



# **Sunrise-Troubadour PROMISE results**

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# Petrophysical trends

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**clean wet sand:**

$$vp(\text{in m/s}) = 4039 \pm 230$$

$$vs(\text{in m/s}) = 0.595 * vp + 9 \pm 122$$

$$\text{porosity} = -9.22e-5 * vp + 0.545 \pm 0.02$$

**mudrock:**

$$vp = 3886 \pm 230$$

$$vs = 0.589 * vp + 4 \pm 85$$

$$\text{density}(\text{in gm/cc}) = 0.1643 * vp^{0.3344} \pm 0.057$$

**gas:**

$$vp = 488 \text{ m/s}$$

$$\text{density} = 0.173 \text{ gm/cc}$$

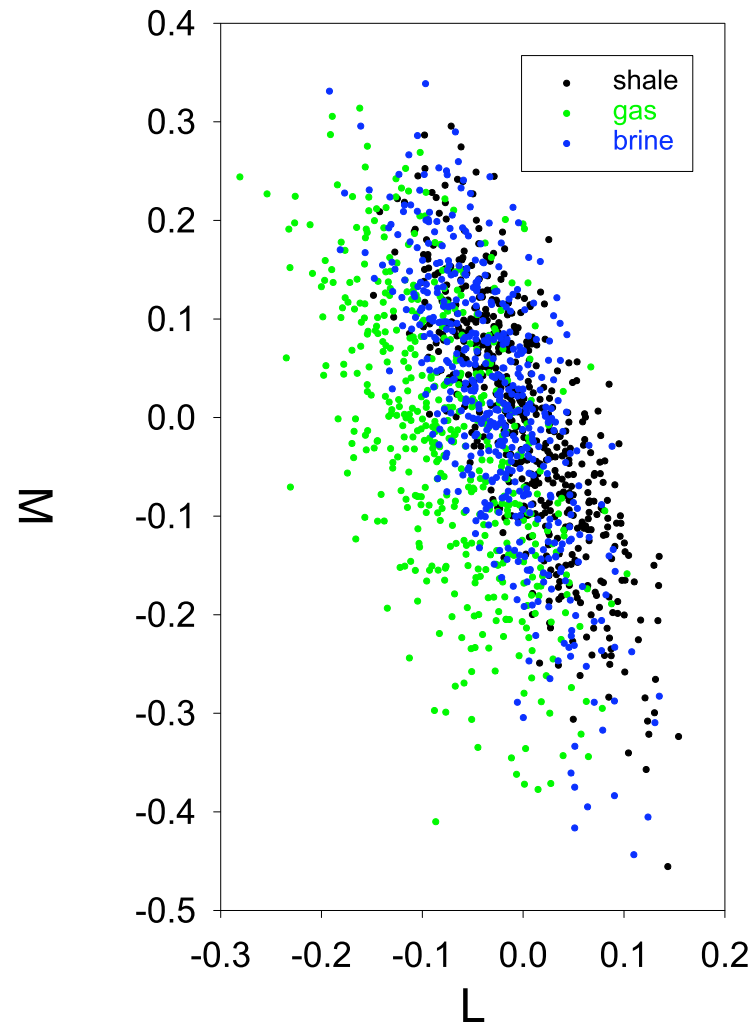
$$\text{saturation} = 80\%$$

**brine:**

$$vp = 1615 \text{ m/s}$$

$$\text{density} = 1.0 \text{ gm/cc}$$

# View of trends in L-M space



# Details of the inversion

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**DepSim model constructed from:**

**1 interpreted horizon**

**6 wells (thickness, N/G, vp, vs, density & saturations)**

**9 layers**

**constrained time horizon: top Radiolarite (2 ms)**

**all thicknesses constrained with a standard deviation of 3 m**

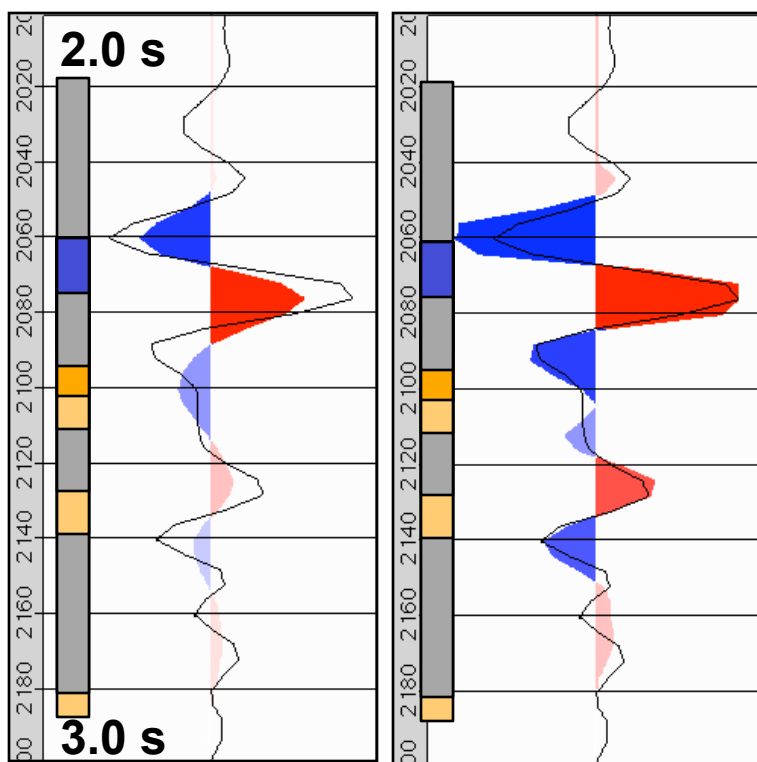
**N/G from krieged well values; standard deviation of 0.2**

**prior pay probability = krieged well values of gas  
saturation**

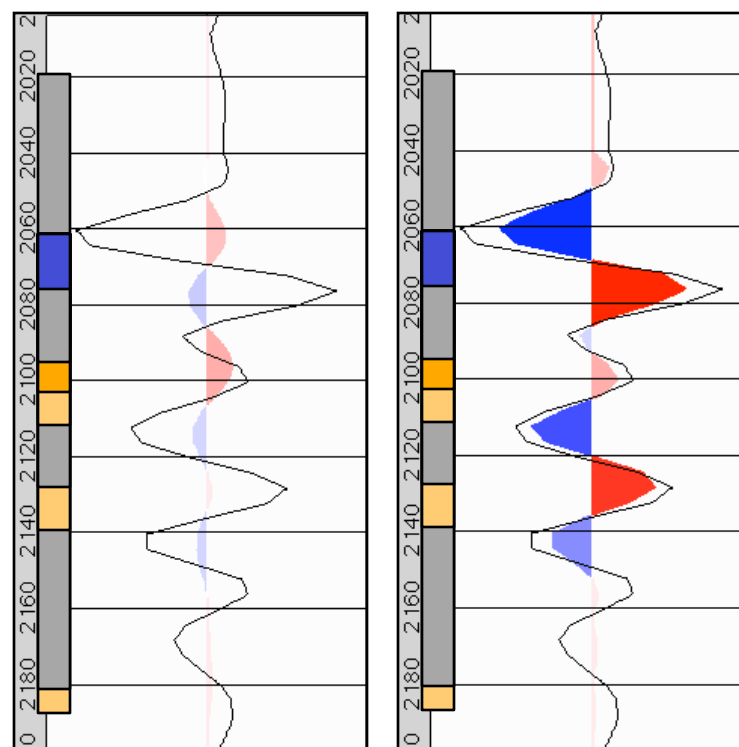
# PROMISE inversion at a well (ss1)



near stack  
before inversion    near stack  
after inversion



far stack  
before inversion    far stack  
after inversion



time (ms)



# Multiple stack inversion improves determination of pay probability

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|             | upper<br>Plover | main<br>Plover | lower<br>Plover |
|-------------|-----------------|----------------|-----------------|
| ss1 actual  | 1.00            | 1.00           | 1.00            |
| ss1 w/AVO   | 0.29            | 0.99           | 0.99            |
| ss1 wo/AVO  | 0.36            | 0.74           | 0.86            |
| ss1 prior   | 0.41            | 0.54           | 0.64            |
| ssw1 actual | 1.00            | 1.00           | 0.000           |
| ssw1 w/AVO  | 0.61            | 0.49           | 0.000           |
| ssw1 wo/AVO | 0.42            | 0.37           | 0.000           |
| ssw1 prior  | 0.52            | 0.50           | 0.003           |

# Multiple stack inversion improves estimate of N/G in high N/G layers



|             | upper<br>Plover | main<br>Plover  | lower<br>Plover |
|-------------|-----------------|-----------------|-----------------|
| ss1 actual  | 0.30            | 0.80            | 0.90            |
| ss1 w/AVO   | $0.28 \pm 0.16$ | $0.77 \pm 0.15$ | $0.86 \pm 0.14$ |
| ss1 wo/AVO  | $0.30 \pm 0.19$ | $0.66 \pm 0.19$ | $0.80 \pm 0.15$ |
| ss1 prior   | $0.31 \pm 0.19$ | $0.64 \pm 0.19$ | $0.78 \pm 0.17$ |
| ssw1 actual | 0.50            | 0.50            | 0.70            |
| ssw1 w/AVO  | $0.59 \pm 0.19$ | $0.49 \pm 0.20$ | $0.52 \pm 0.20$ |
| ssw1 wo/AVO | $0.58 \pm 0.19$ | $0.48 \pm 0.20$ | $0.55 \pm 0.19$ |
| ssw1 prior  | $0.53 \pm 0.20$ | $0.46 \pm 0.21$ | $0.58 \pm 0.20$ |



# Multiple stack inversion improves estimate of net pay



| Plover (m)  |               |
|-------------|---------------|
| ss1 actual  | 5.0           |
| ss1 w/AVO   | $4.0 \pm 0.8$ |
| ss1 wo/AVO  | $3.2 \pm 1.2$ |
| ss1 prior   | $2.5 \pm 1.5$ |
| ssw1 actual | 2.5           |
| ssw1 w/AVO  | $1.5 \pm 1.2$ |
| ssw1 wo/AVO | $1.2 \pm 0.9$ |
| ssw1 prior  | $0.9 \pm 0.9$ |

**net pay = thickness \* N/G \* porosity \* pay probability**

# Conclusions

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- **estimation of saturation was significantly improved by the inversion**
- **there was a 20% decrease in the standard deviation of N/G in high N/G areas**
- **there was a 10-20% decrease in the standard deviation of porosity**
- **the standard deviation of two-way travel times were decreased by up to a factor of 4 to less than 1 ms when the initial model was good; in some places the model was not within the stated error in thickness - leading to no decrease in the standard deviation (ss1 has good model, ssw1 does not)**
- **there was a 20% decrease in the standard deviation of thickness**
- **the distribution of net pay was significantly improved !!!**

# Some additional cross plots of the SDDI lithotype parameters

