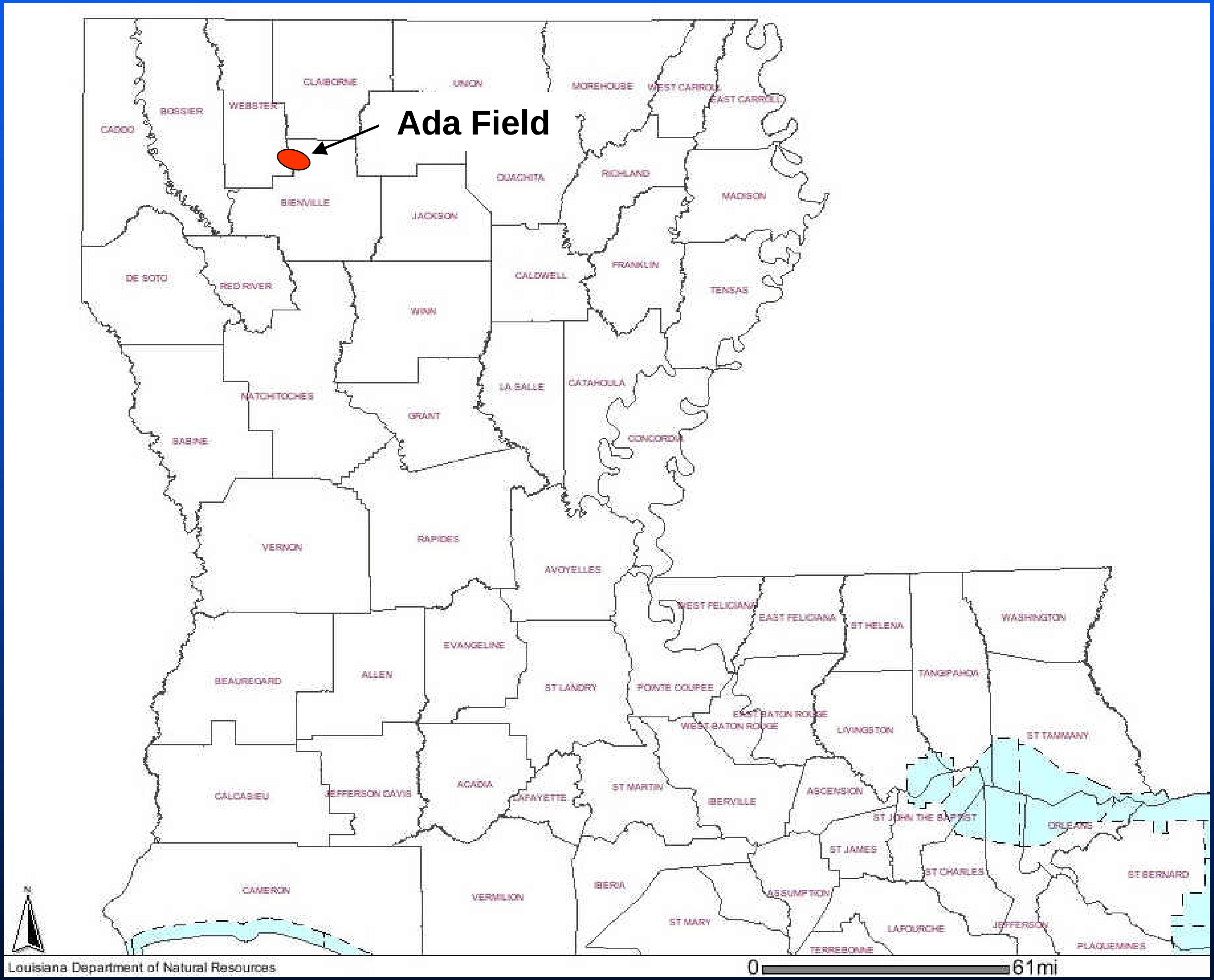
Location Map



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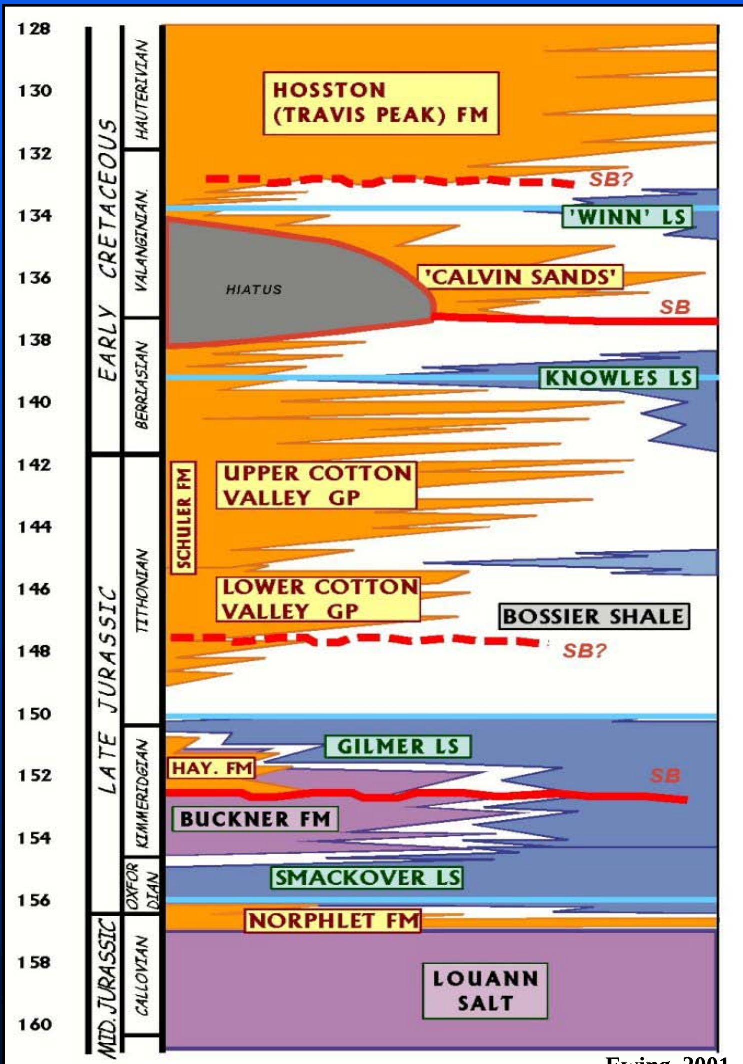
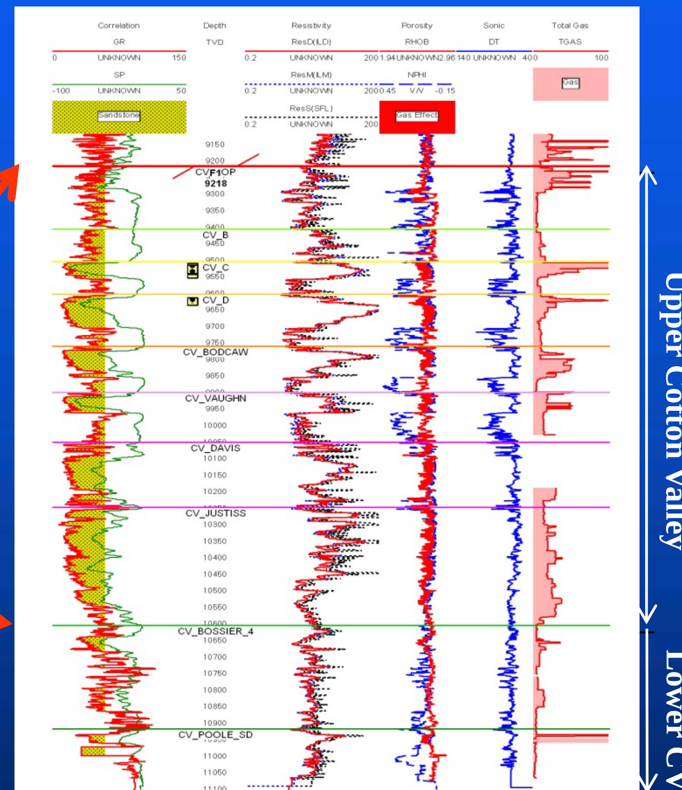
ArkLaTex Stratigraphic Column and Type Log

Stratigraphic Column



Type Log



Cotton Valley Sandstones:

- Deltaic / bar sand complex deposits, fine to medium grained, well sorted and strongly compacted. Relatively low porosity and permeability due to compaction and quartz cementation.
- The Upper Cotton Valley section is sub-divided into CV A, B, C, D, Bodcaw, Vaughn, Davis and Justiss, from top to bottom. The sand thickness vary from 50 ft. to 200 ft.

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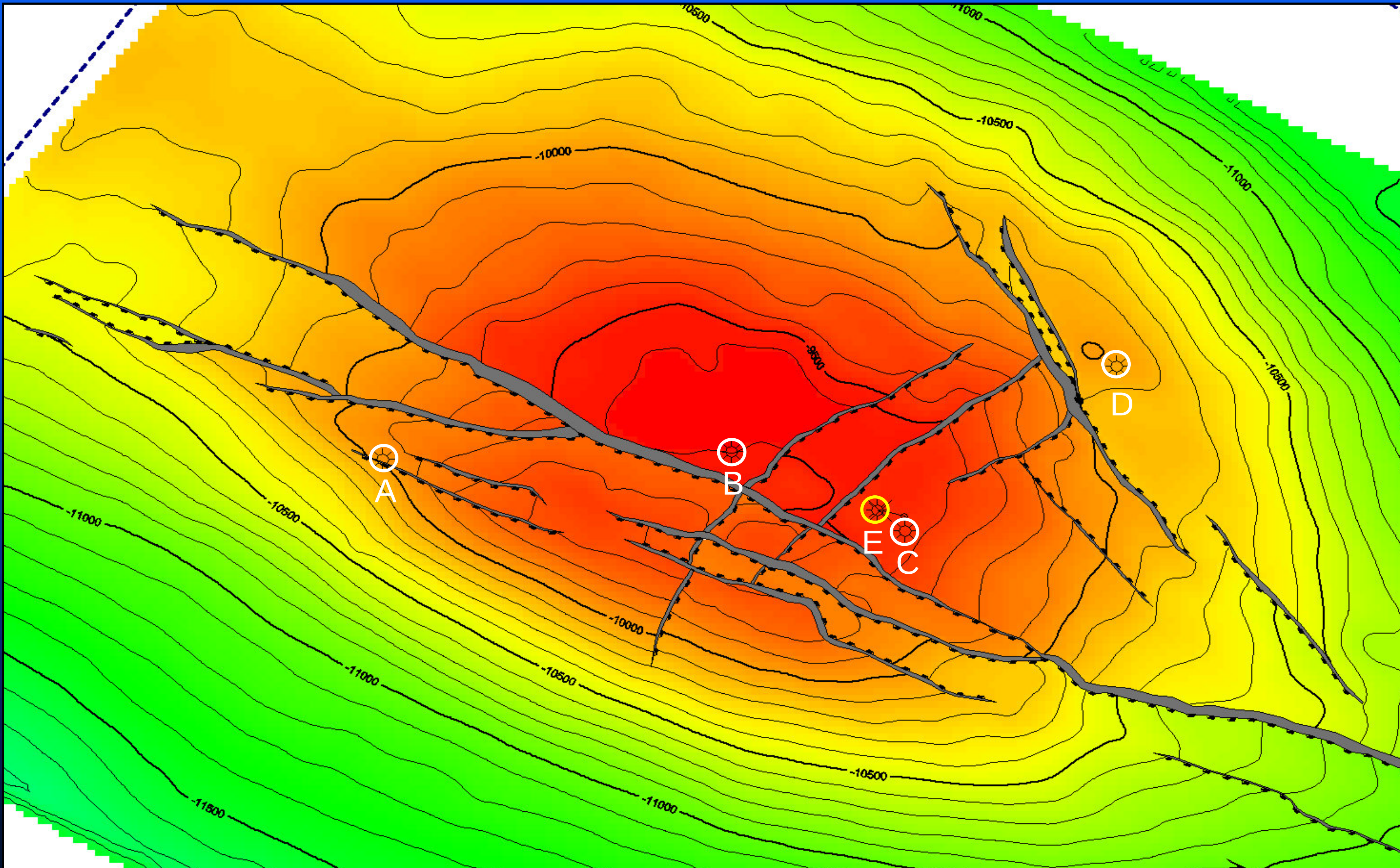
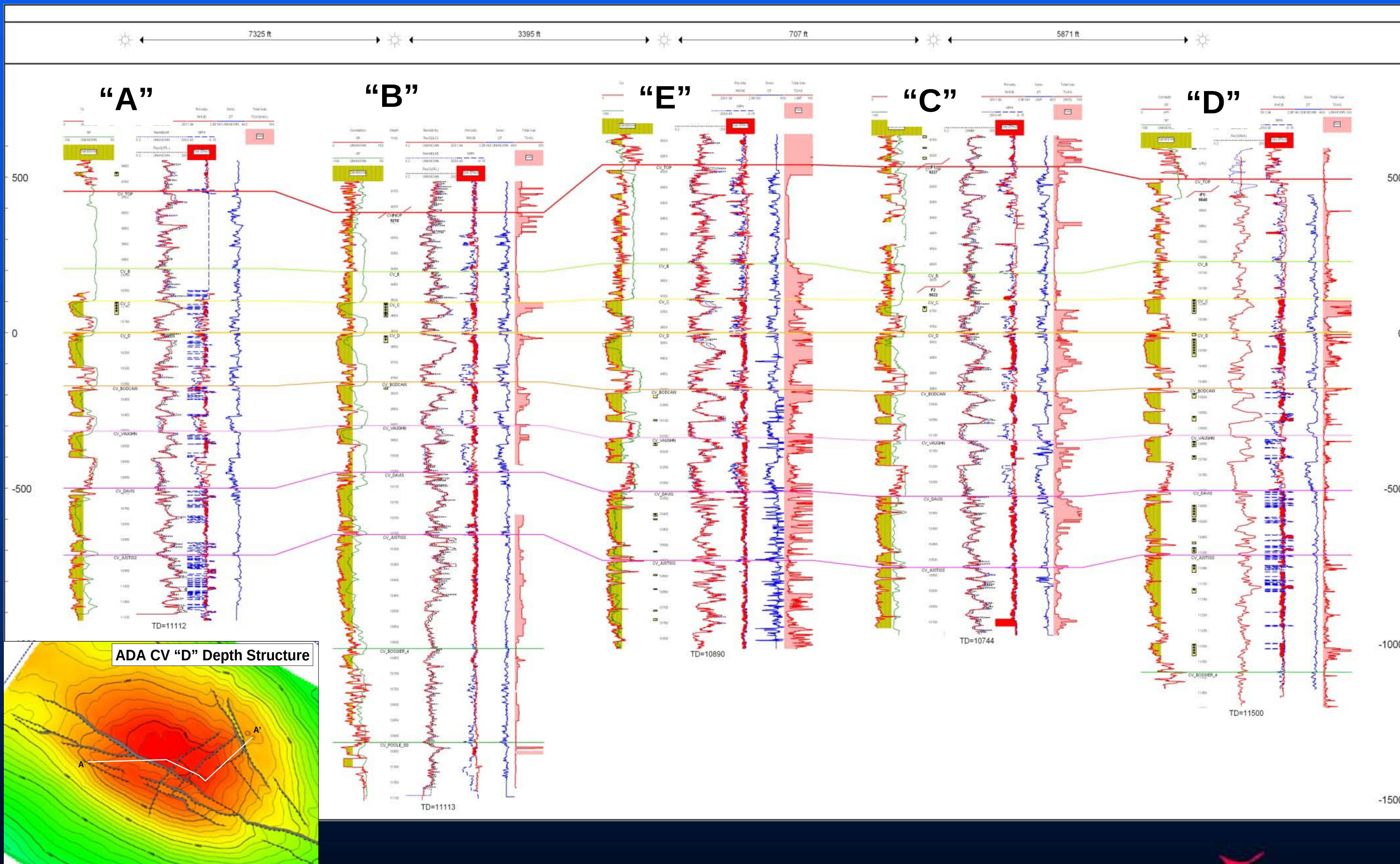
Cotton Valley "D" Depth Structure



Stratigraphic Cross Section on CV "D" Sand



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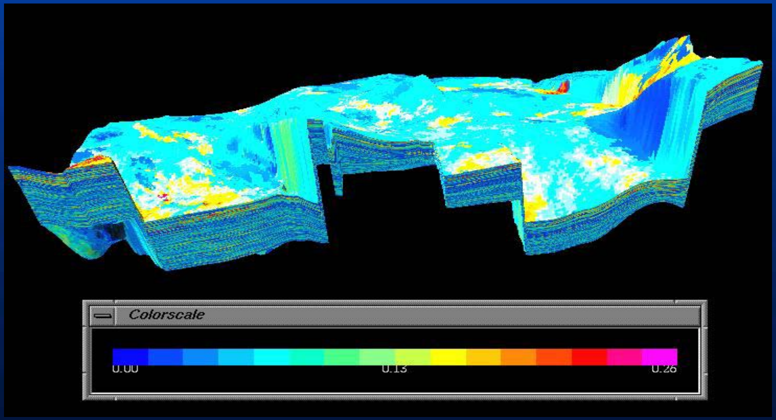
Why Seismic Inversion?

Field Development Programs:

- Well-to-well Sand Correlation
- Well Trajectory Optimization
- Horizontal Well Steering
- Porosity Estimation
- Reservoir Modeling



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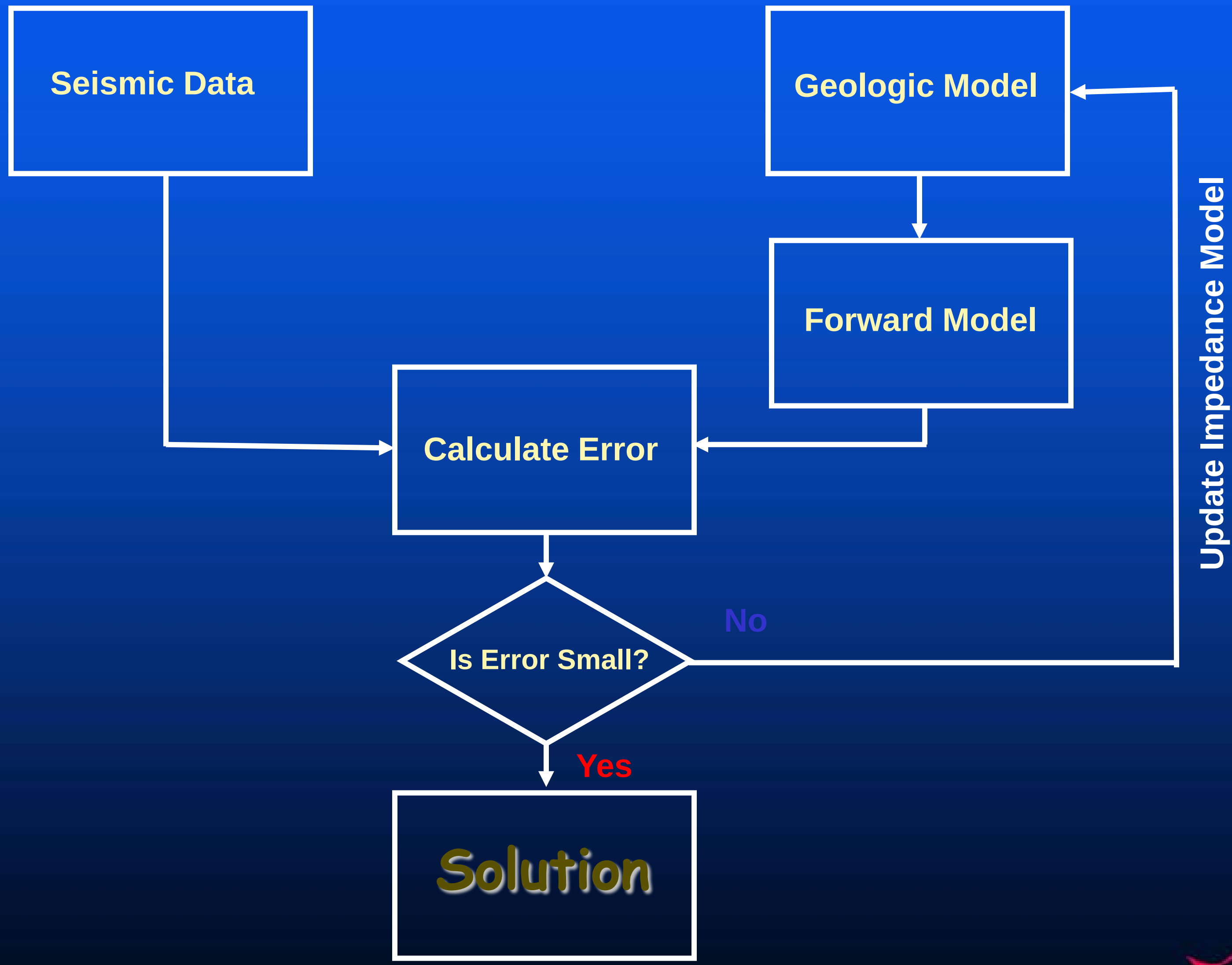
Model-based Inversion Workflow



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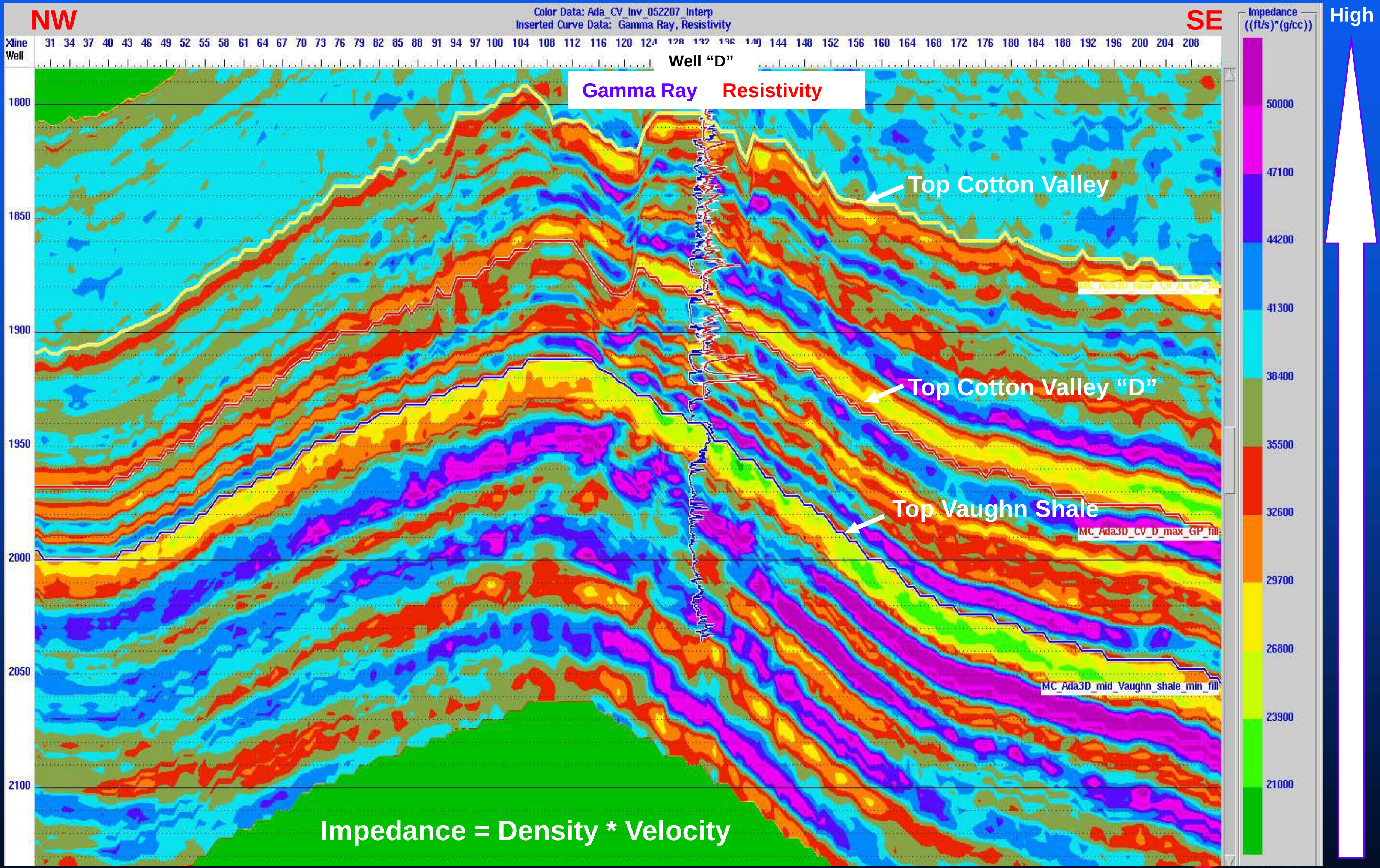
Seismic Impedance Model: Well “D”



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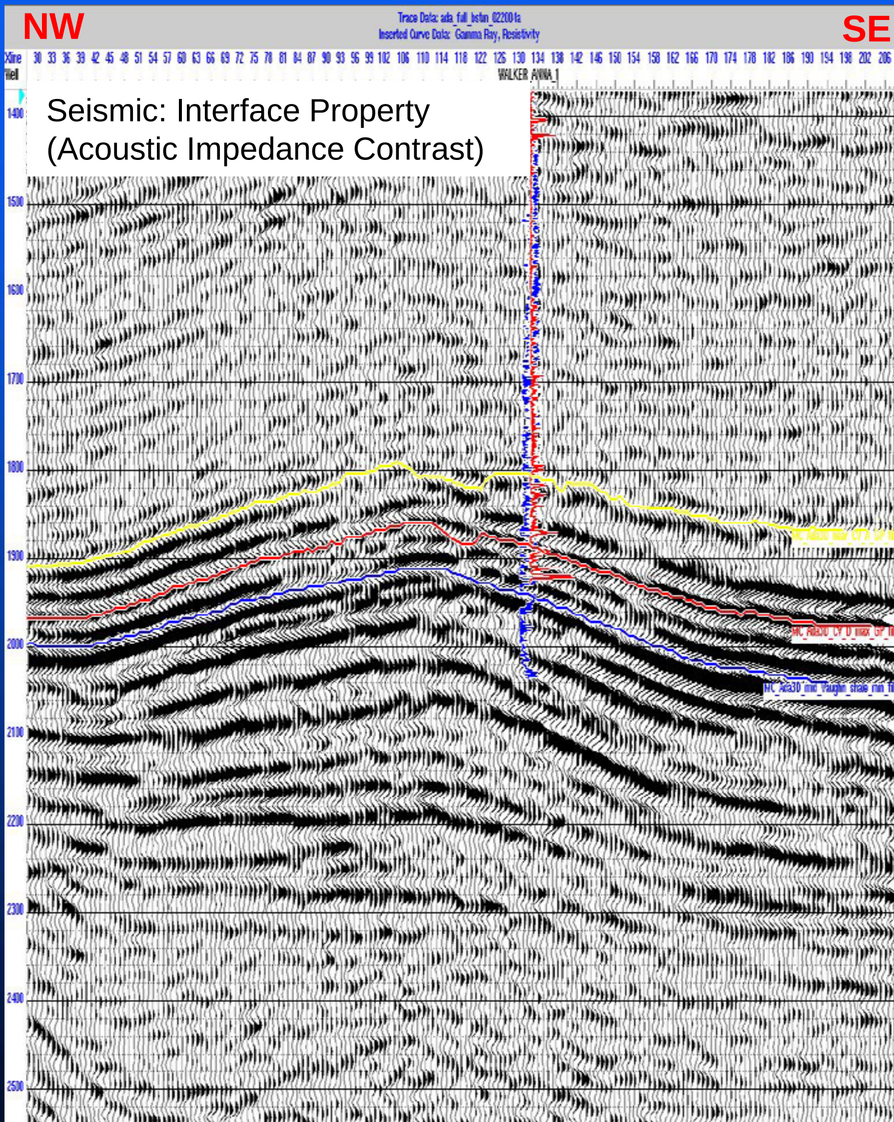
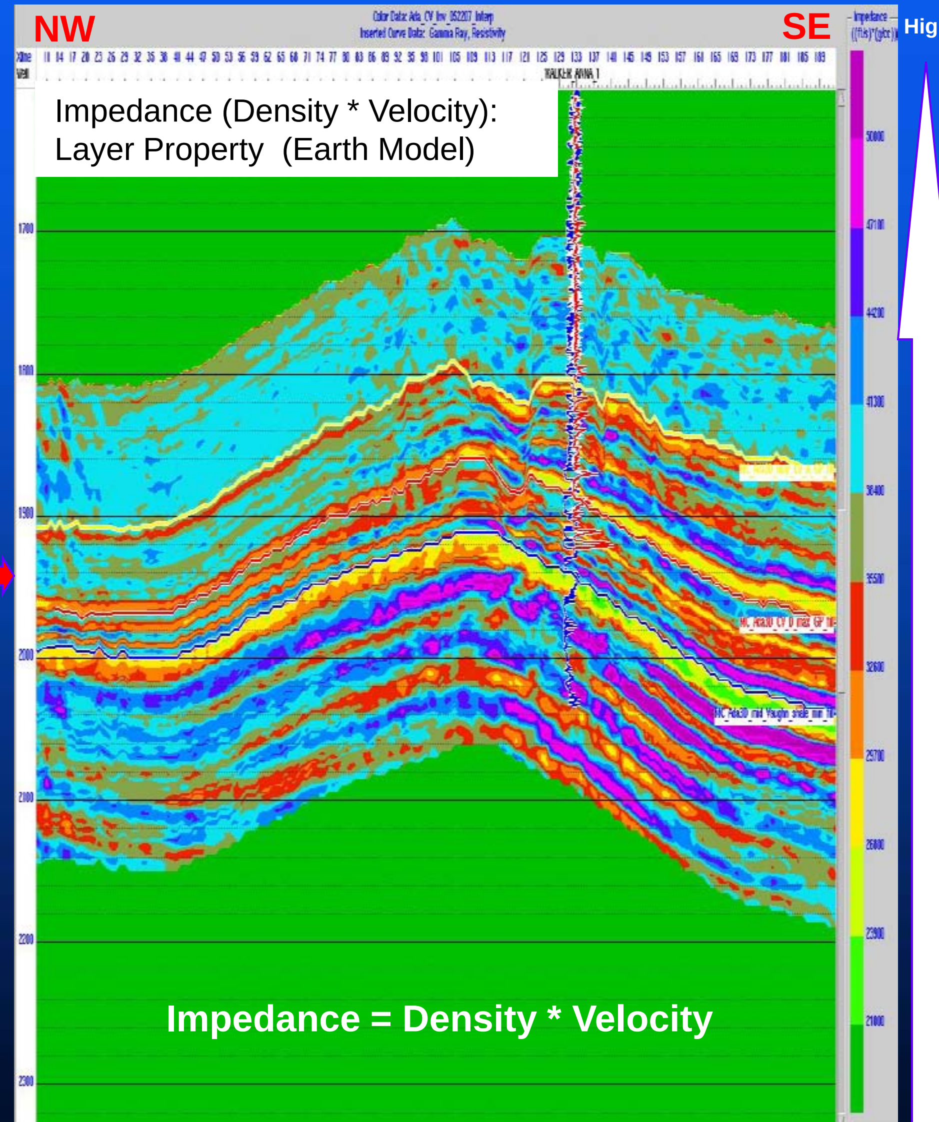
Seismic vs. Impedance: Well “D”





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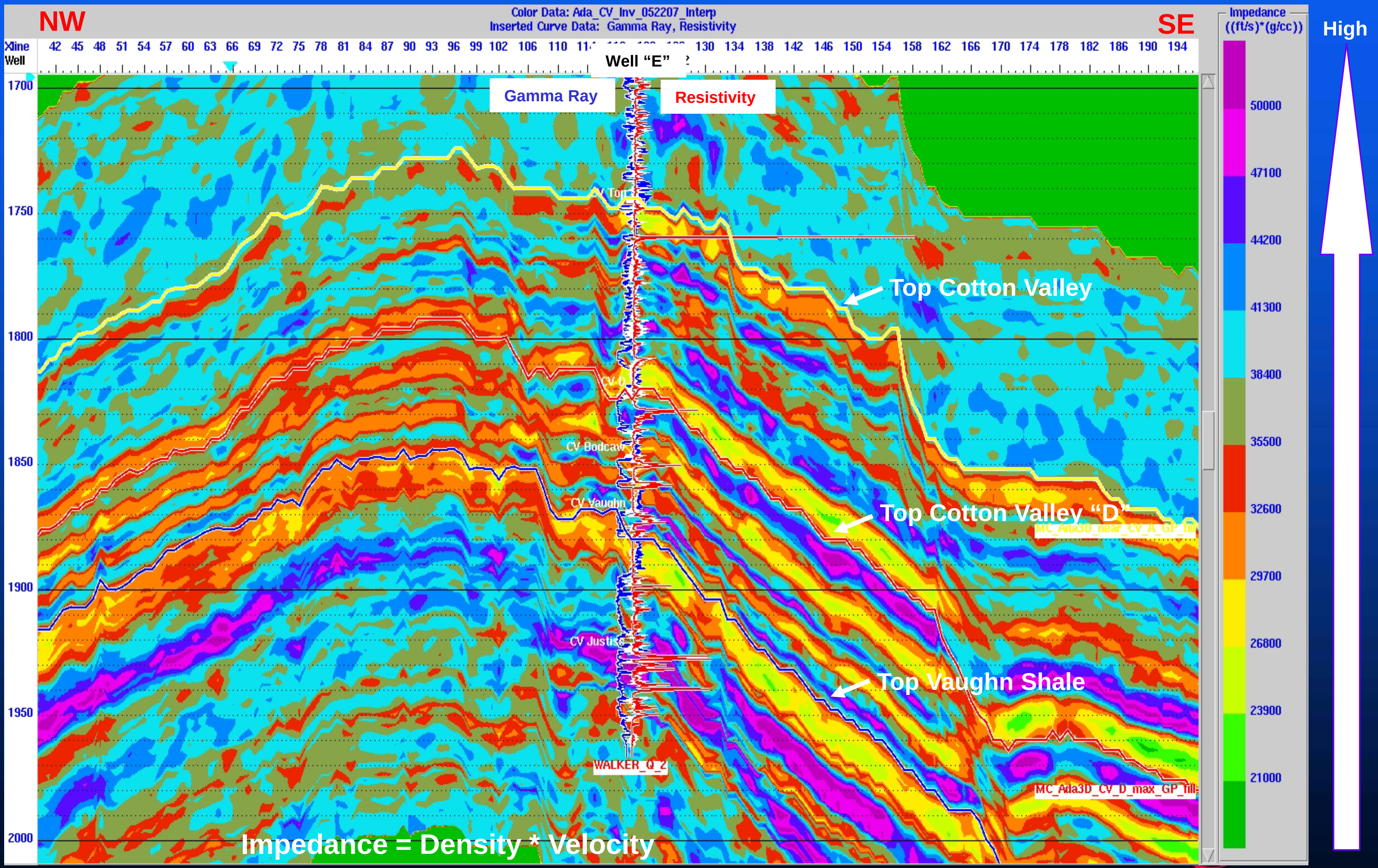
Seismic Impedance Model: Well “E”



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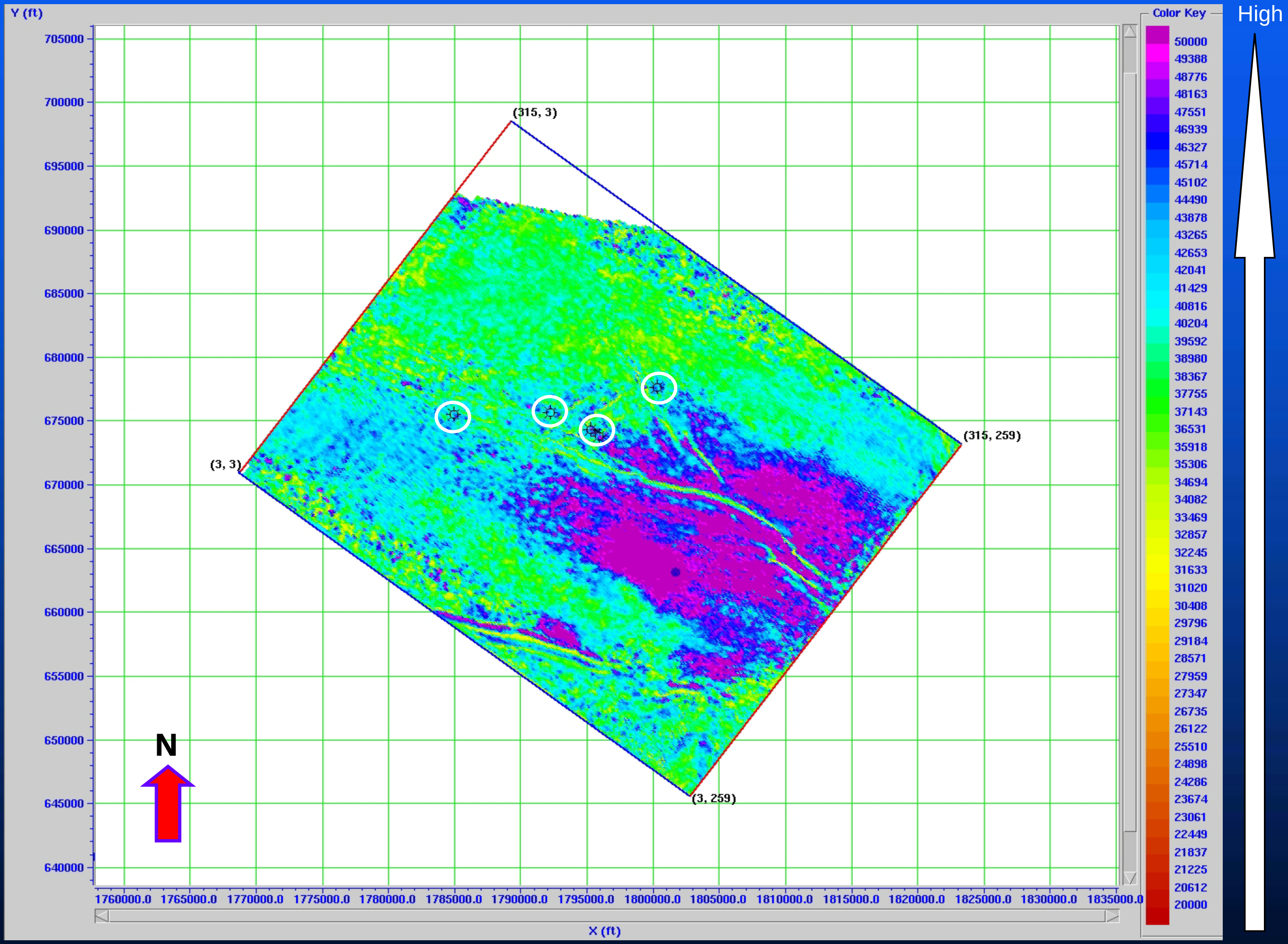
Seismic Impedance Slice: Cotton Valley “D”



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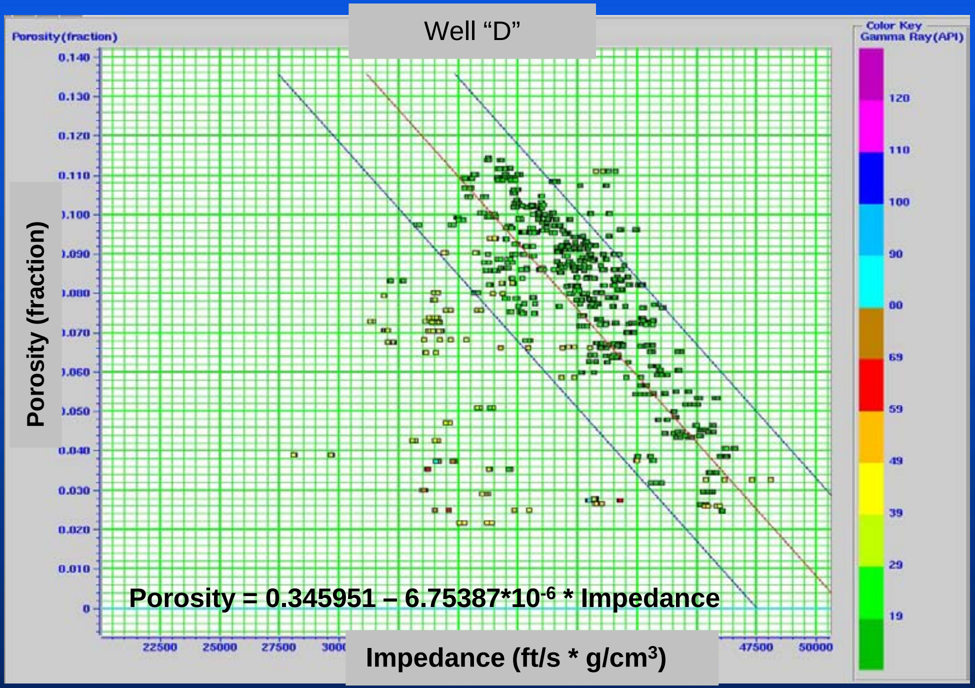
Porosity Estimation from Impedance Model



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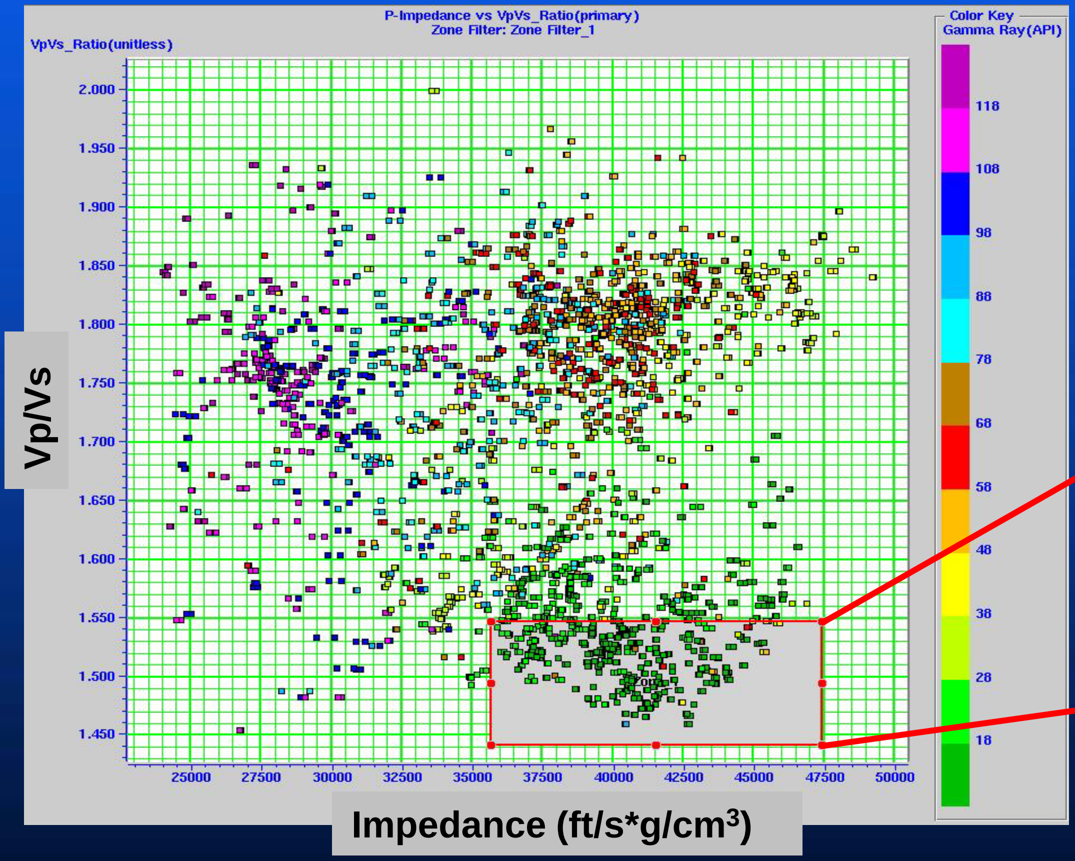
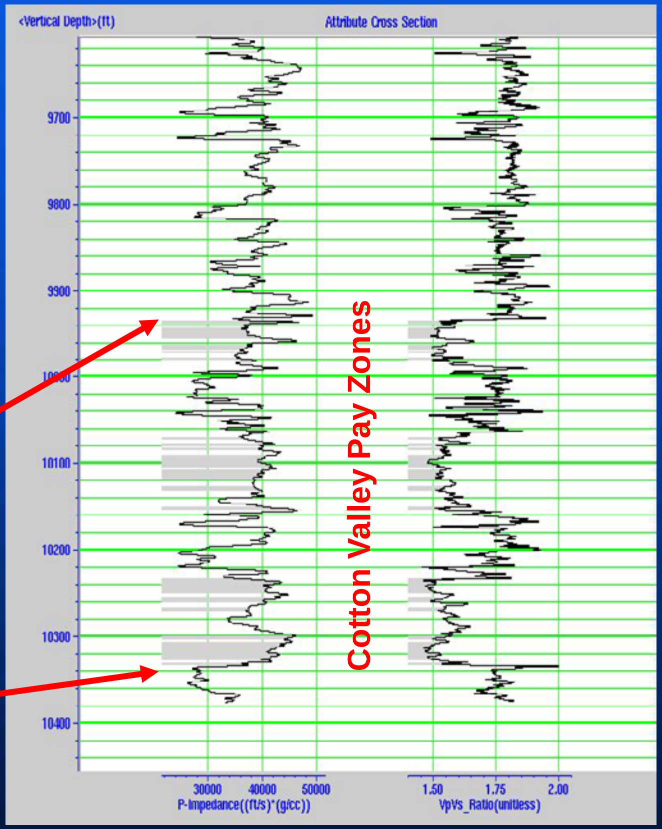
Well "D": Impedance - Vp/Vs Cross Plot

Vp/Vs vs. Impedance



Impedance Vp/Vs



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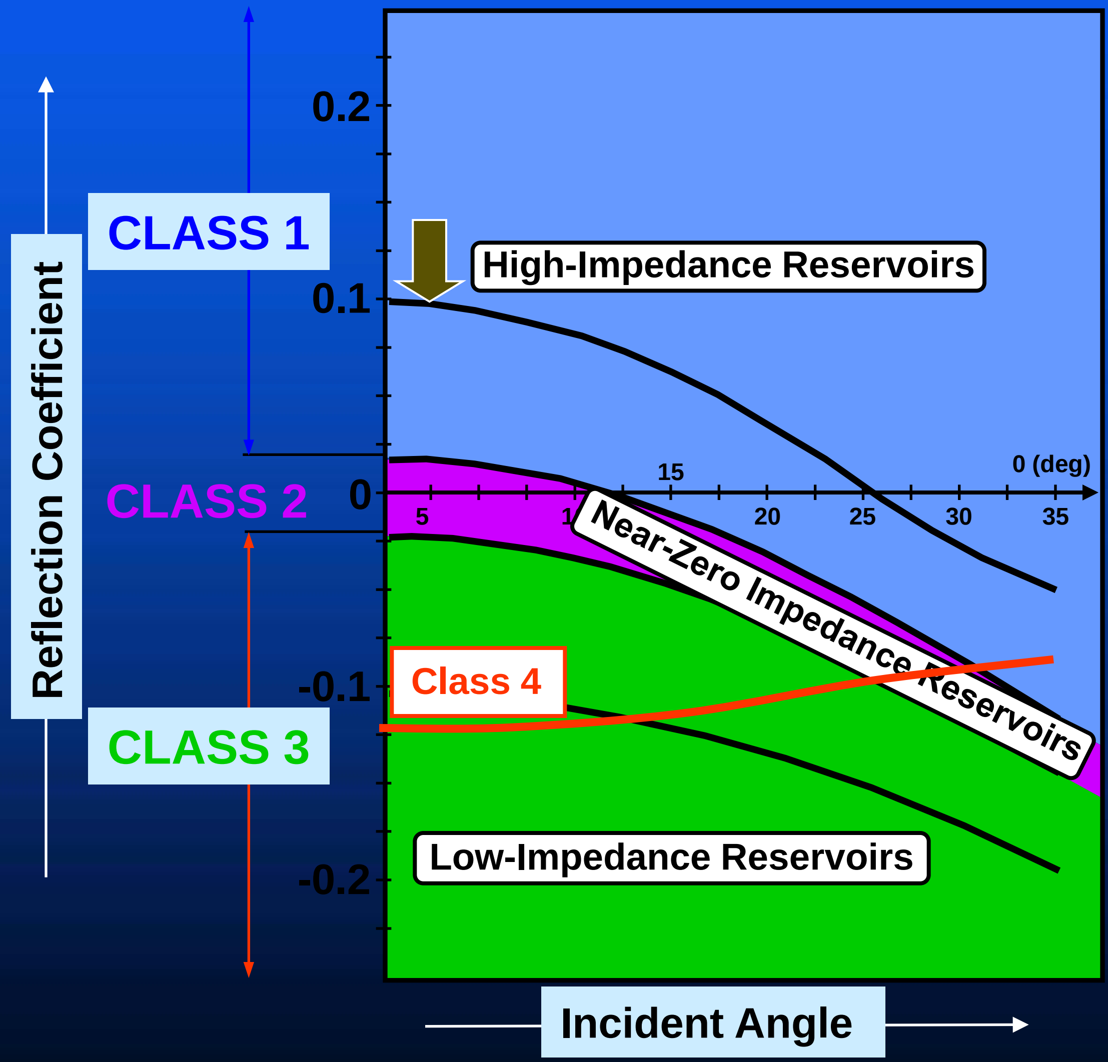
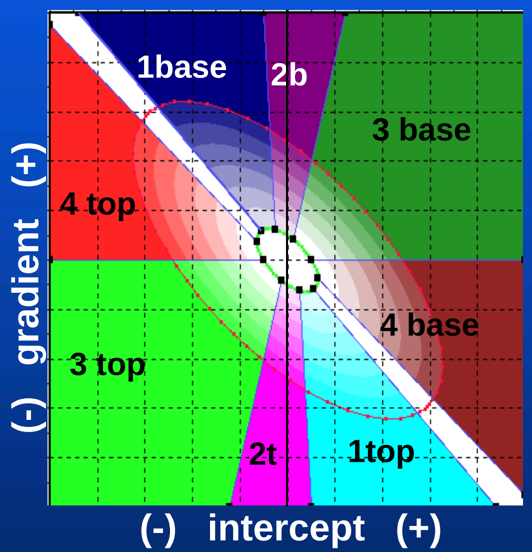
AVO Classification





(Rutherford and Williams, 1989 & Castagna et al. 1998)

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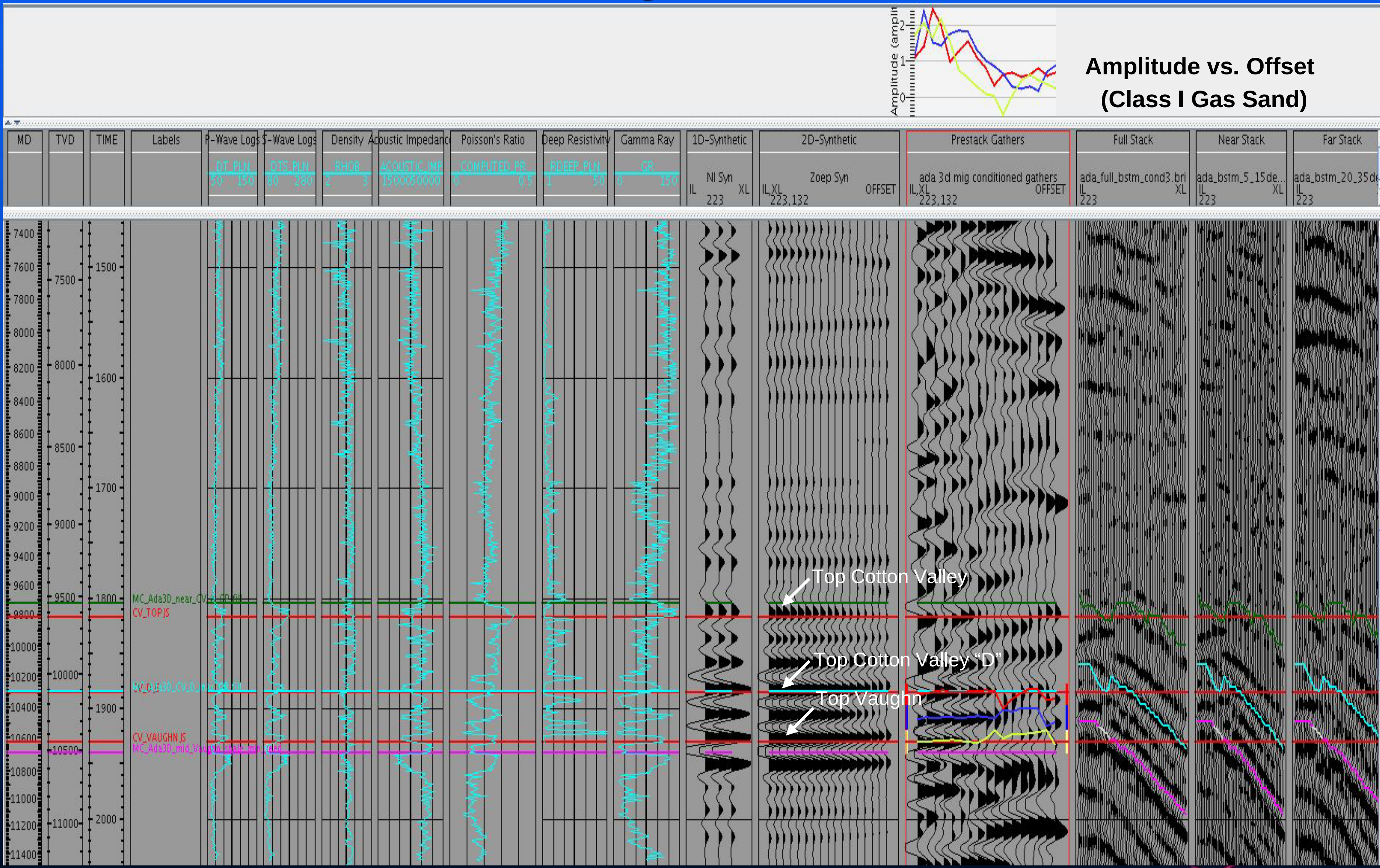
AVO Analysis: Well “D”



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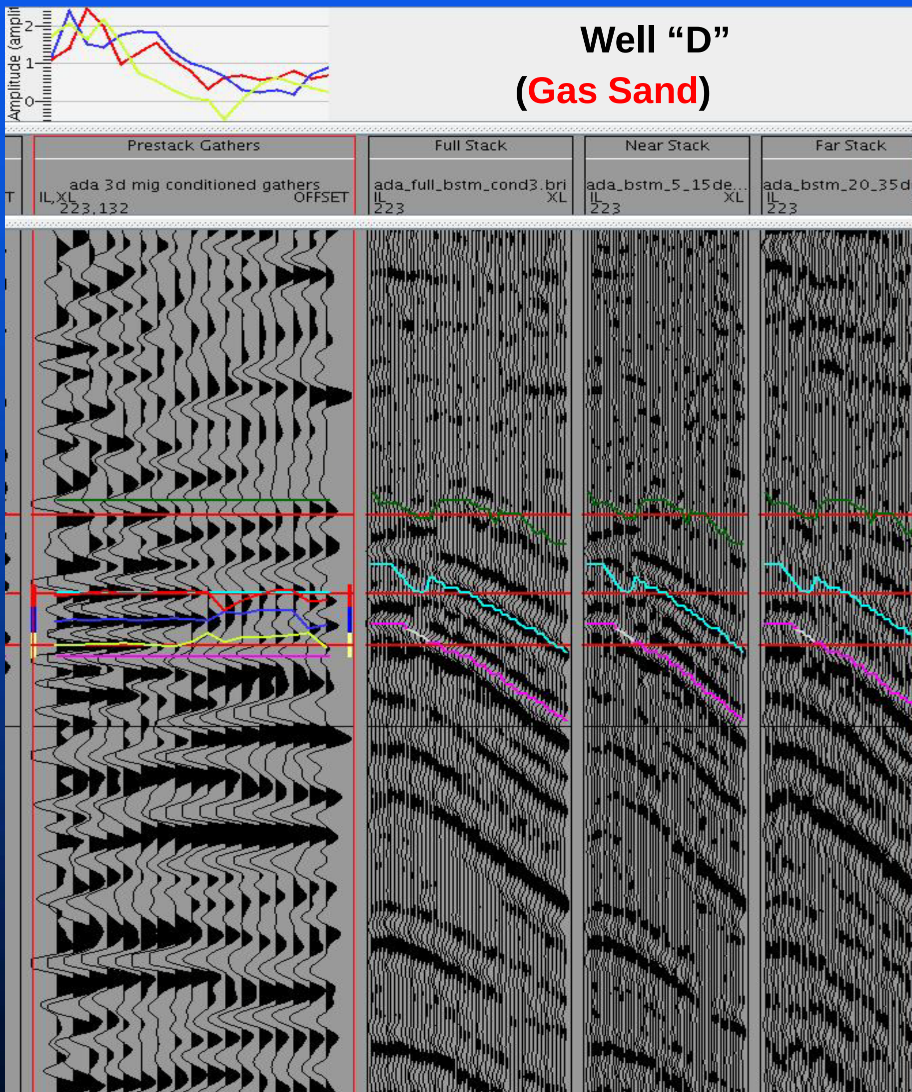
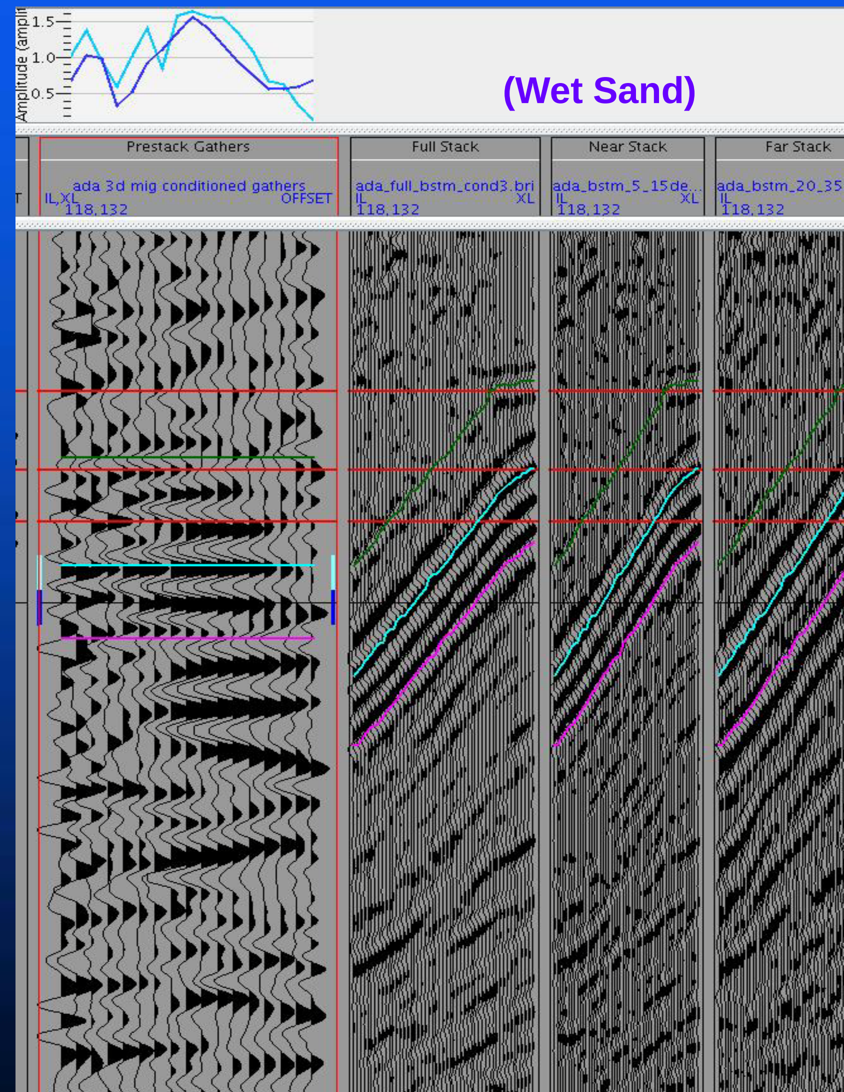
AVO Comparison - Gas sand (left) vs. Wet Sand (right)

Amplitude vs. Offset



Amplitude vs. Offset



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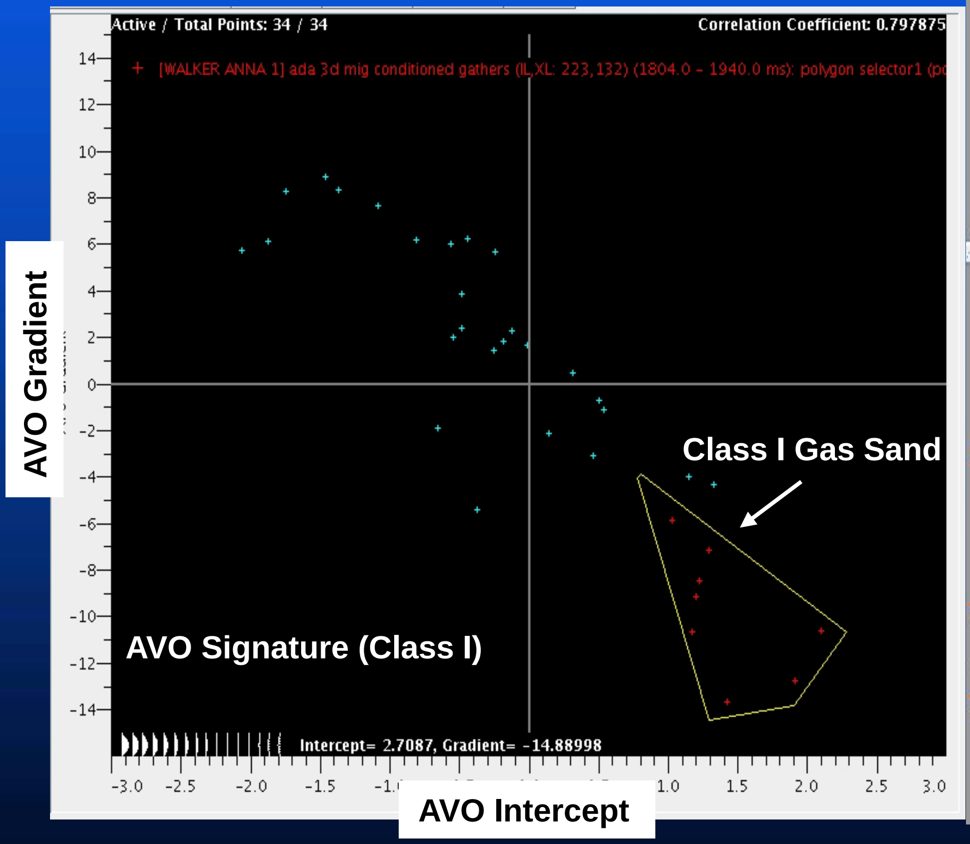
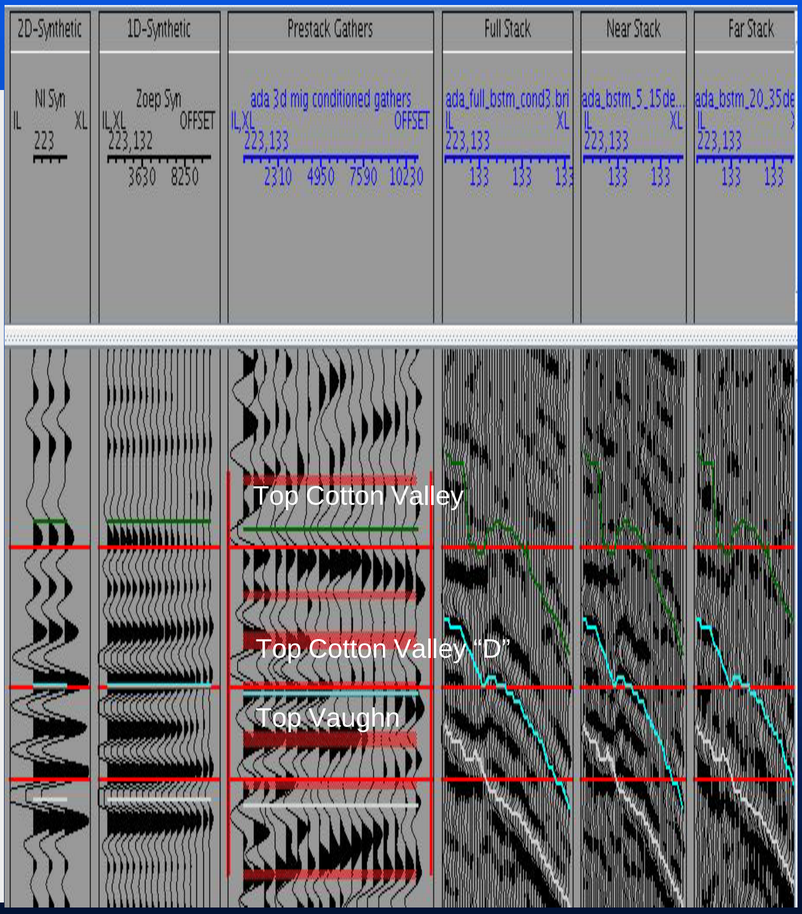
Well "D": AVO Intercept - Gradient Cross Plot (left); CMP Gather (right)

AVO Intercept vs. Gradient



CMP Gather



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- *Ada 3D Seismic Inversion*
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Conclusions

- Seismic Inversion - Definition, continuity and thickness estimate of the Cotton Valley Sands
- AVO modeling / analysis - Identification / prediction of Class I gas pay zones
- Well “D” Pay Zones - High impedance and low Vp-Vs ratio characteristics
- Empirical relationship between Impedance and Porosity
- Results in Well “E” drilled post seismic inversion match and validate the impedance model
- Results will be used to drill the future in-fill wells and find new opportunities for infill drilling

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Thank You

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