Pre-drill pore pressure modelling and post-well analysis using seismic interval velocity and seismic frequency-based methodologies: a deepwater well case study from Mississippi Canyon, Gulf of Mexico

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STONE ENERGY

eSeis

Frequency-Based PP, Called PP-Q?

What is Q?

Q stands for Quality Factor

Q is the inverse of attenuation

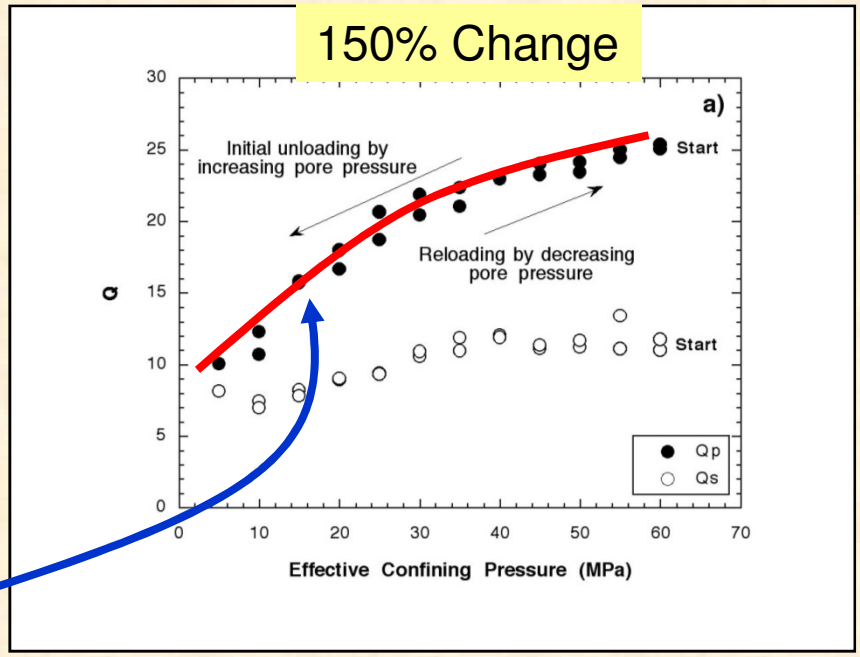
Experimental Results

Numerous authors have reported on the experimental relationship between Q_p and Pressure ($P_{eff\ stress}$, P_p) .

Such as:

Birch and Bancroft	1938
Johnston et al	1979
Lucet and Zinszner	1992
Best and Sams	1997
Carcione	2000
Siggins and Dewhurst	2001

With results like this



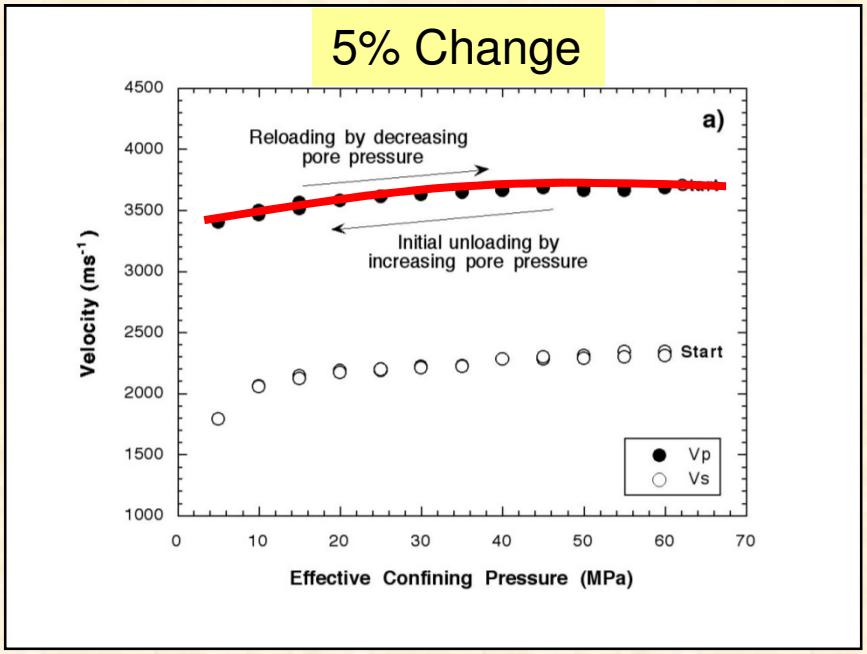
Lab Results

OTC 13043

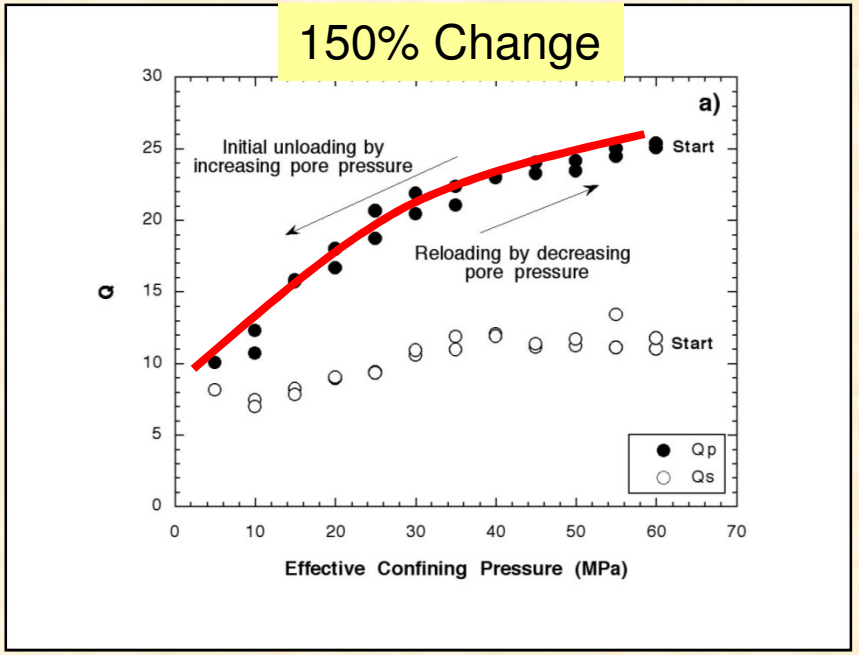
Stress Path, Pore Pressure and Microstructural Influences on Q in Carnarvon Basin Sandstones

A.F. Siggins and D.N. Dewhurst (CSIRO Petroleum, Australia) and P.R. Tingate (National Centre for Petroleum Geology and Geophysics, University of Adelaide, Australia).

5% Change



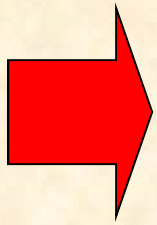
150% Change

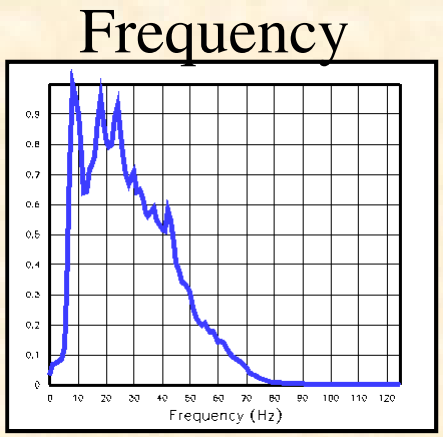


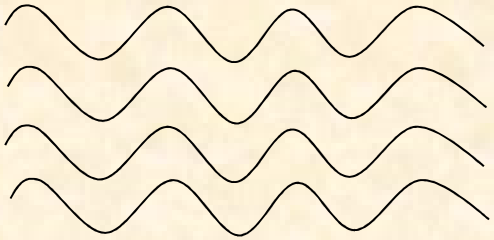
Q-Based Pore Pressure

An Intuitive Explanation

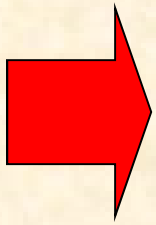
Q-Based Shale Pore Pressure

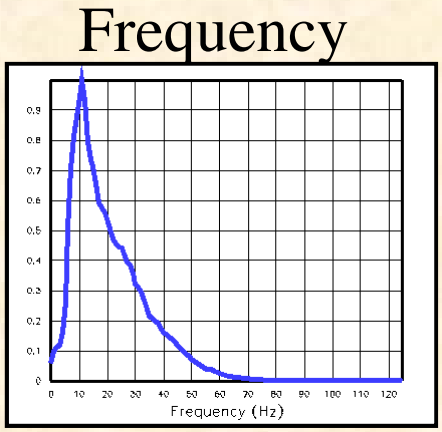


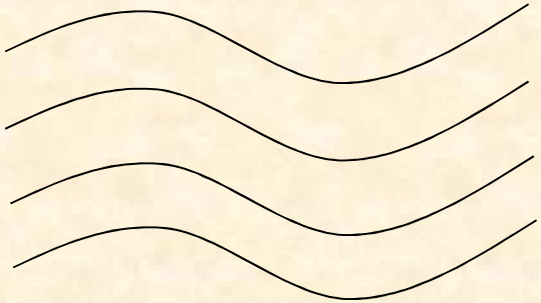




Hi Q

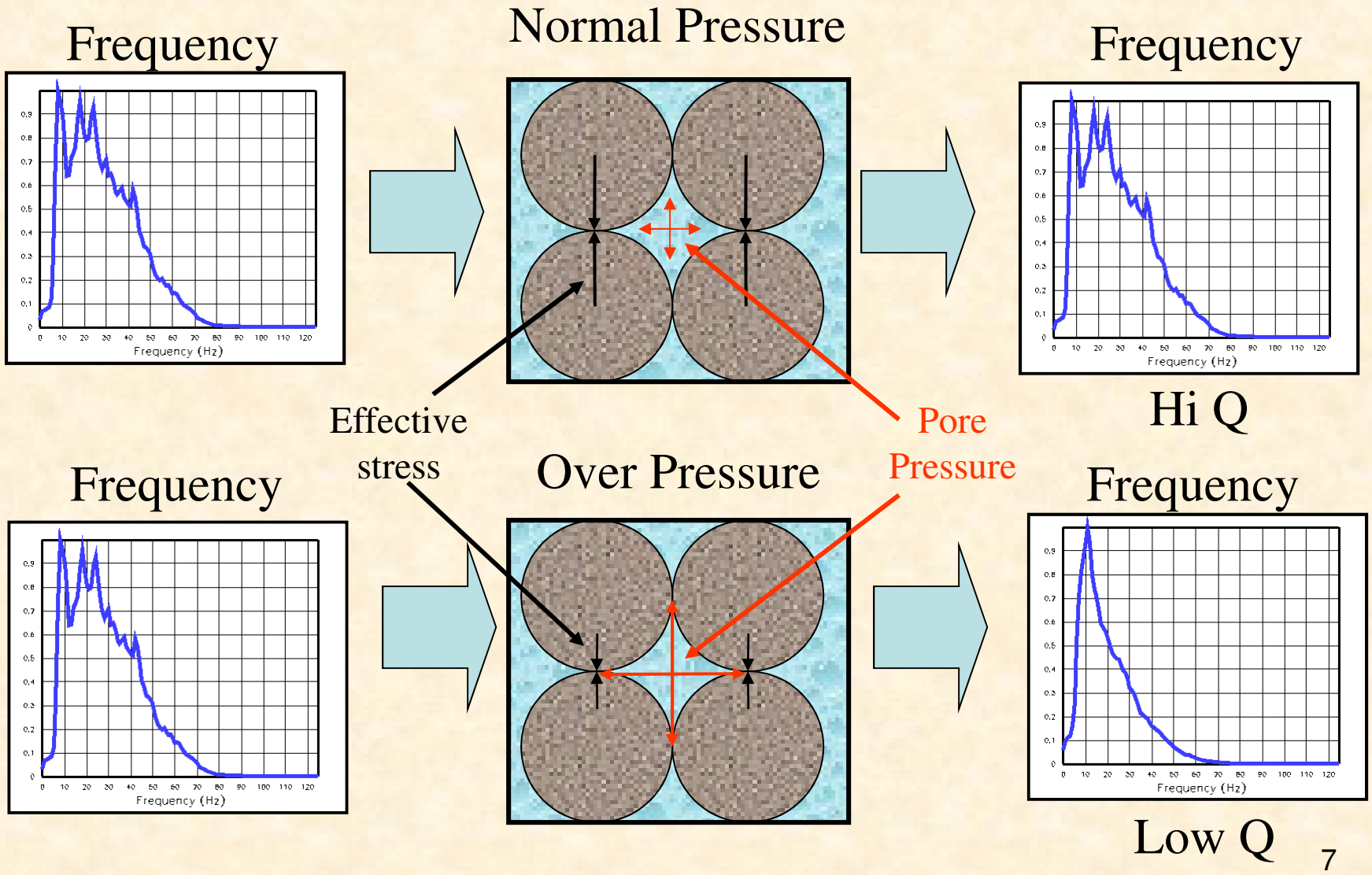






Low Q

Q Responds to Effective Stress

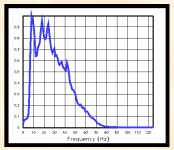


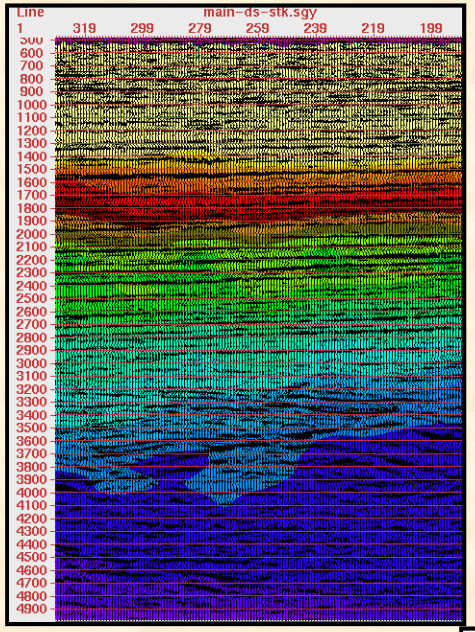
Q-Based Pore Pressure

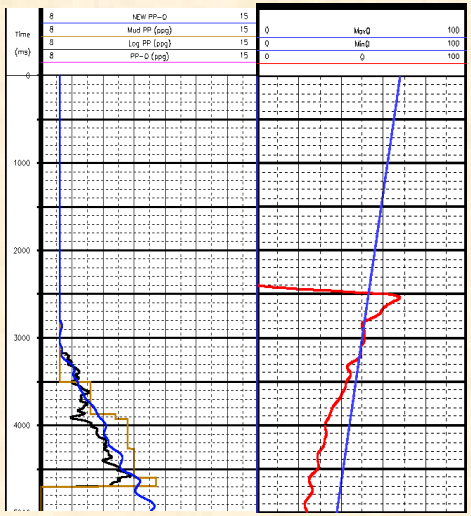
Procedure

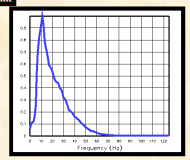
Q-Based PP Procedure

Frequency Decay

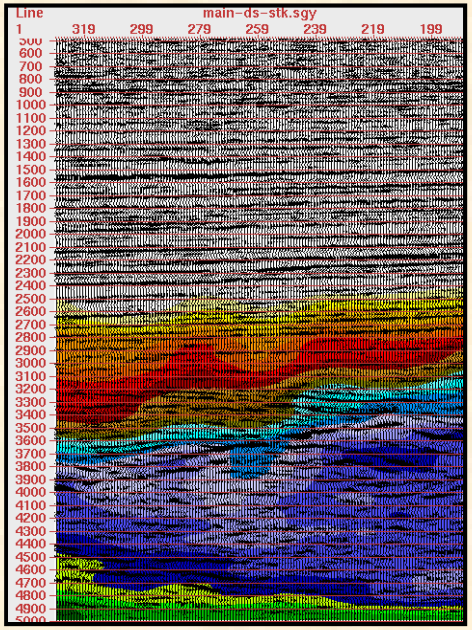


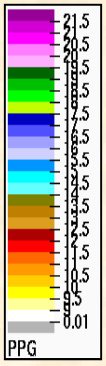




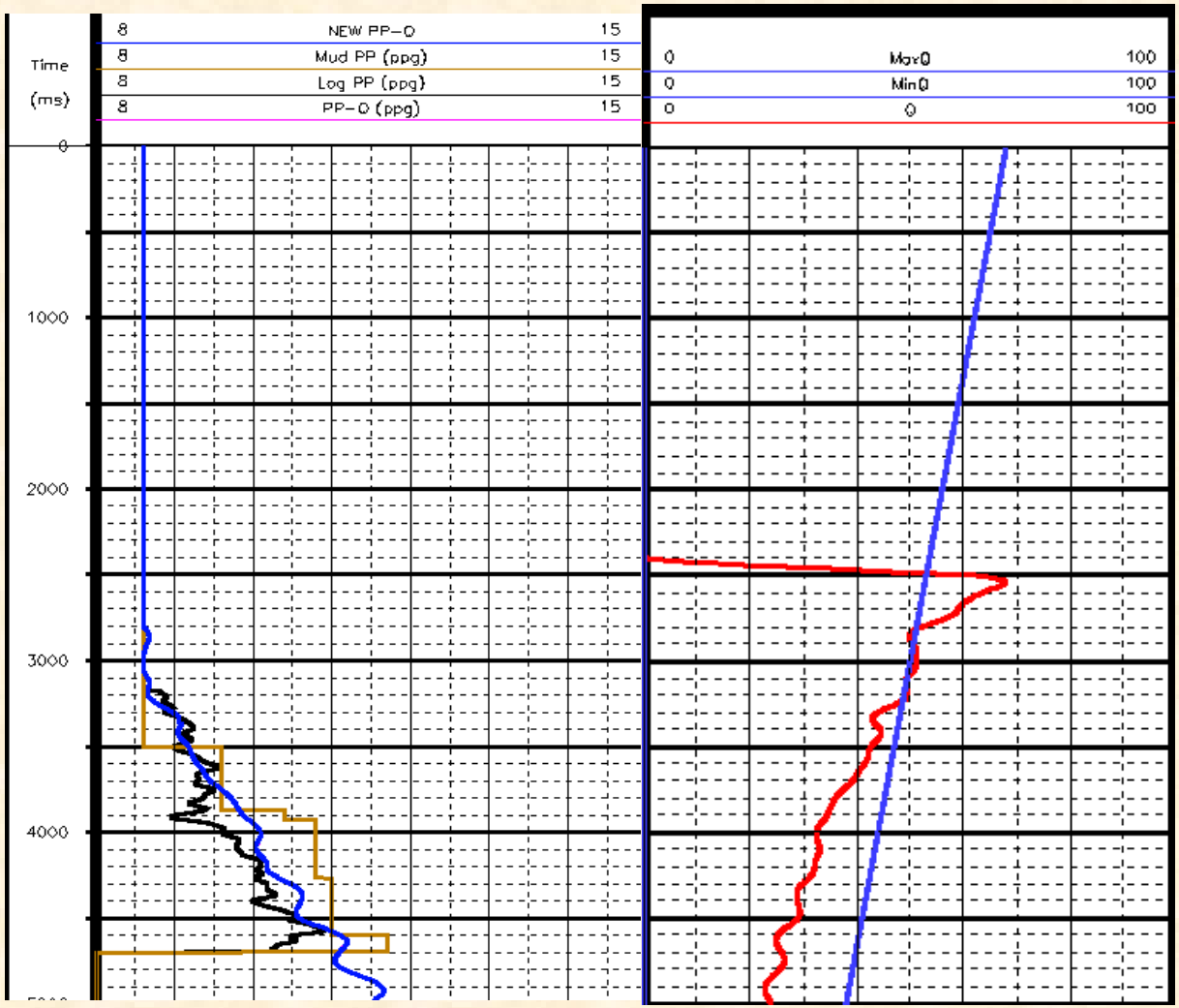


Pore Pressure

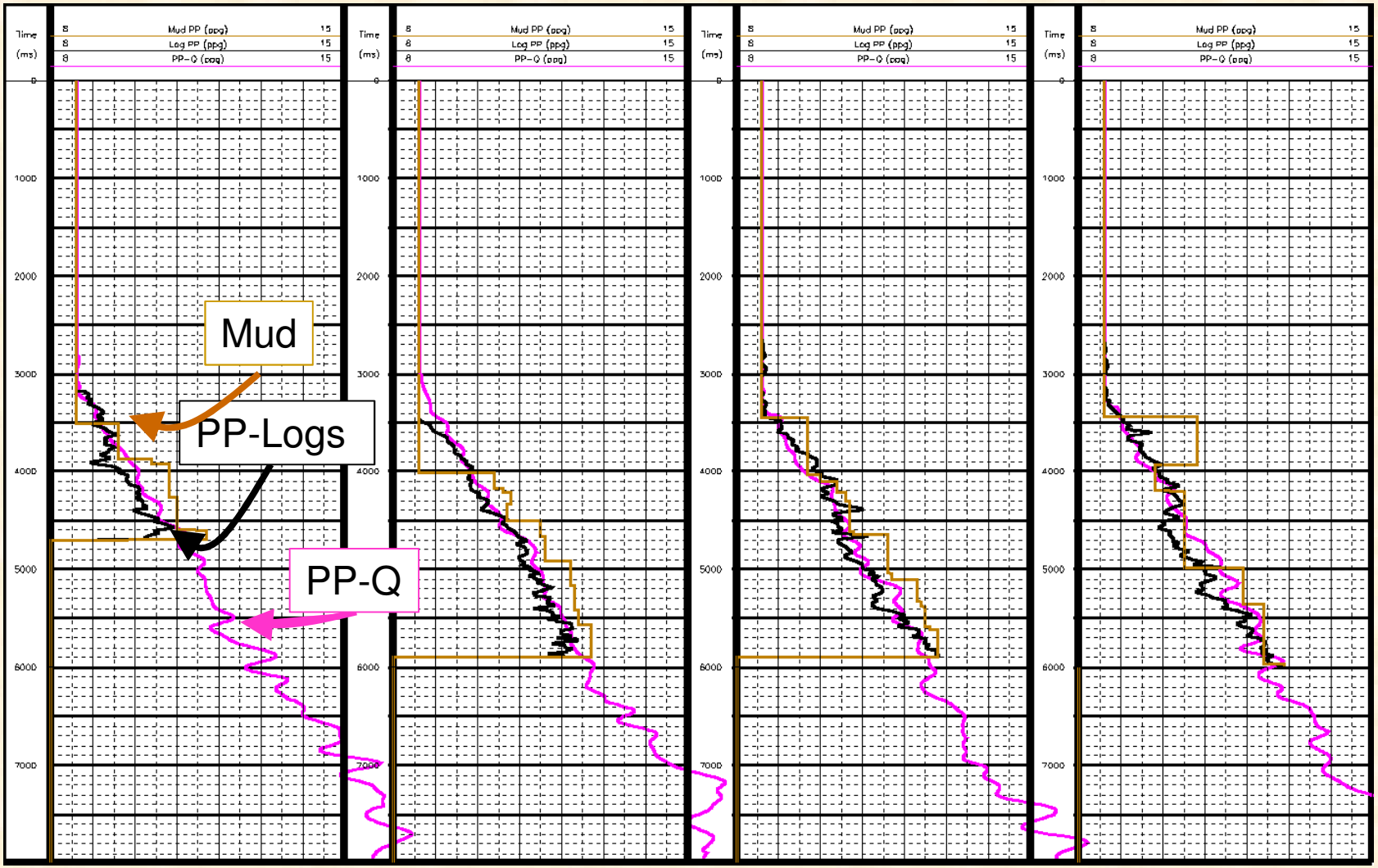




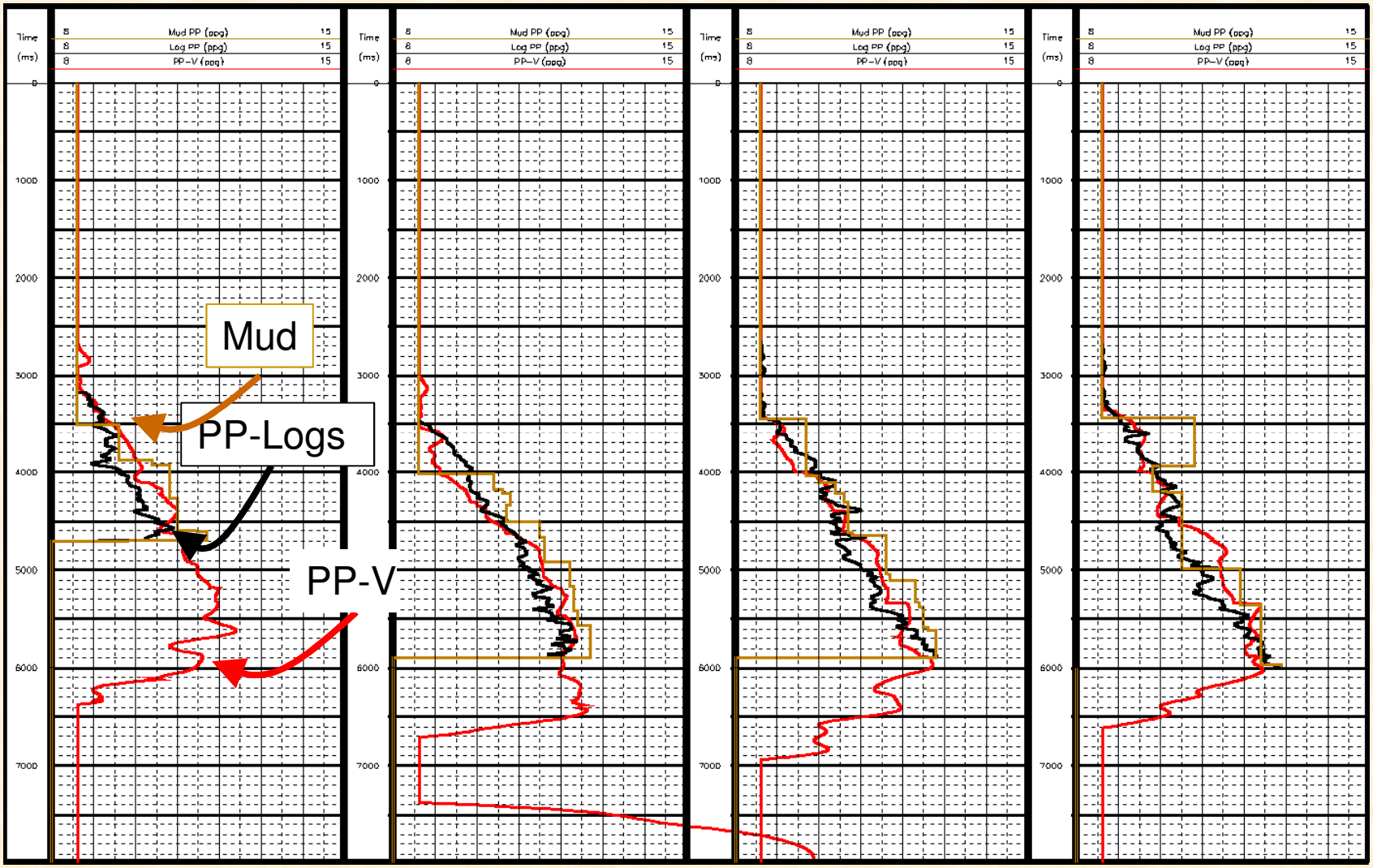
Deep Water Frequency Trend



PP-Q Calibration

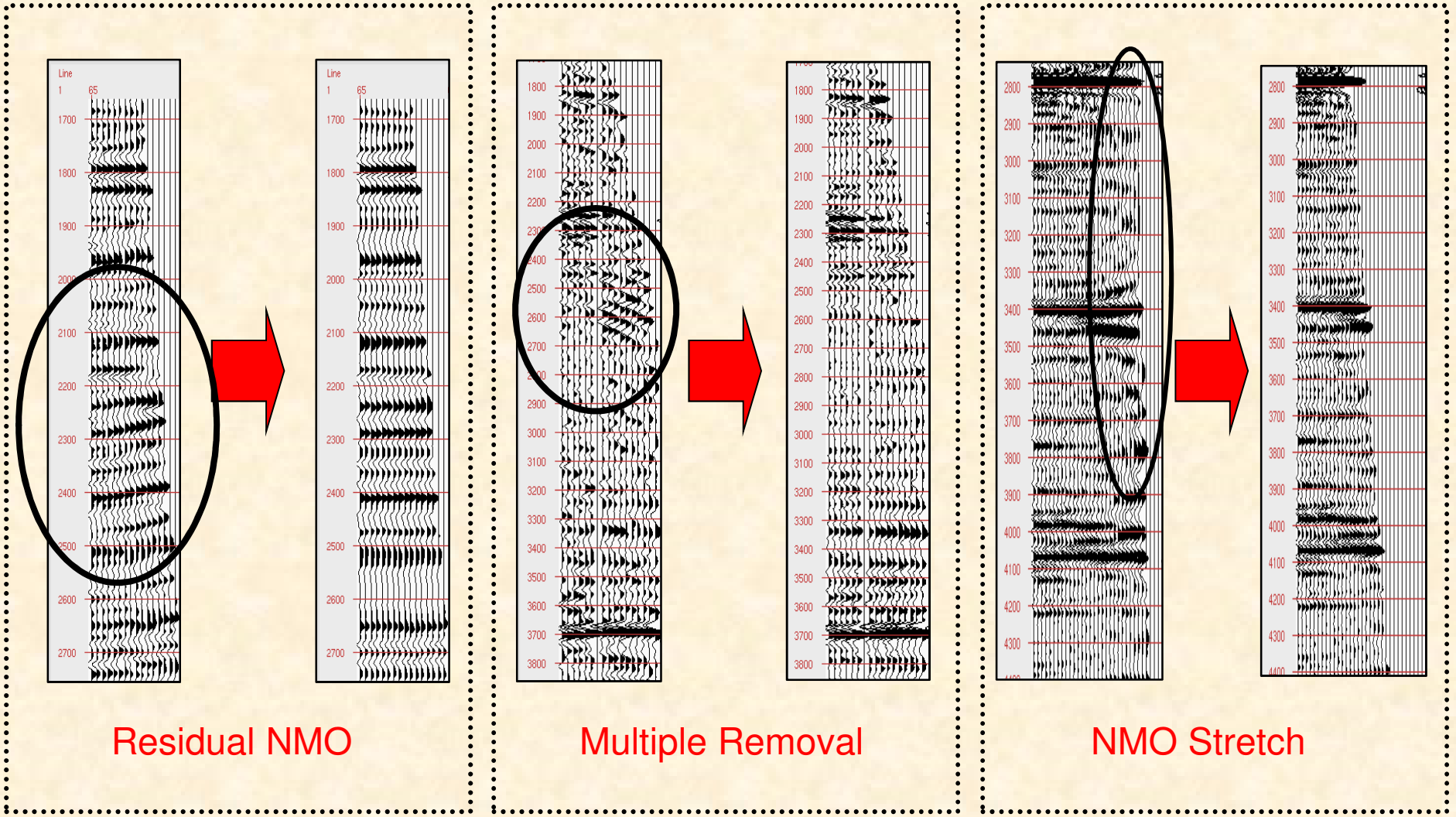


PP-V Calibration

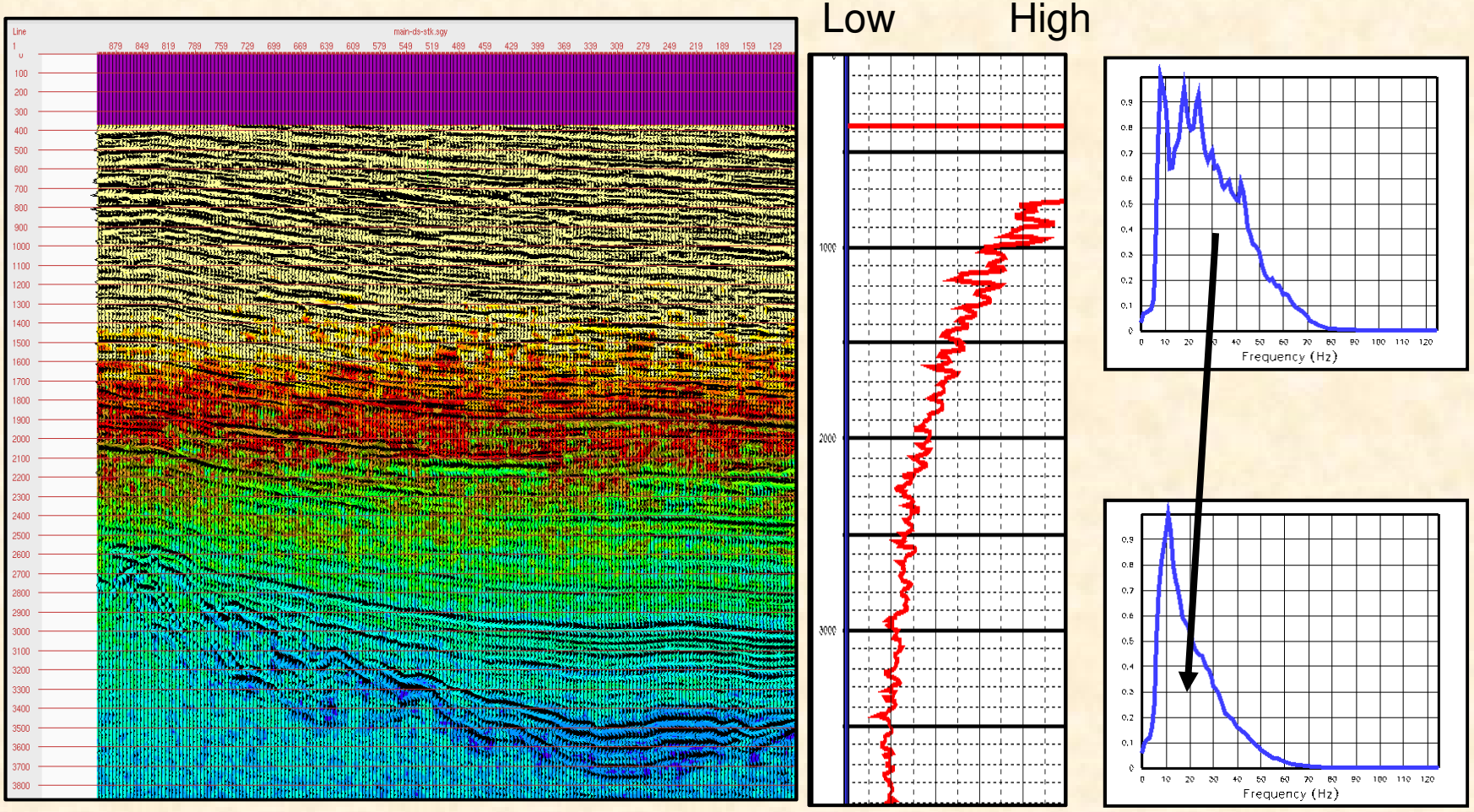


PP-Q
More Detail

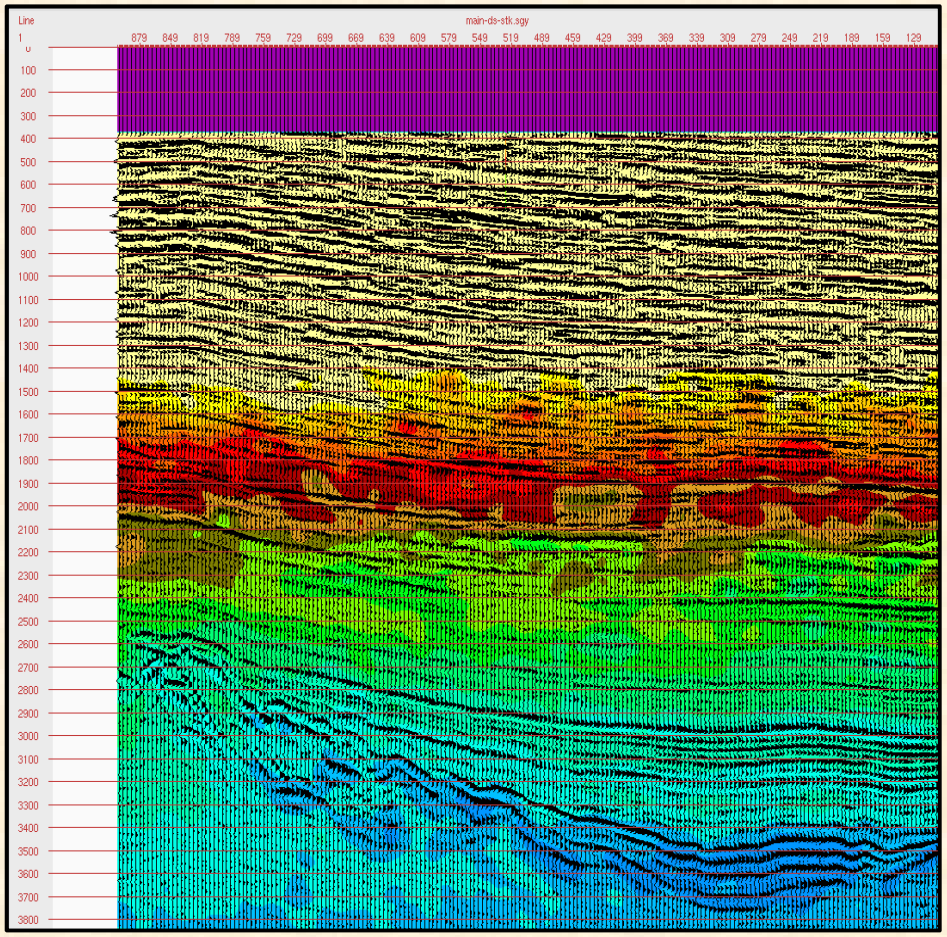
Seismic Data Preparation



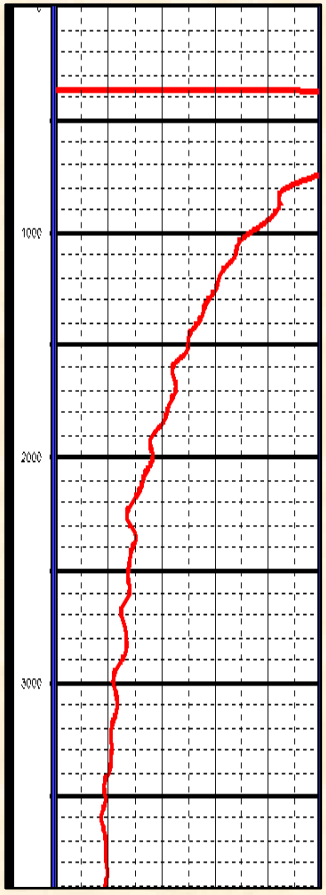
Seismic Frequency

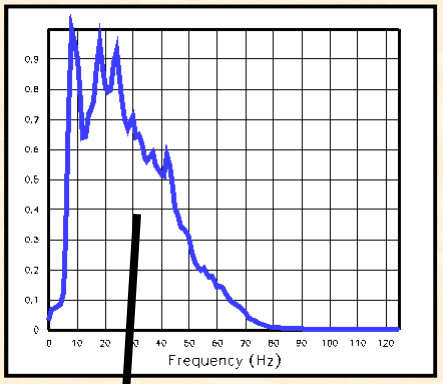


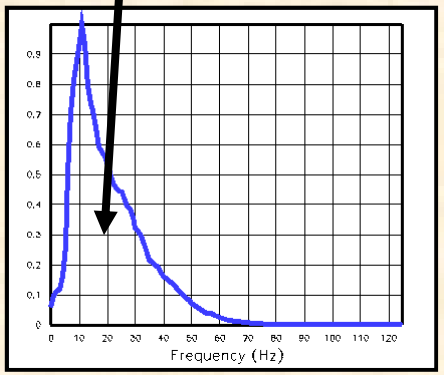
Seismic Frequency



Low High

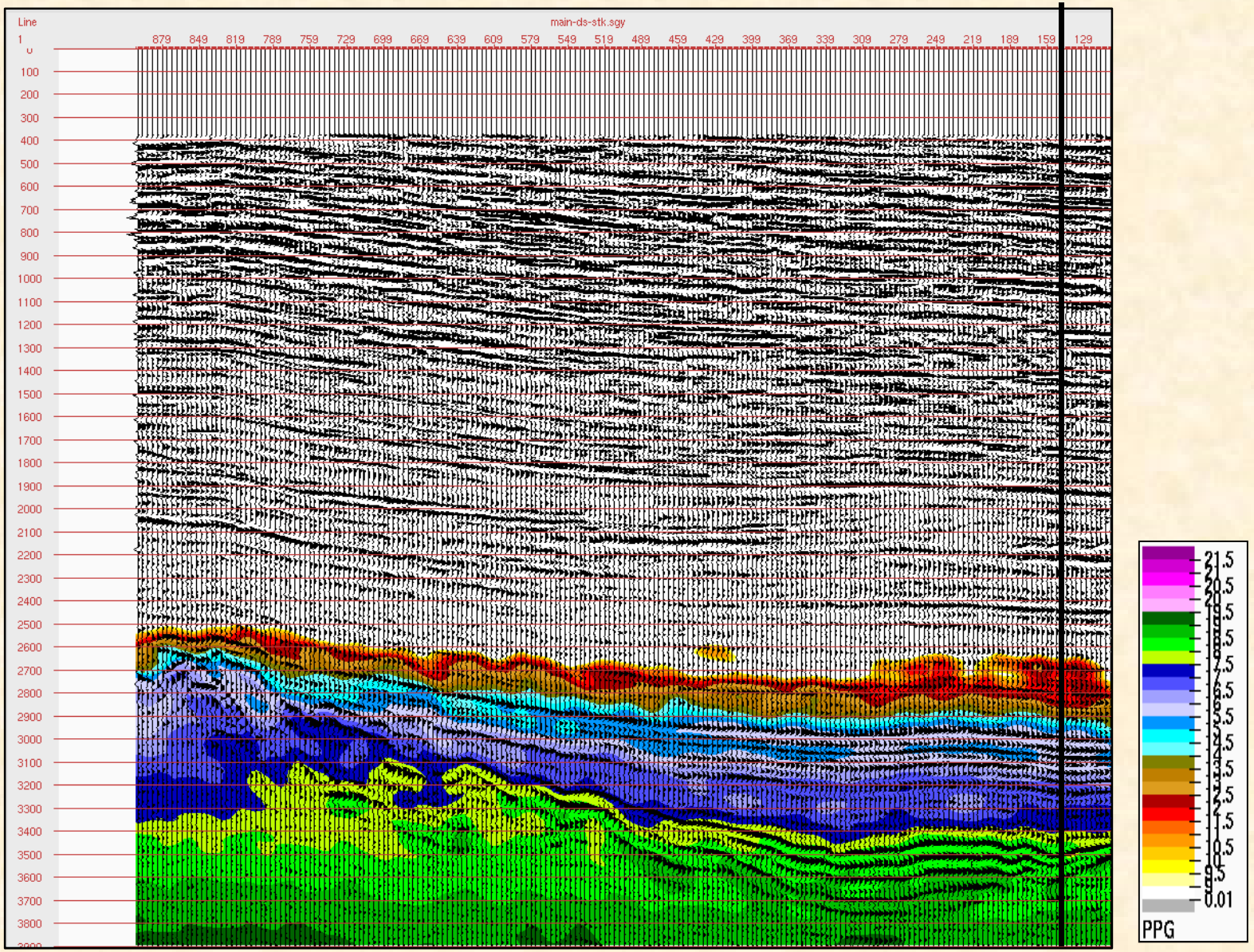




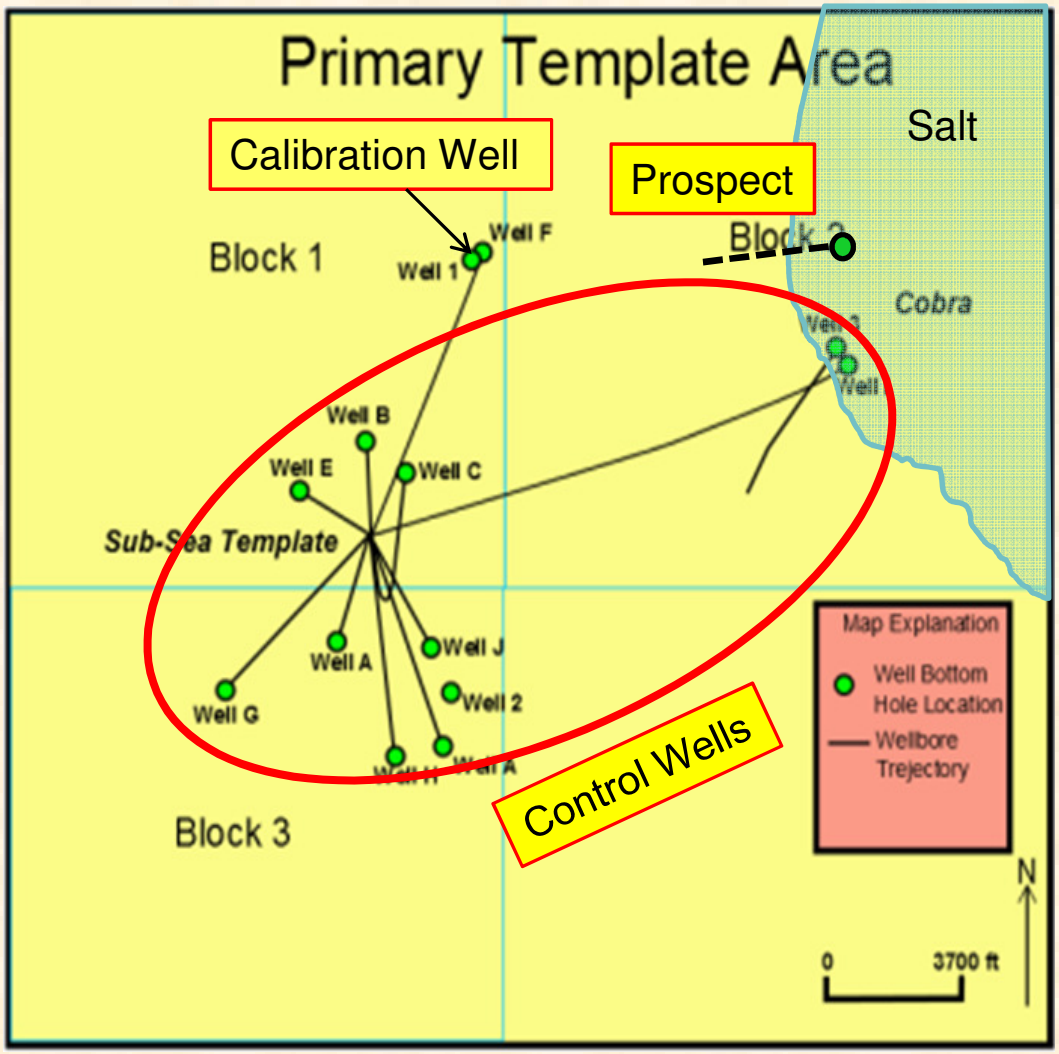


PP-Q

Well

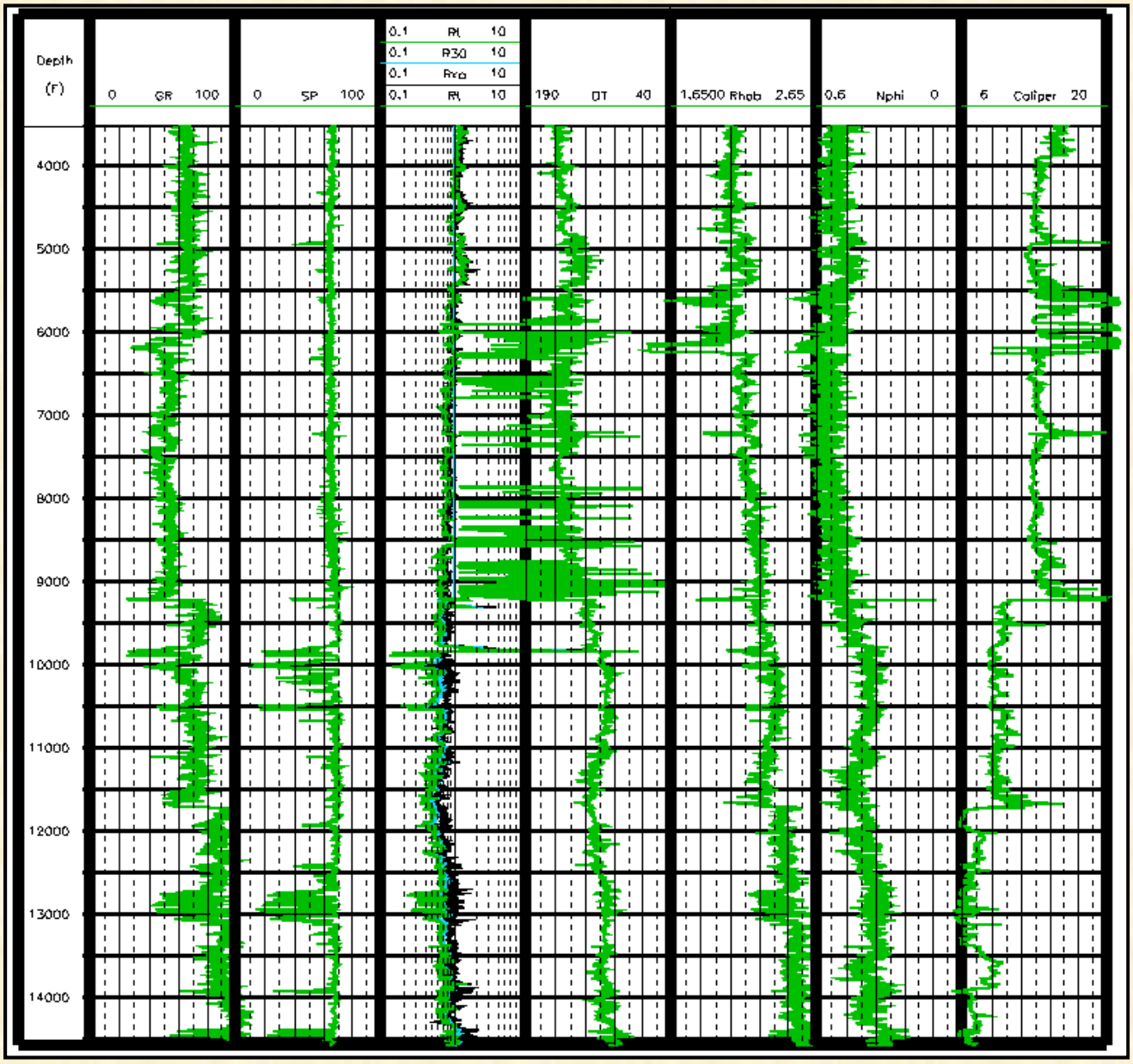


Field Overview



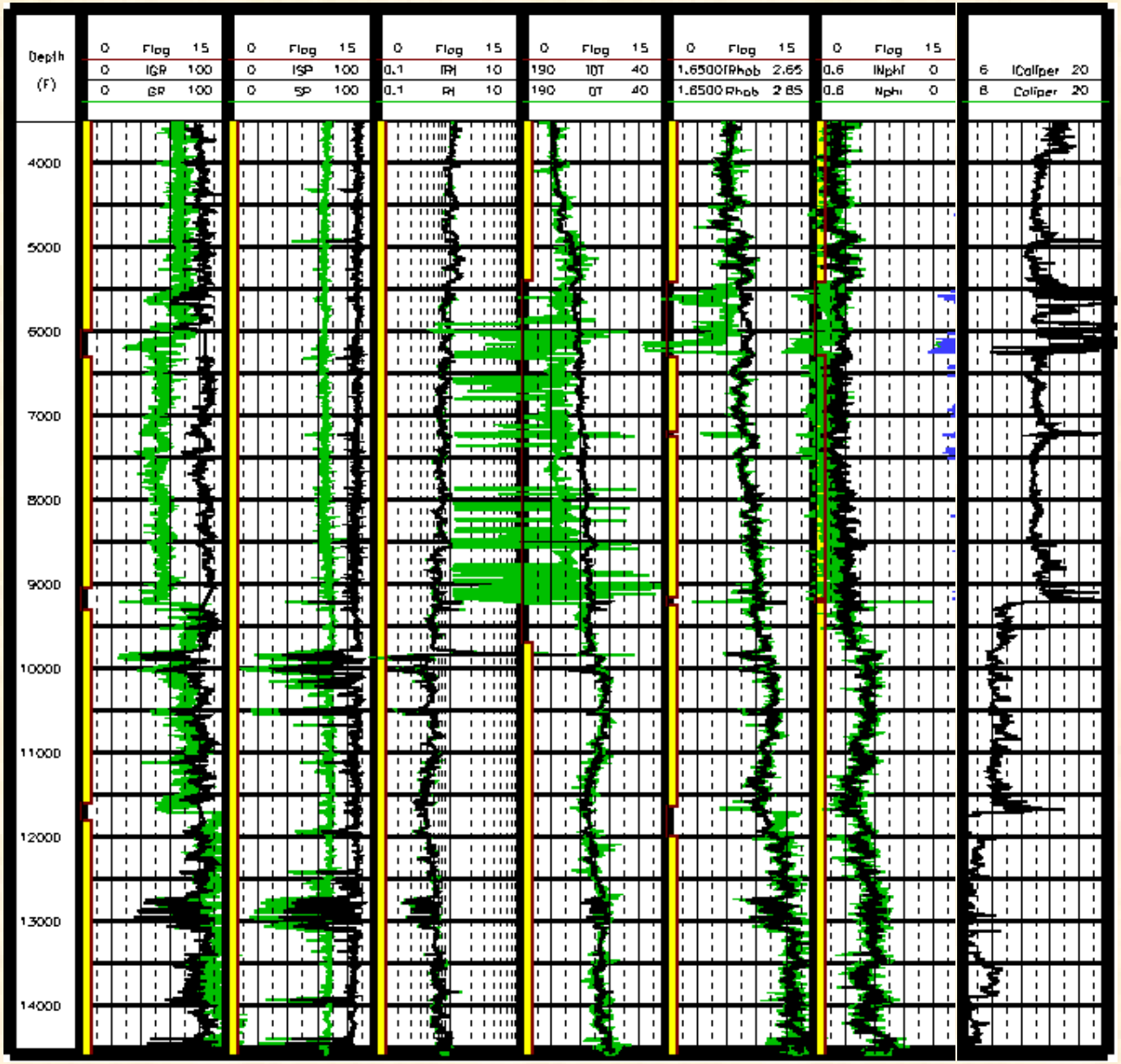
Calibration Well

Input curves – **green**



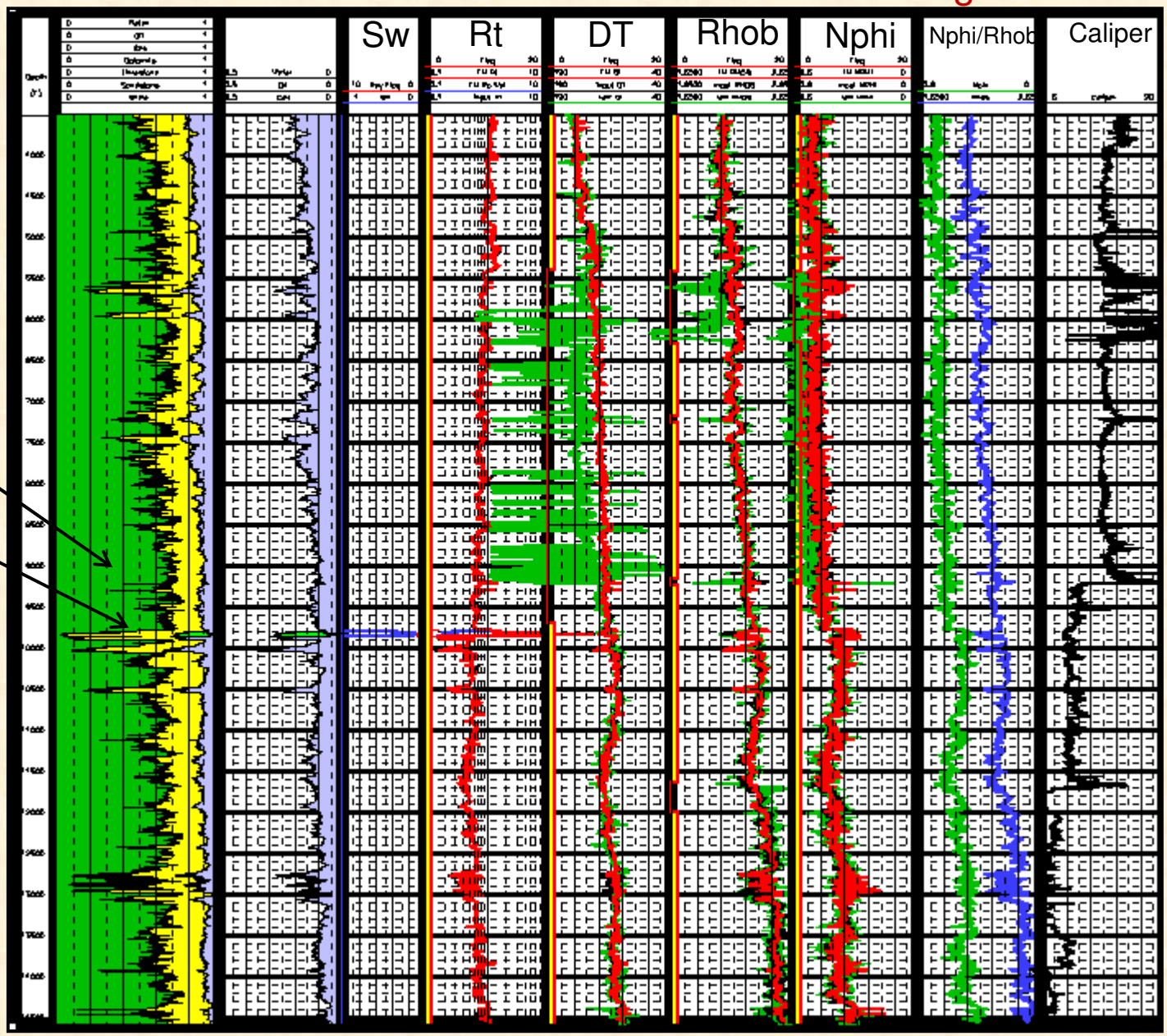
Calibration Well Pre-Processing Log Edits

Input curves – **green**
Edited curves - black

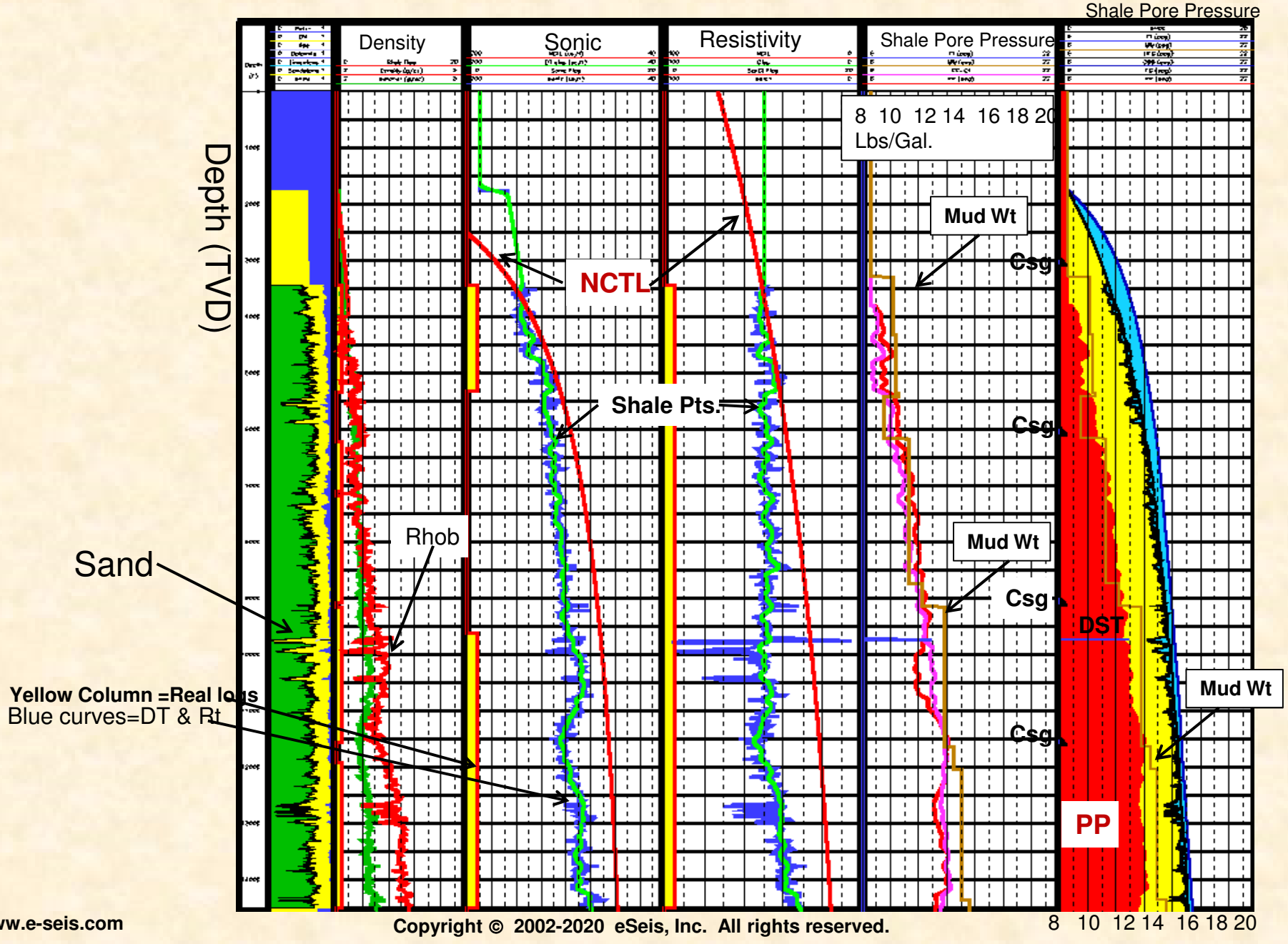


Calibration Well – Log Analysis

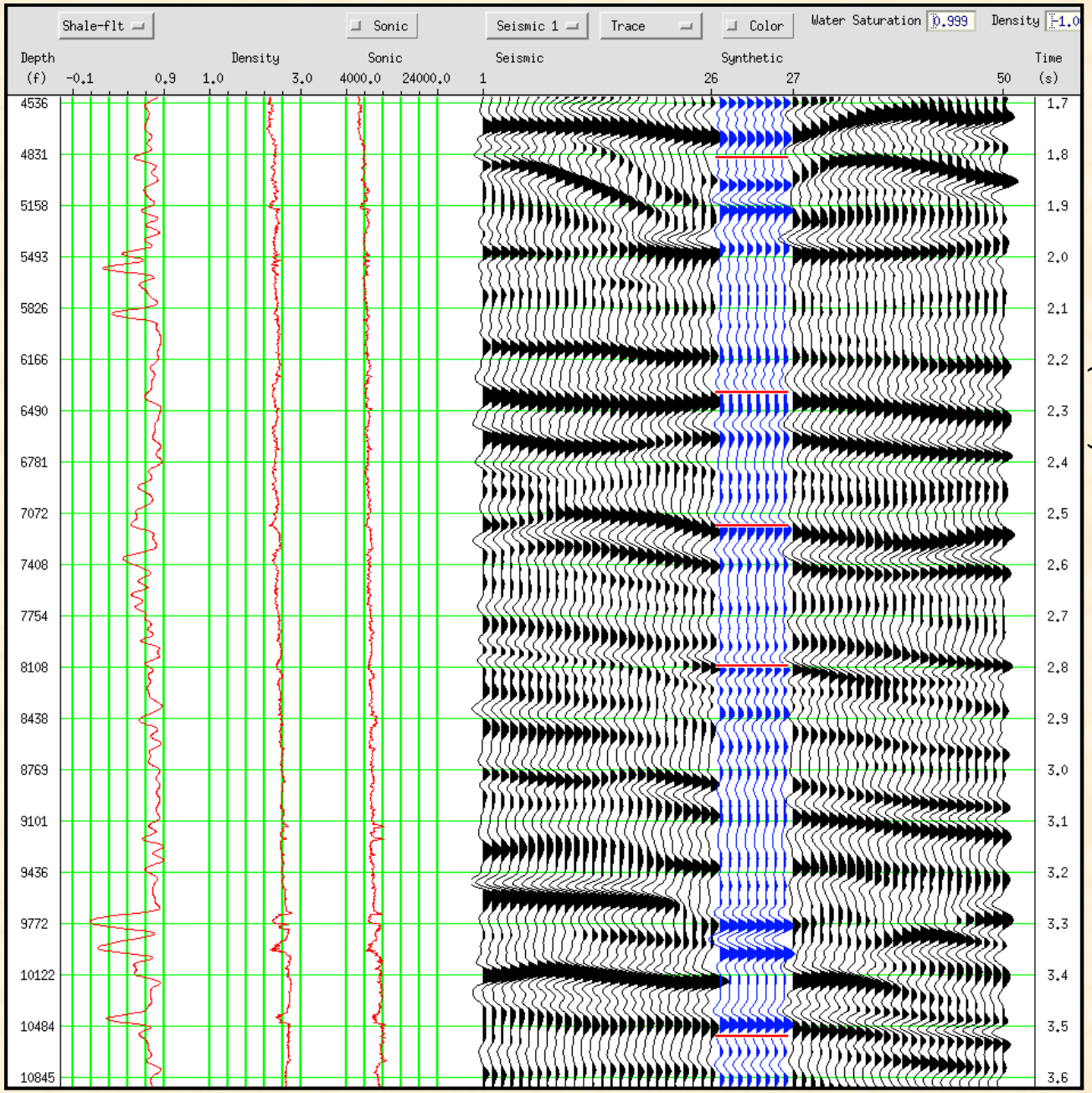
Red curves = Forward modeled logs



Calibration Well PPFG



Calibration Well: Synthetic Tie To Seismic



Depth (TVD-SS)

Time (Sec)

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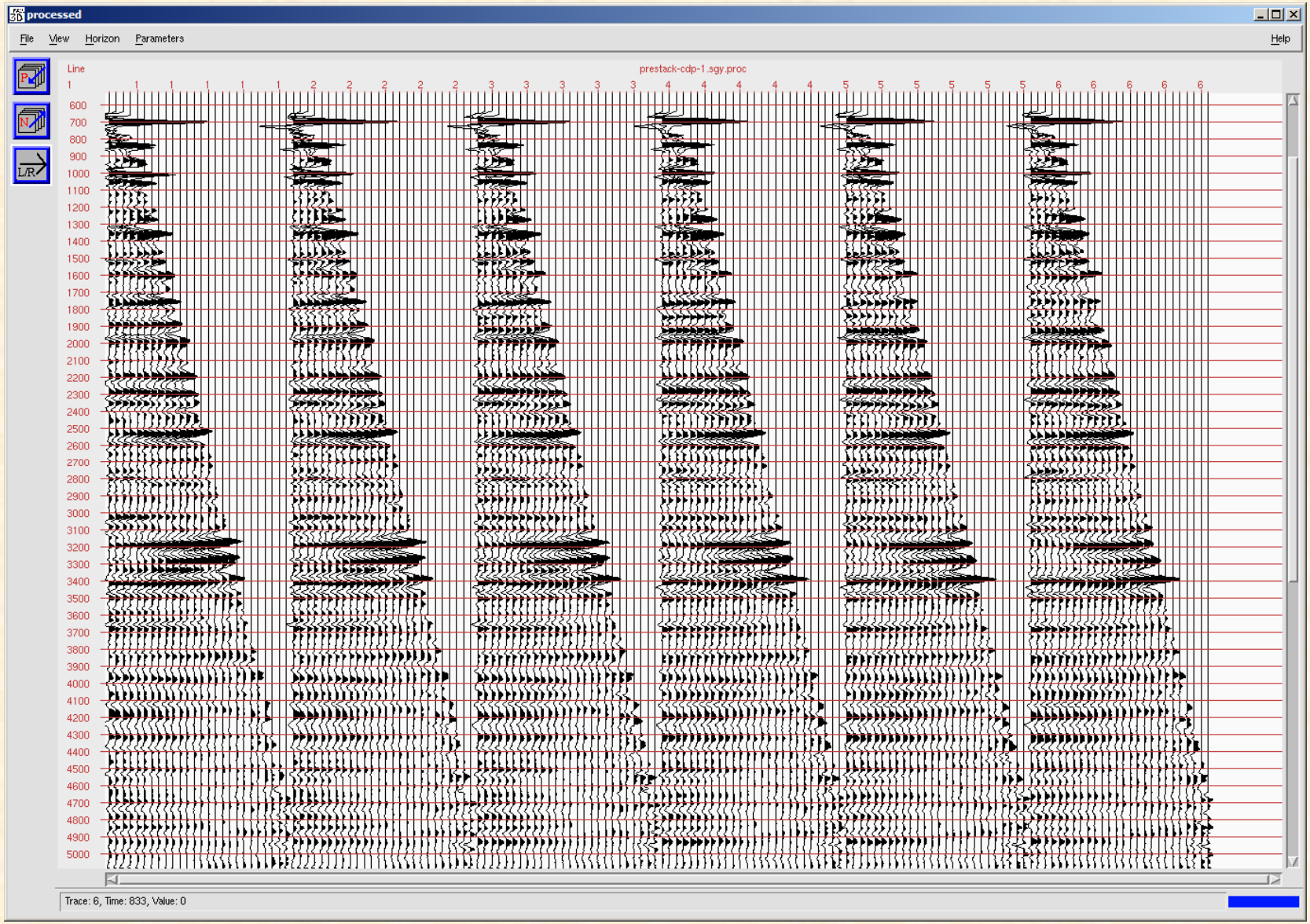
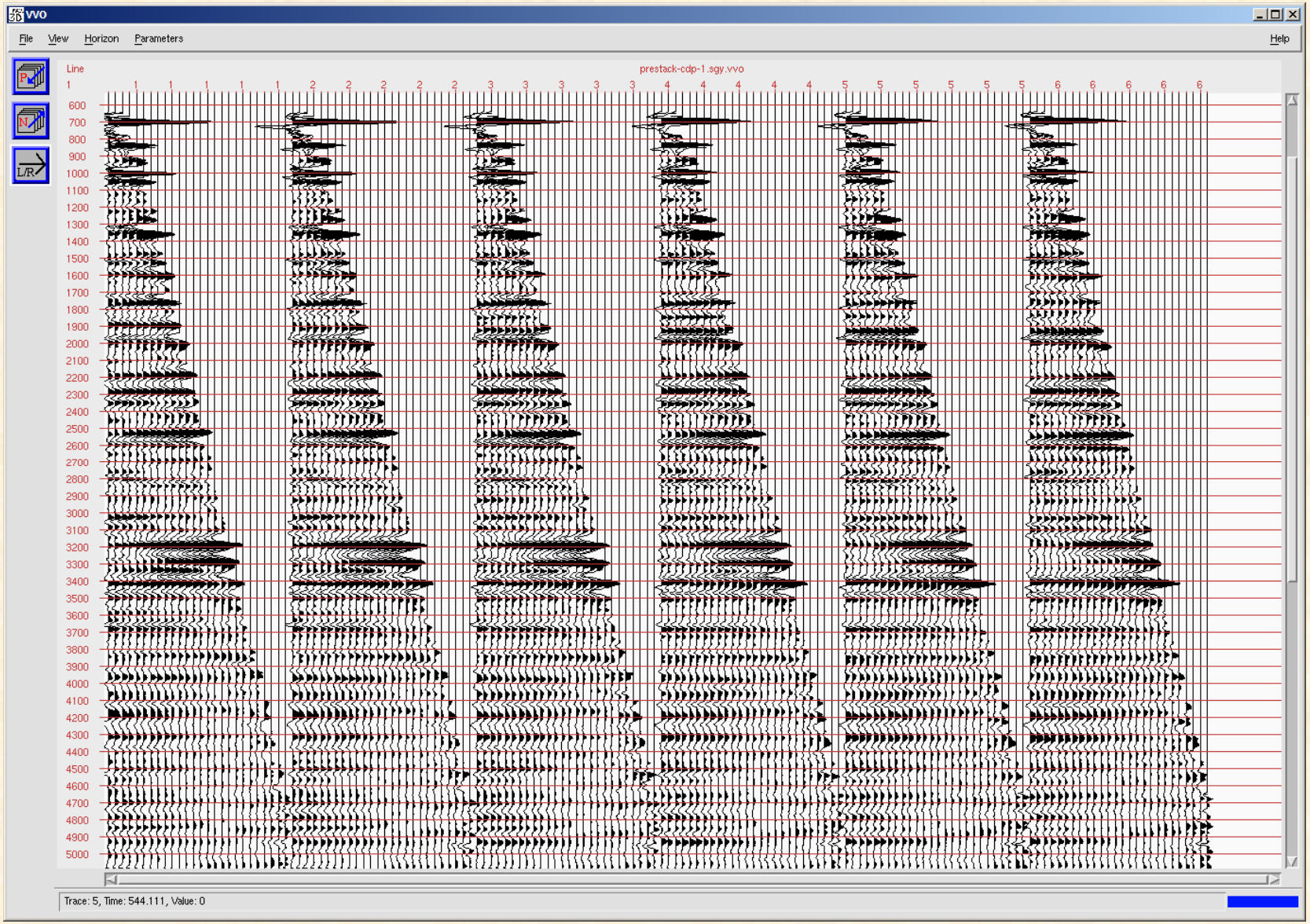
Model for RNMO

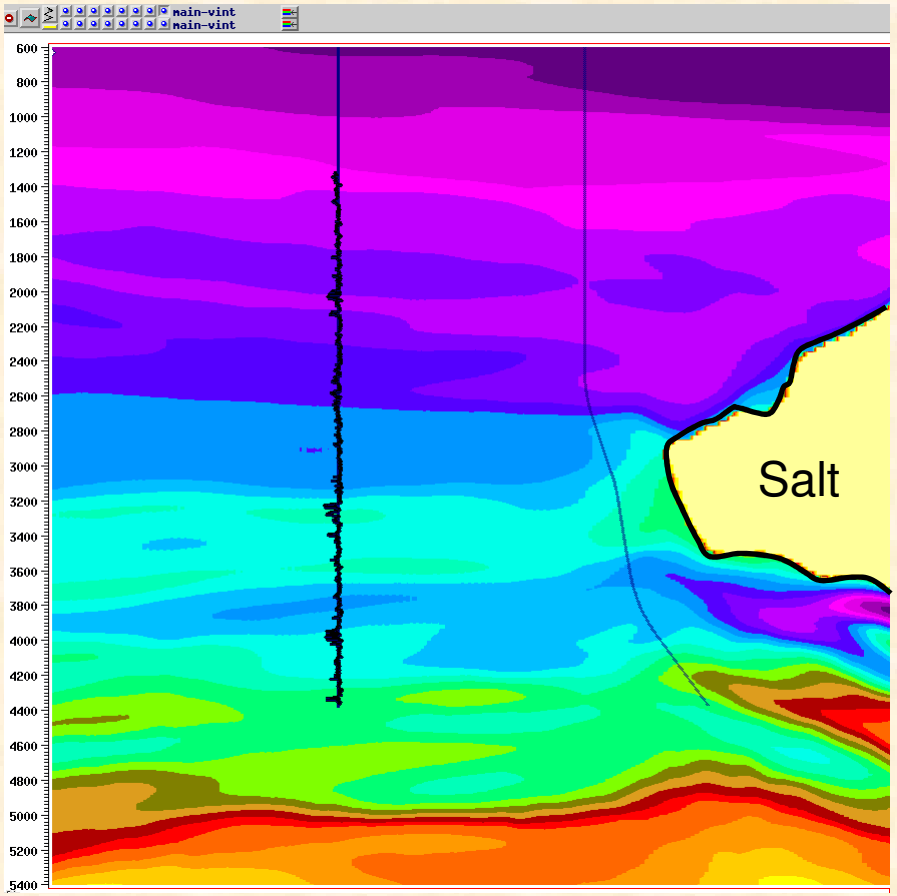


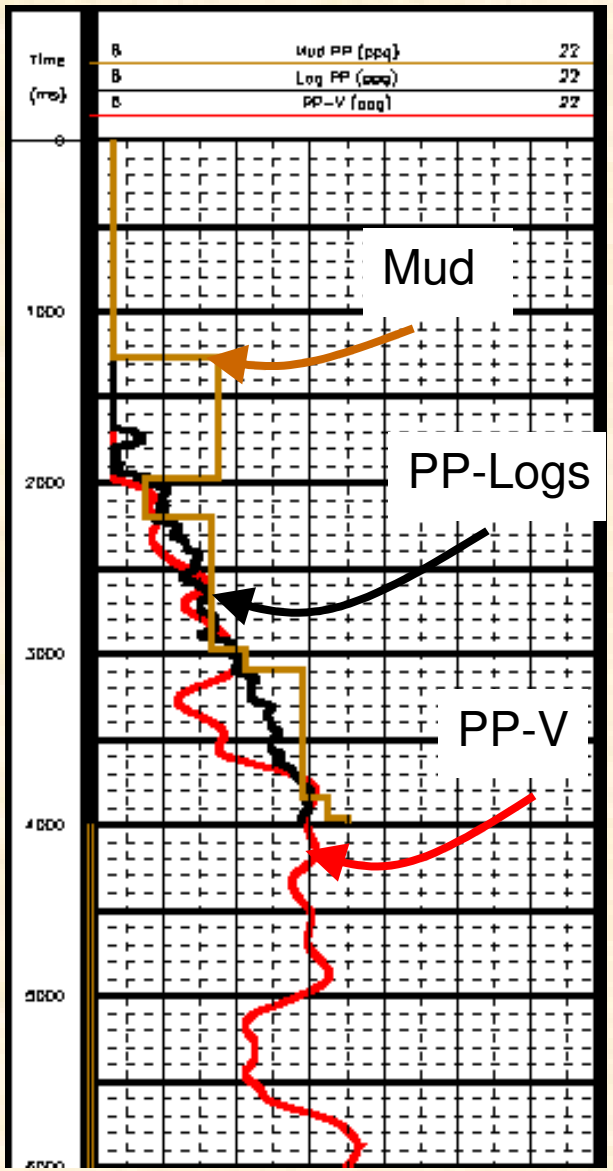
Non-Hyperbolic RNMO



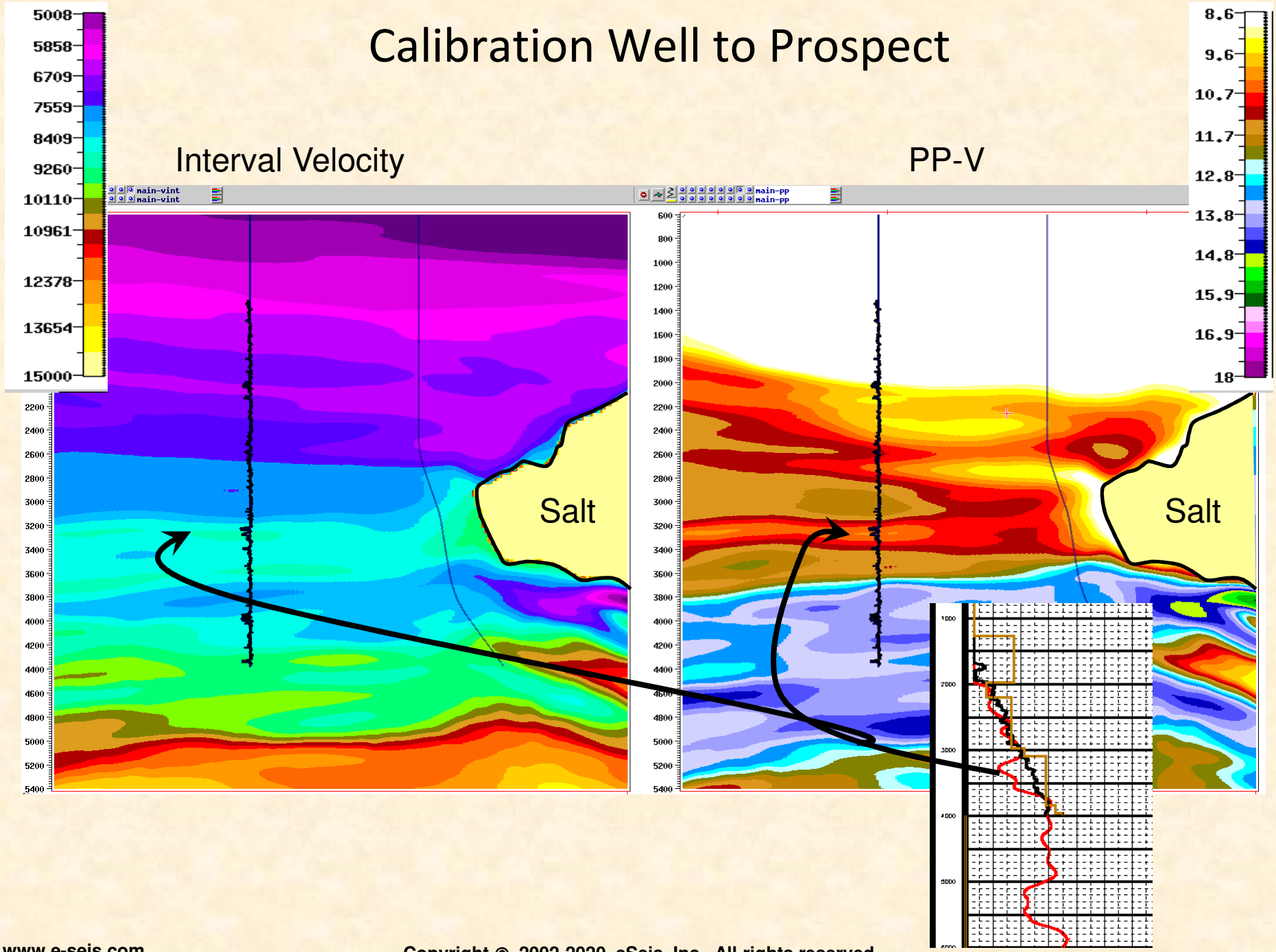
PP-V Calibration at the Calibration Well

Interval Velocity

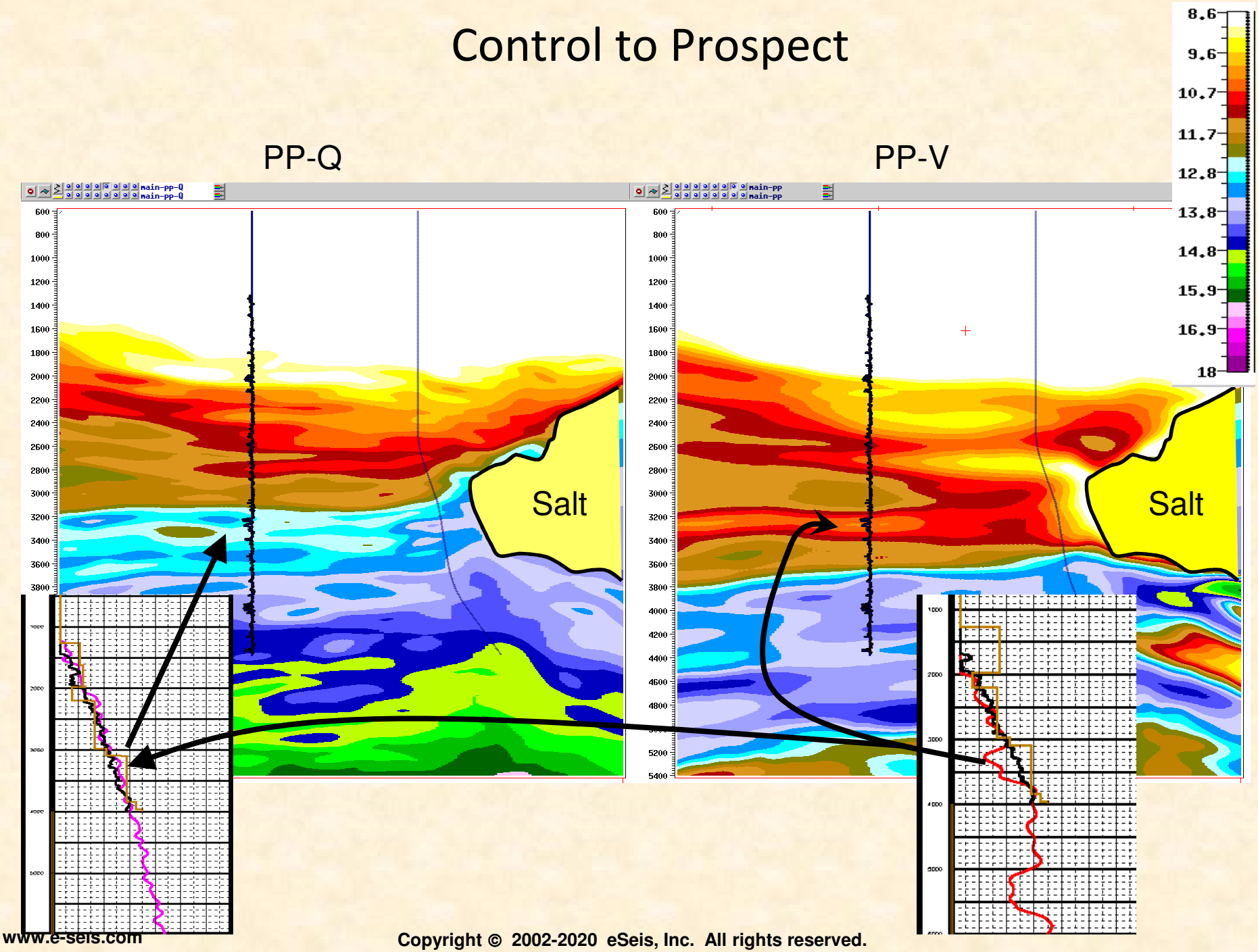




Calibration Well to Prospect

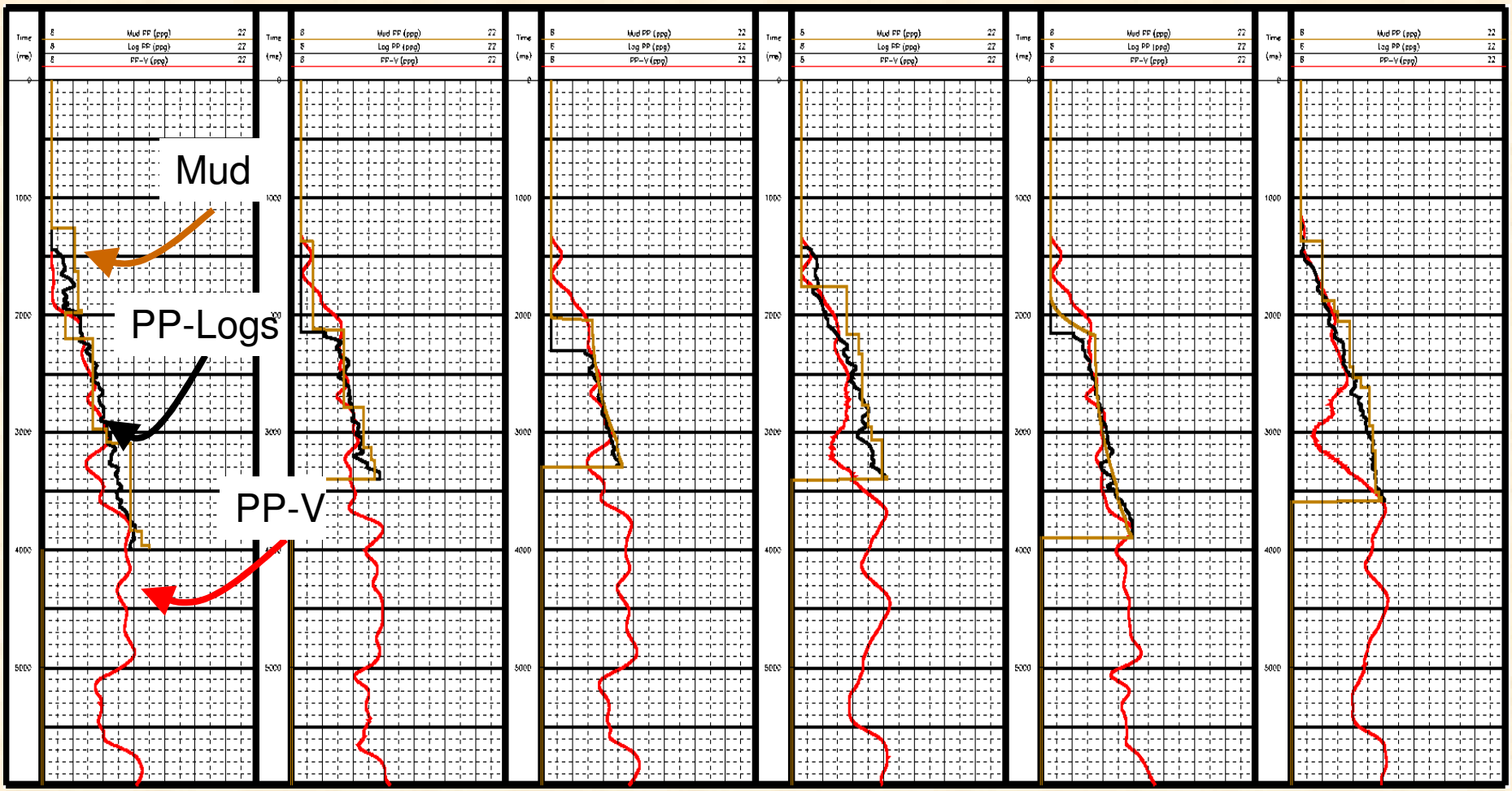


Control to Prospect



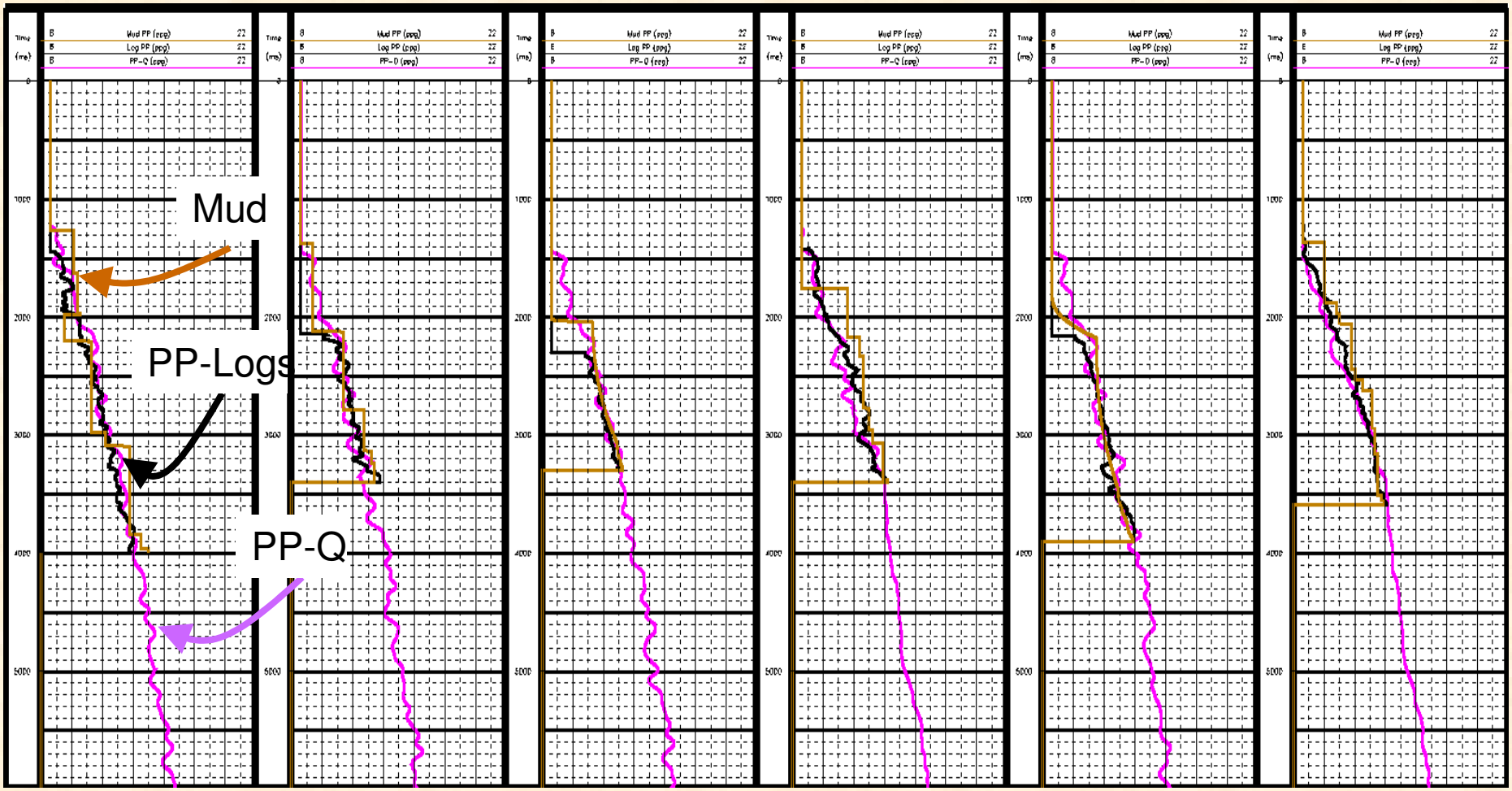
PP-V Calibration

Calibration Test Test Test Test Test



PP-Q Calibration

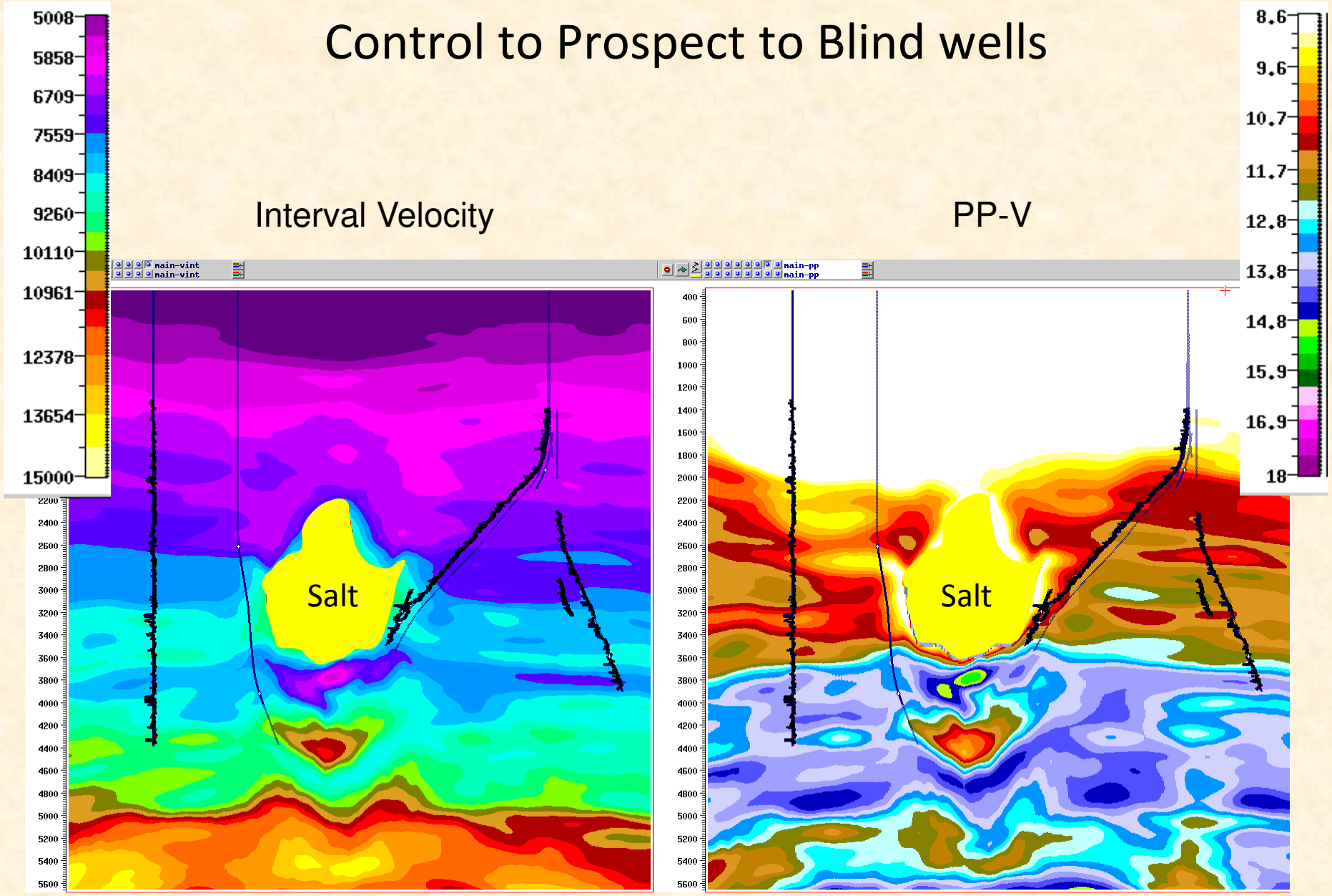
Calibration Test Test Test Test Test



Control to Prospect to Blind wells

Interval Velocity

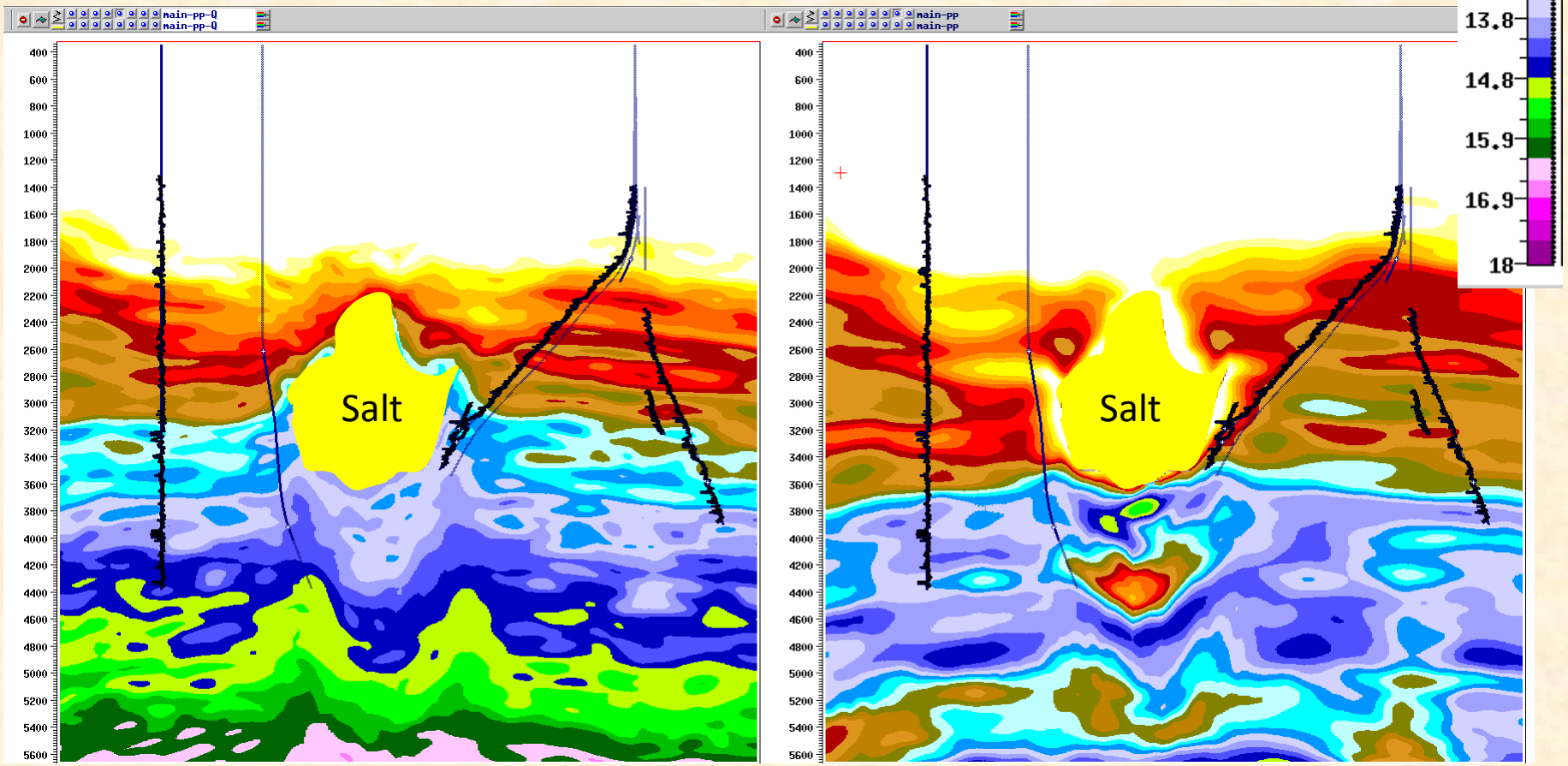
PP-V



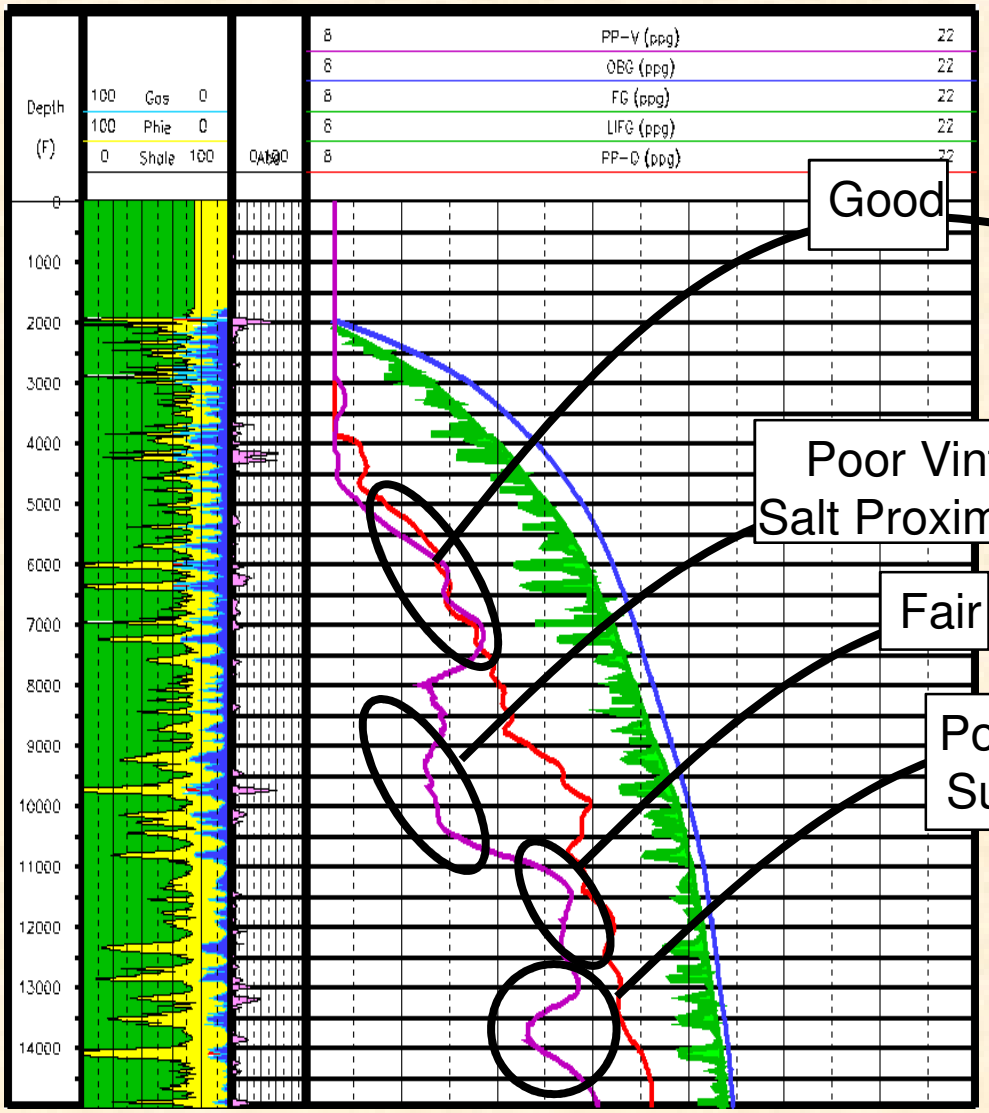
Control to Prospect to Blind wells

PP-Q

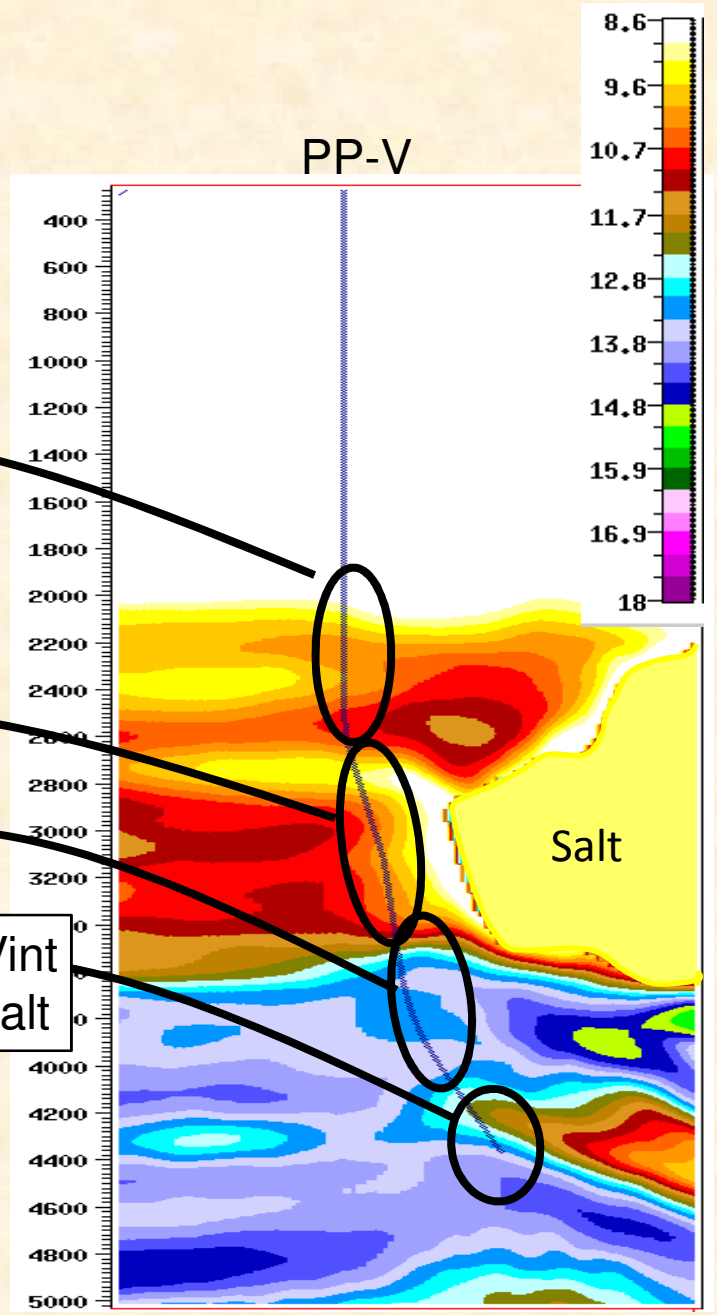
PP-V



PDML
Pre-Drill Mud Log



PP-V



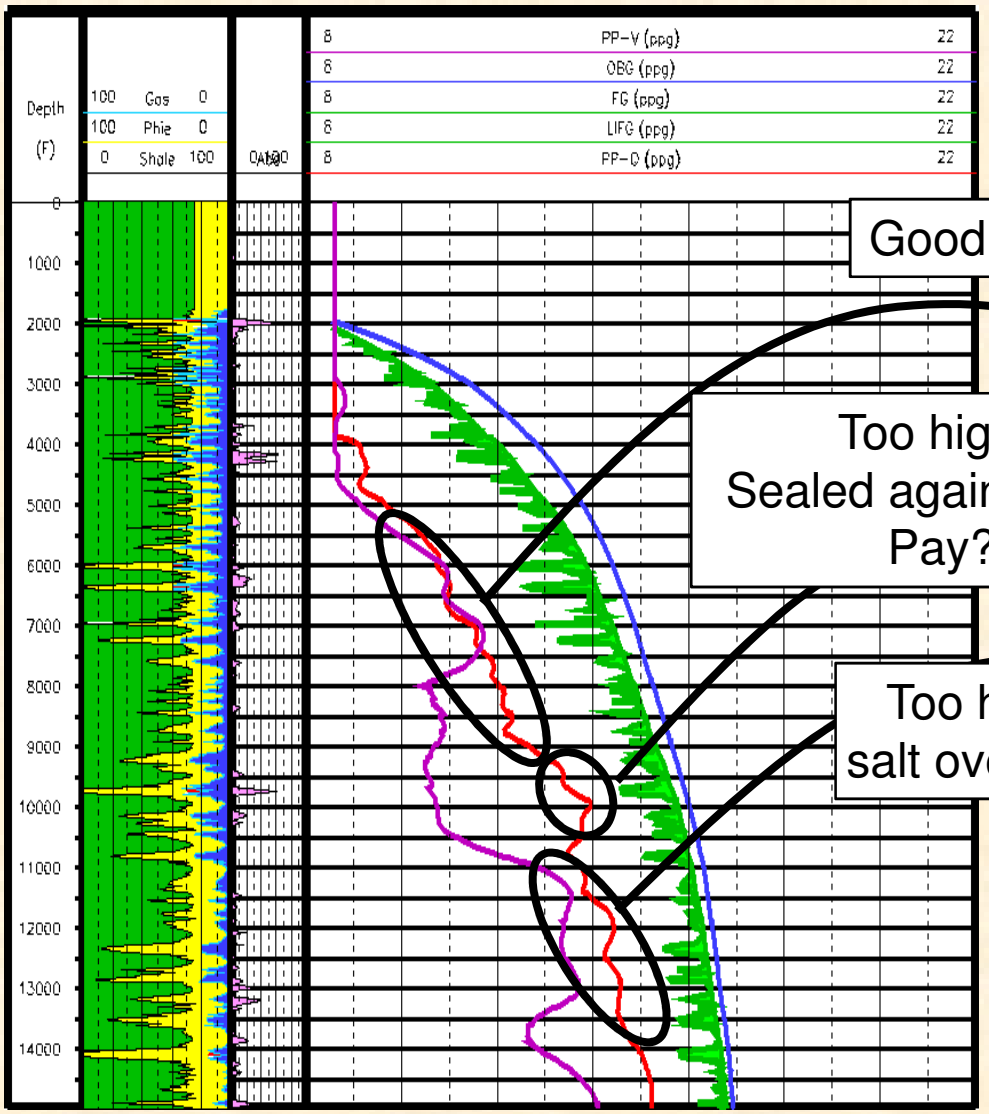
Good

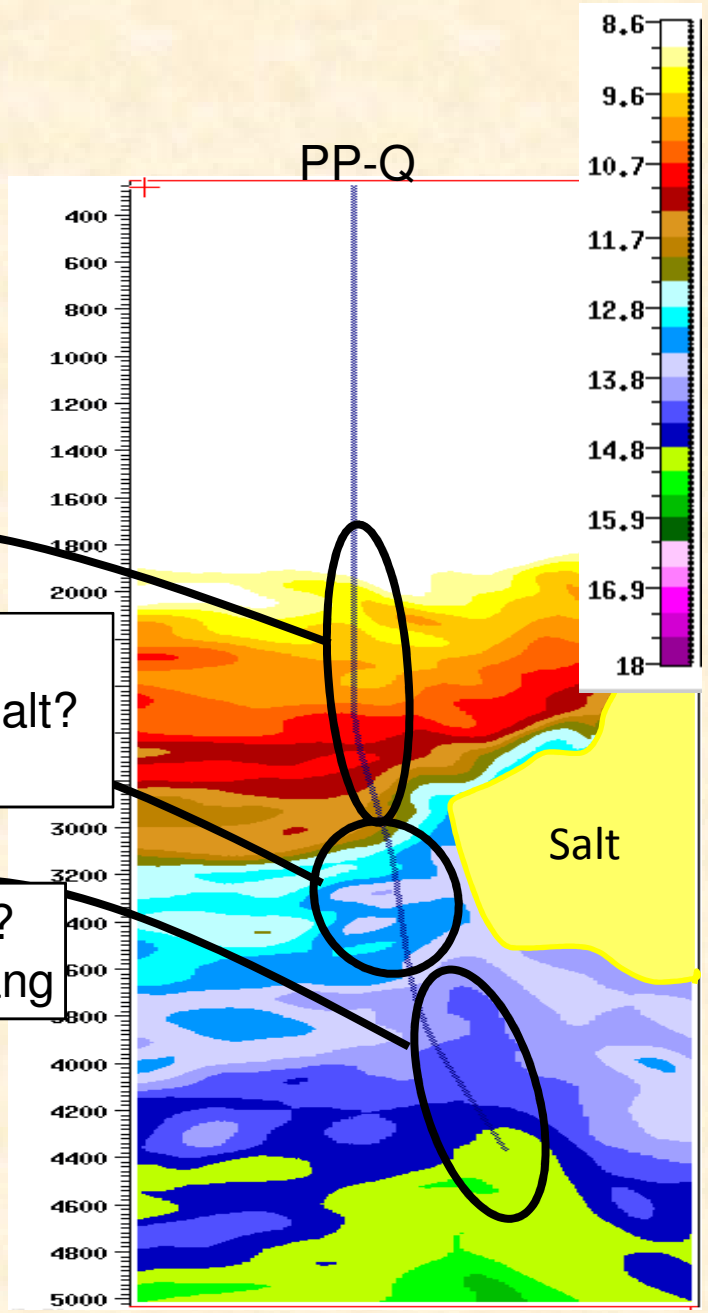
Poor Vint
Salt Proximity

Fair

Poor Vint
Sub Salt

PDML
Pre-Drill Mud Log





Good

Too high?
Sealed against salt?
Pay?

Too high?
salt overhang

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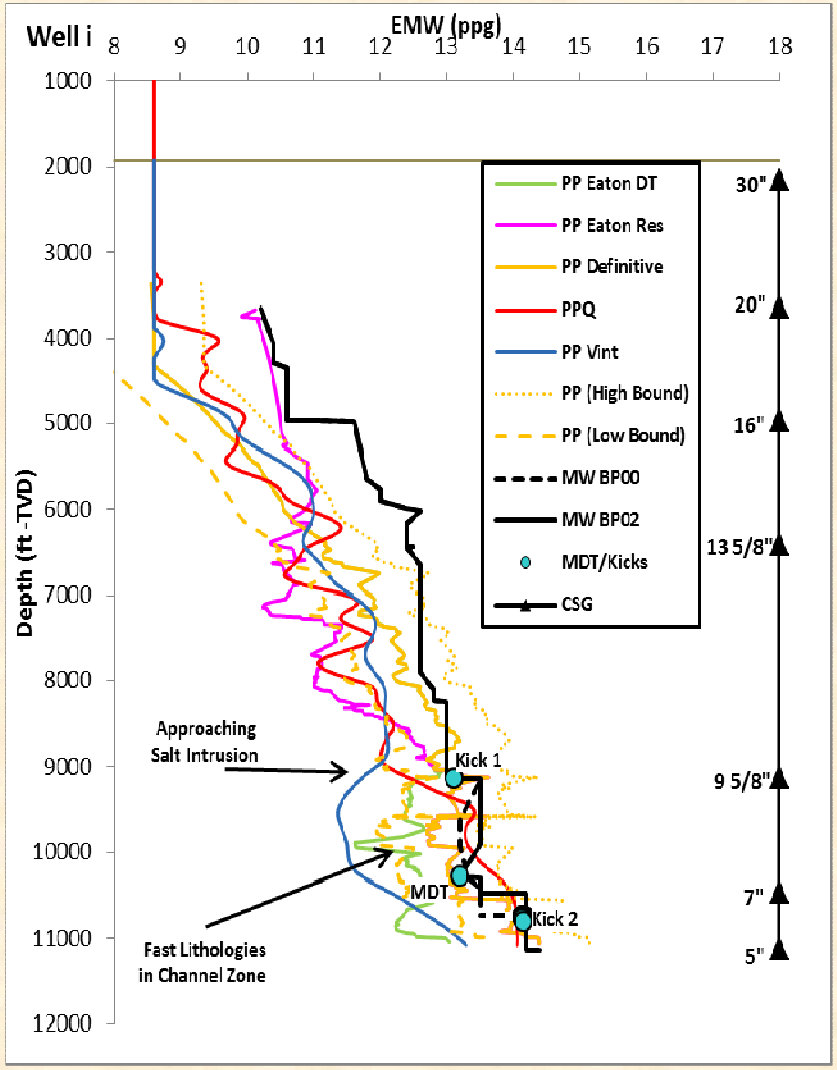
Qualitative Results

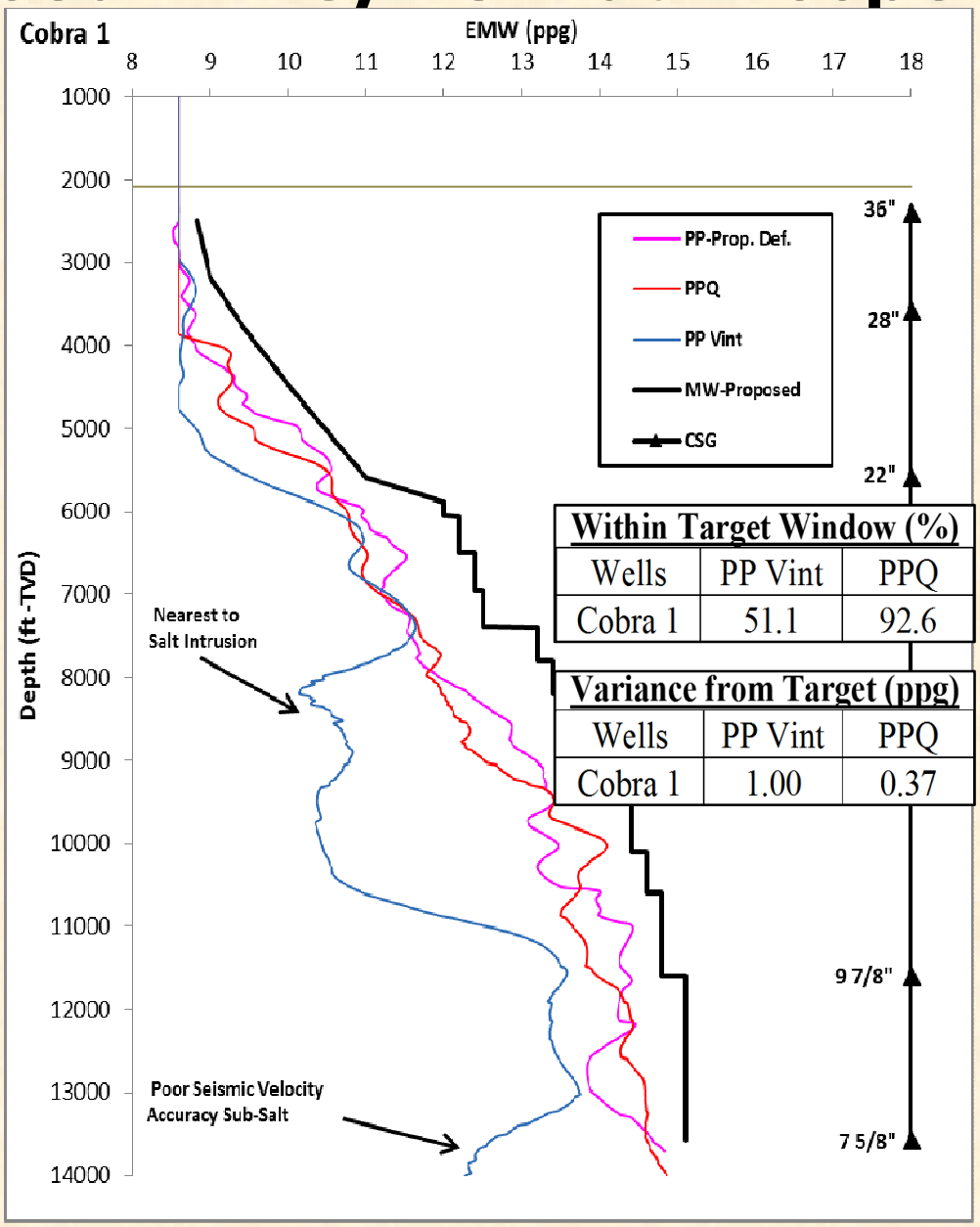
Quantitative Results – PP Accuracy Analysis

Quantify Accuracy

- Percent Within Definitive PP Boundaries
- Average Deviation from Definitive PP



Proposed PPFG/BOD at Prospect Well



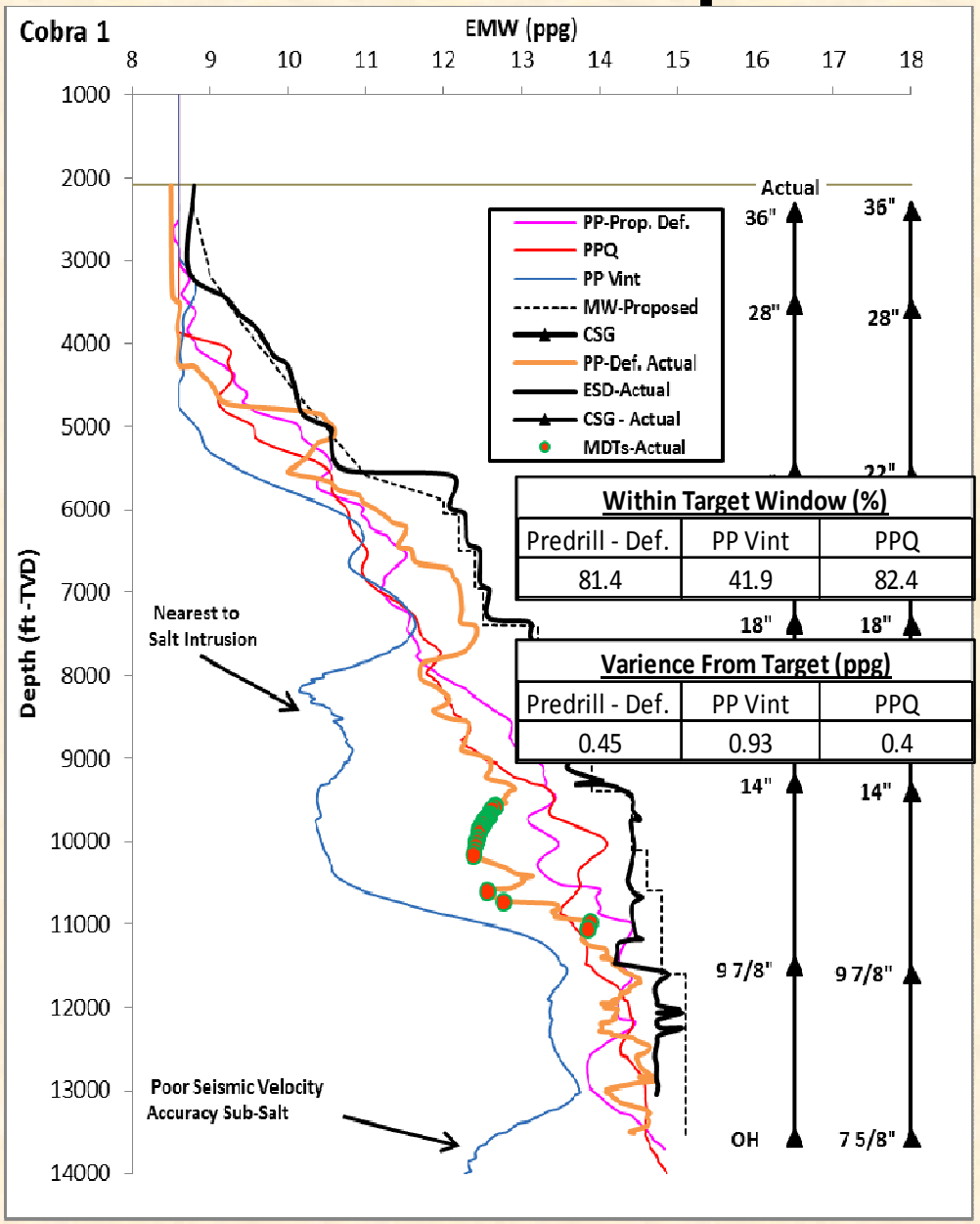
Within Target Window (%)

Wells	PP Vint	PPQ
Cobra 1	51.1	92.6

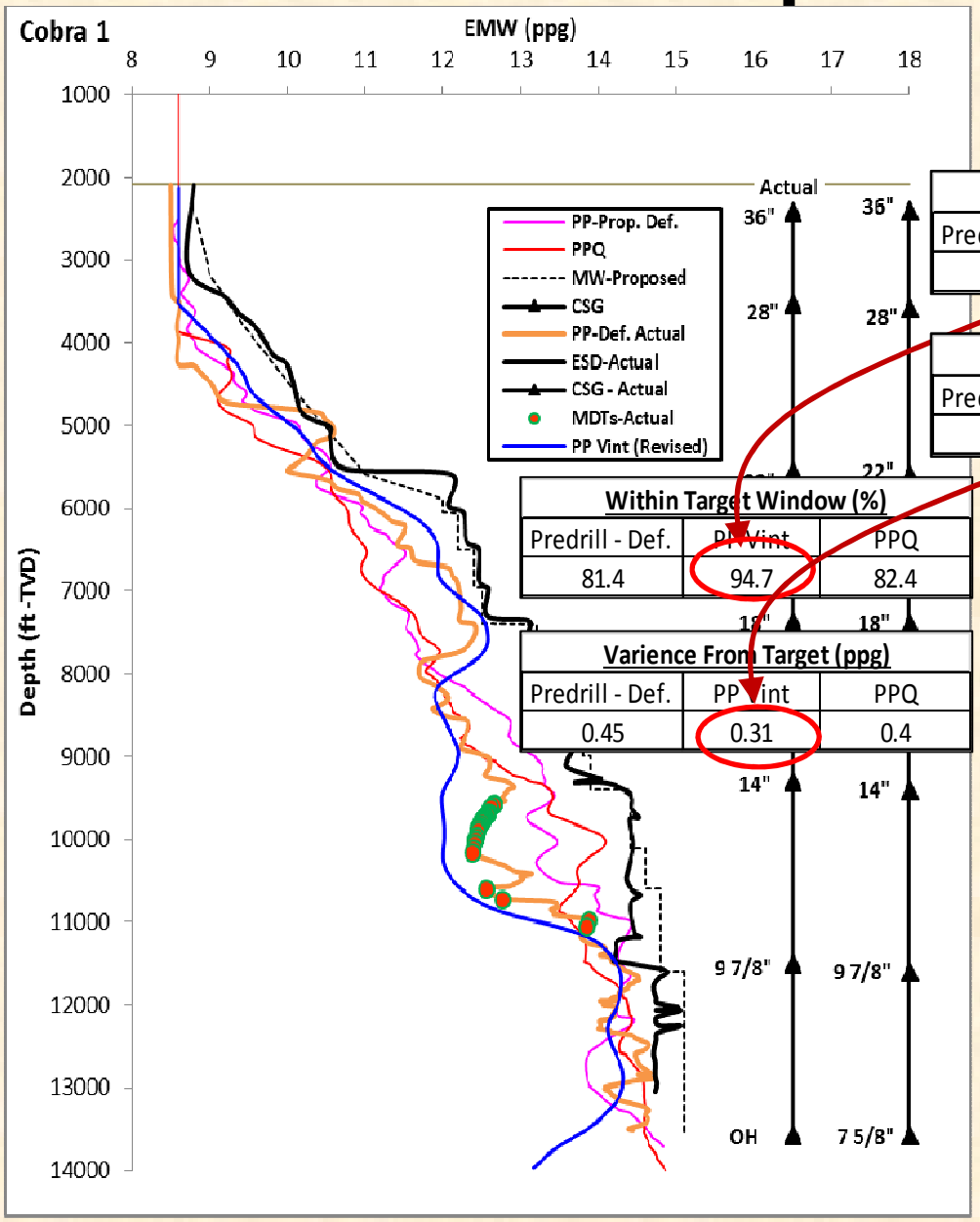
Variance from Target (ppg)

Wells	PP Vint	PPQ
Cobra 1	1.00	0.37

Actual PPFG at Prospect Well



Re-calibrated PP at Prospect Well



Conclusion

Using Multiple Pore Pressure Prediction Techniques provides a way to mitigate risk.