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Staked Pay Pad Development in the Midland Basin

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Technology Integration Engineer

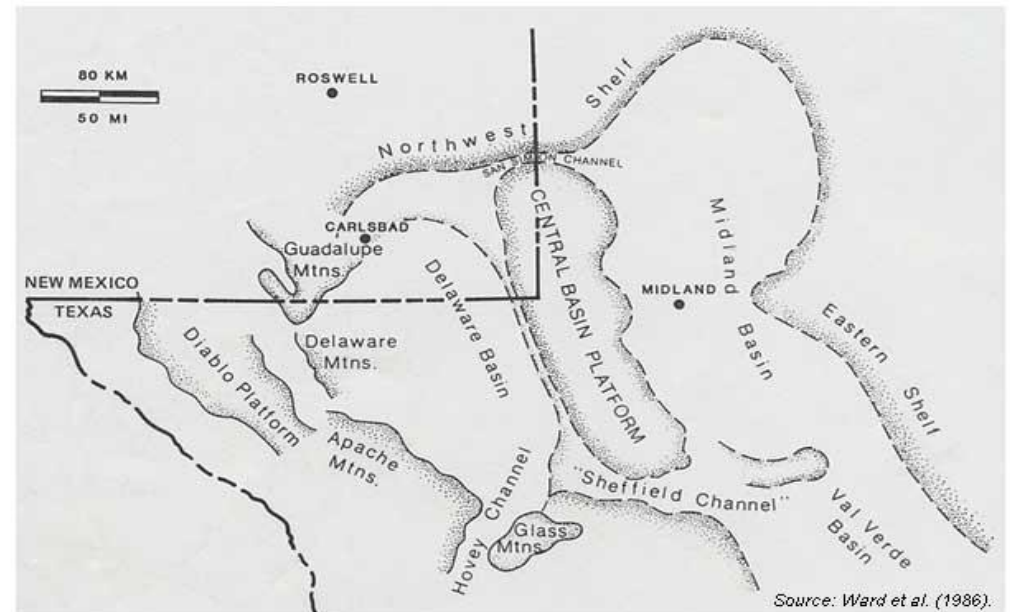
Schlumberger

Co-authors: R. Malpani, R. Jose, E. Haddad,
E. Velez, L. Smith, S. Lati

Outline

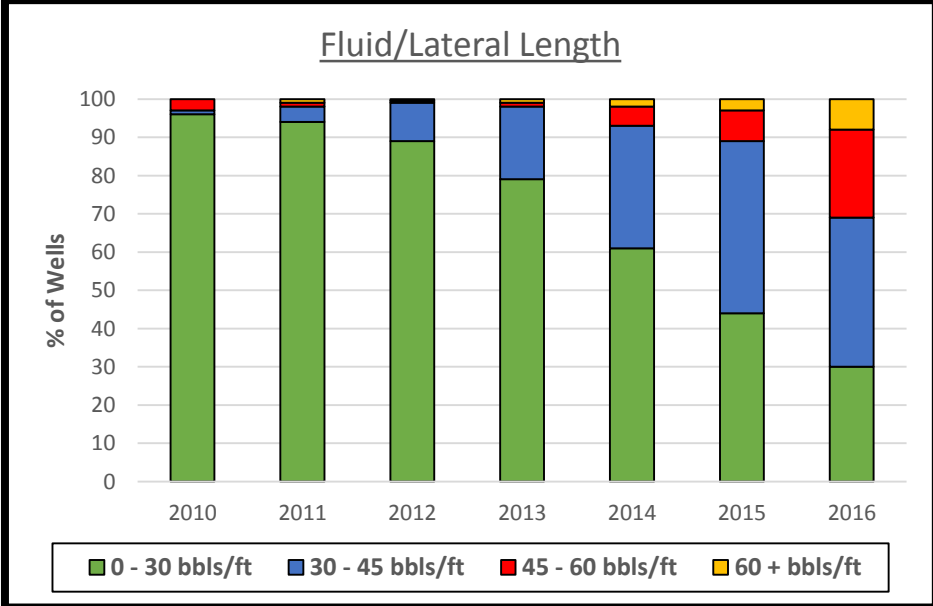
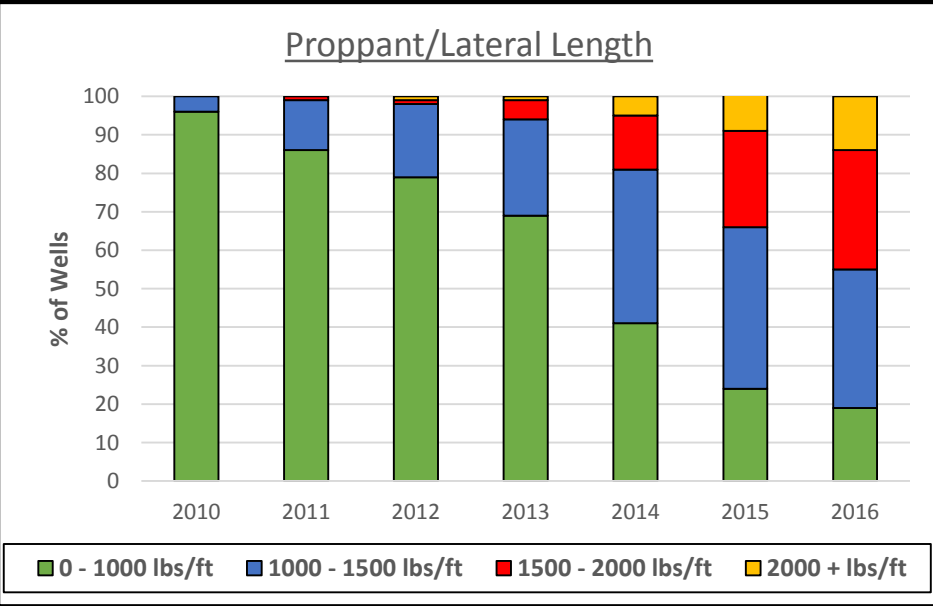
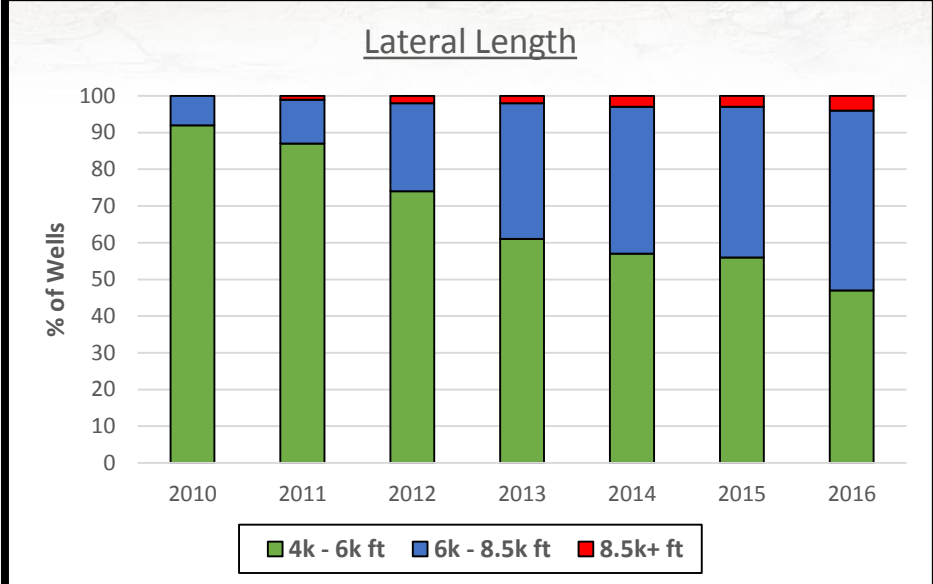
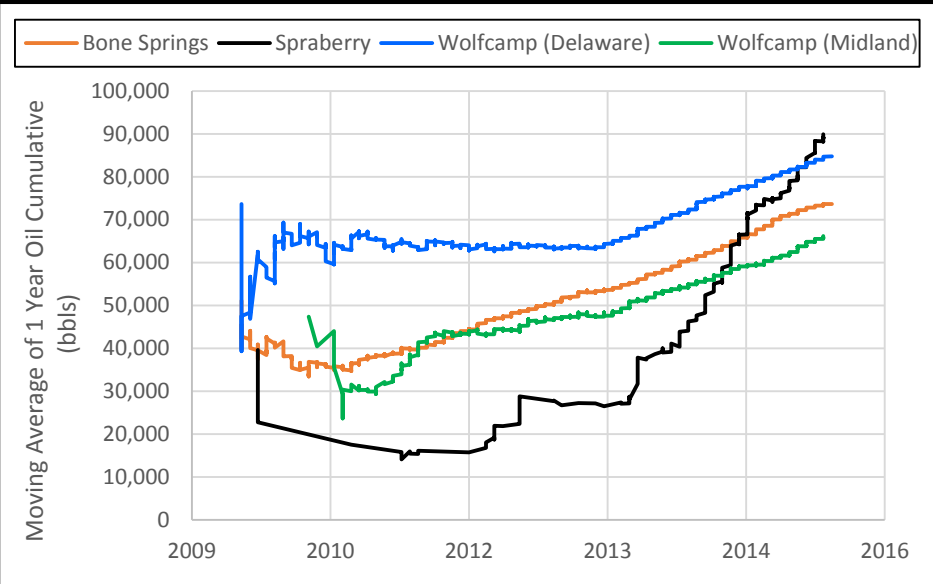
- Permian Basin Introduction
- Workflow for Developing the Stacked Pay
- Well Stacking
- Well Spacing
- Conclusion
- Way Forward

Permian Basin of West Texas and New Mexico during late Permian

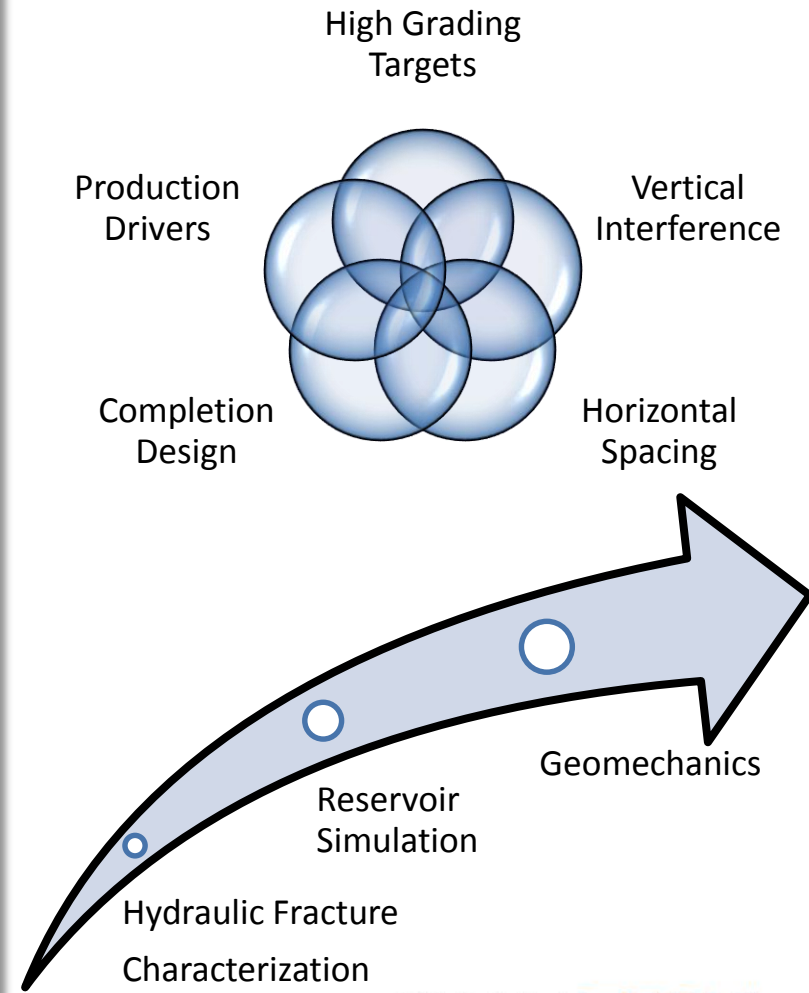
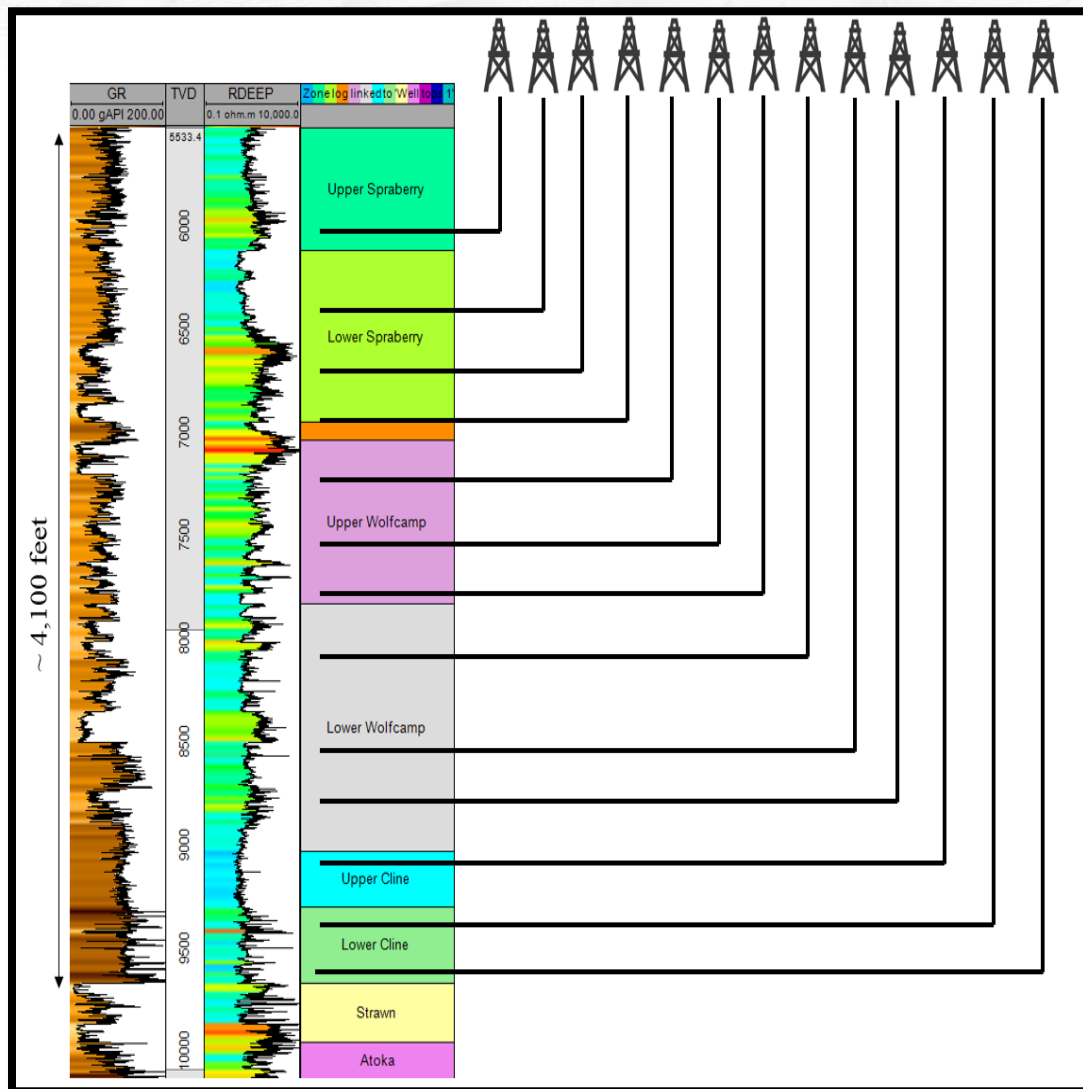


Permian Basin Trends

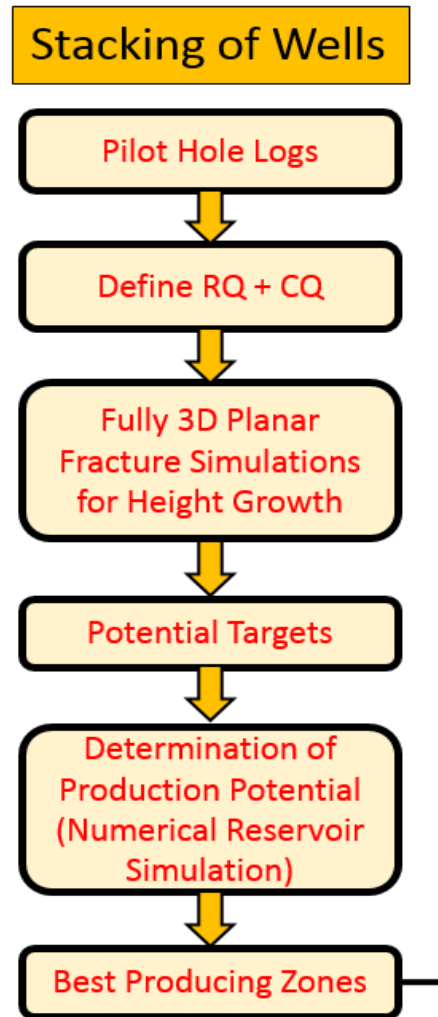
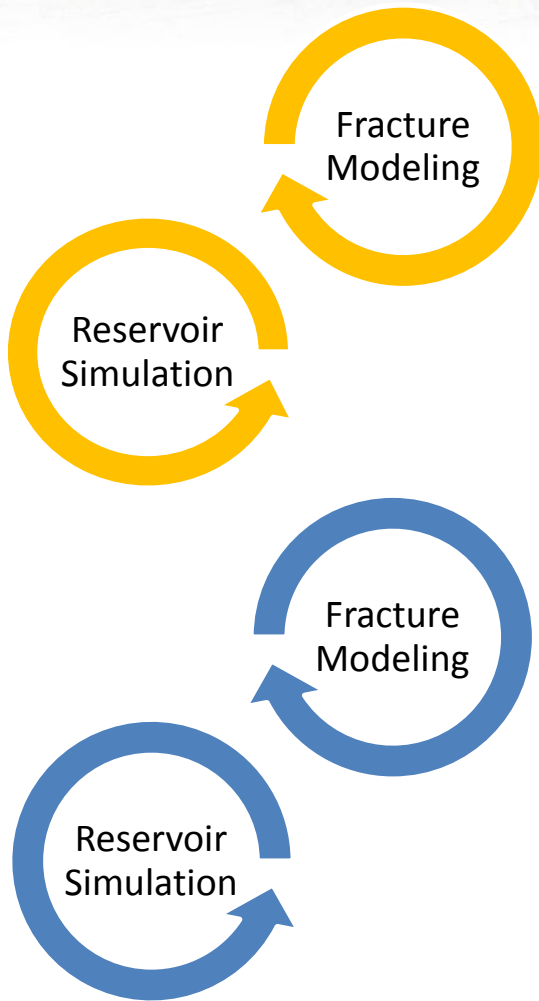
(Data provided by IHS)



Stacked Pay

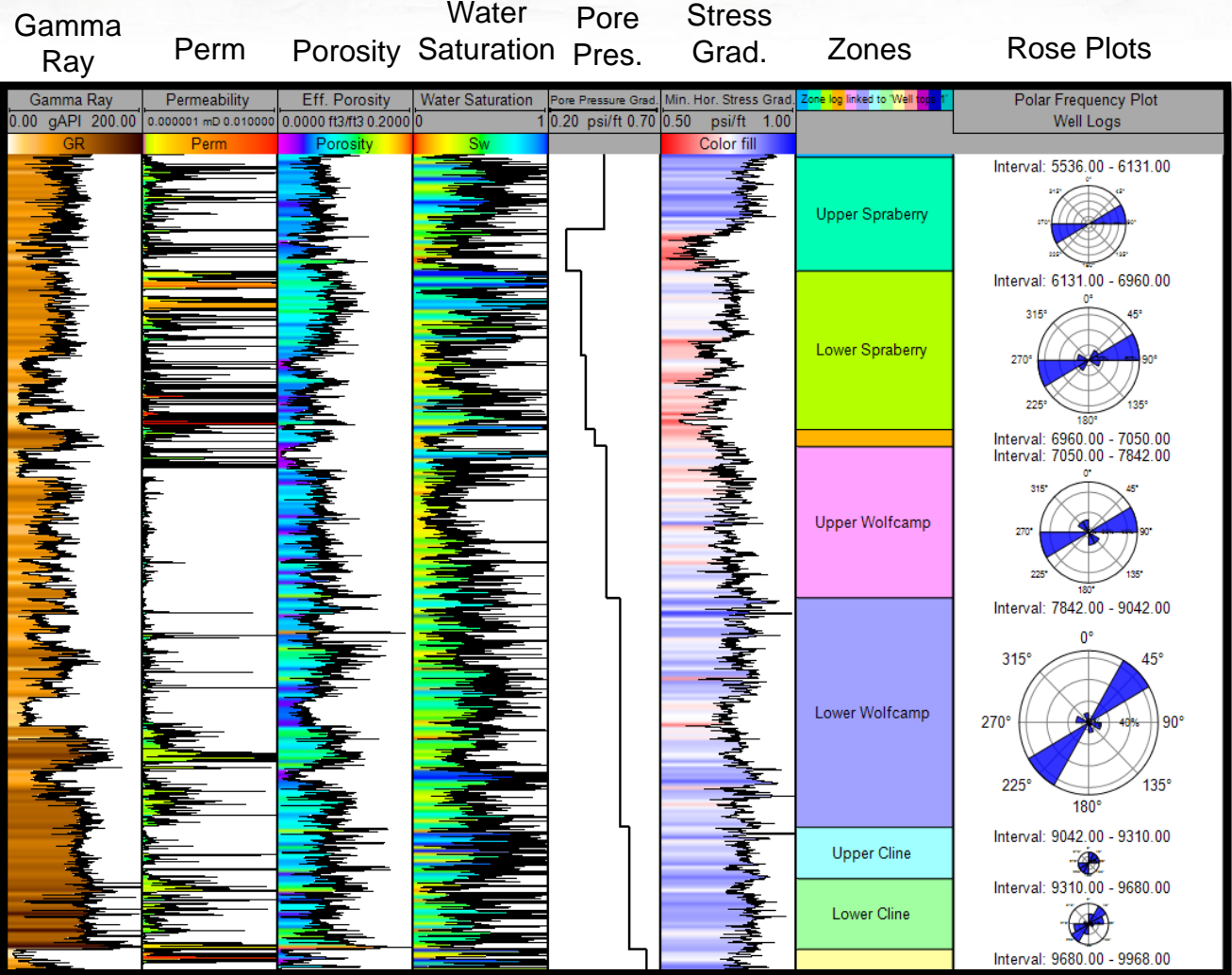


Stepwise Workflow



Pilot Well Logs

- Triple Combo
- Spectral Gamma Ray
- Magnetic Resonance
- Elemental Spectroscopy
- Full Wave Sonic
- Image Log
- Sidewall Cores

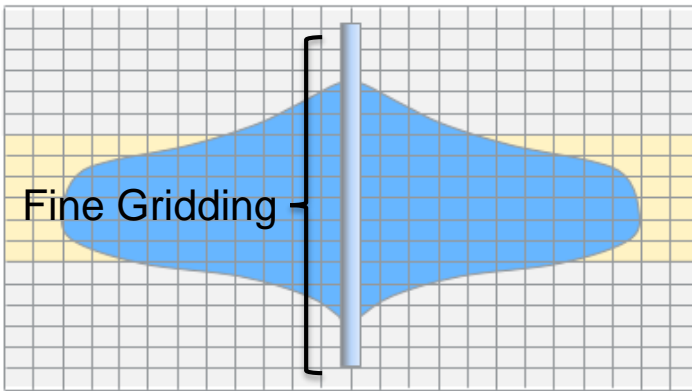


Completion Design

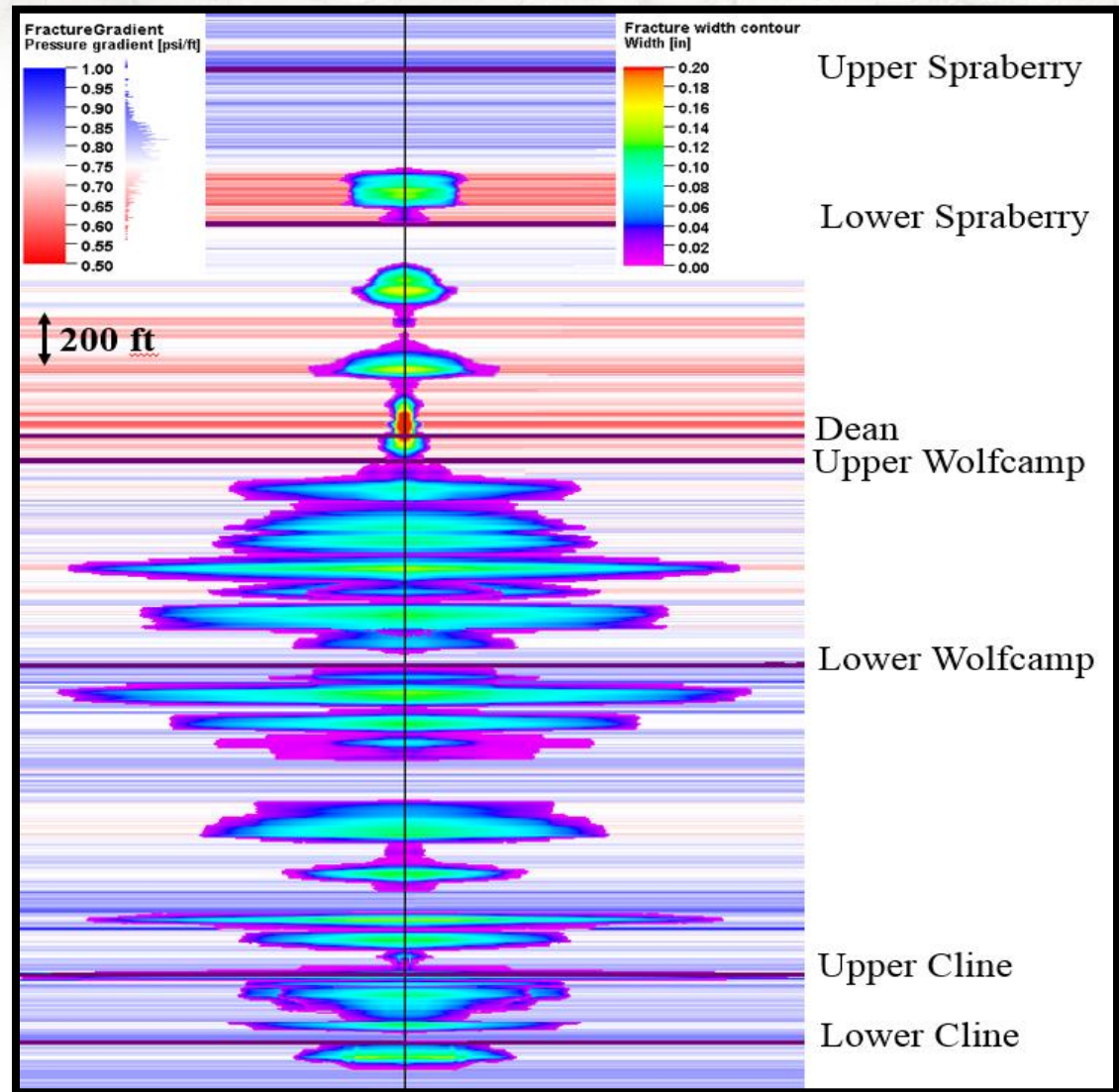
Completion Parameters	Lower & Upper Cline	Lower & Upper Wolfcamp	Lower & Upper Spraberry
Cluster Spacing, feet	30	30	30
Number of Clusters per Stage	5	5	5
Proppant/Lateral Foot (lbs/foot)	1,800	1,800	1,500
Fluid/Lateral Foot (bbls/foot)	45	45	36
Pump Rate (bbls/min)	80	80	70
Proppant Types	100 Mesh, 40/70	100 Mesh, 40/70	100 Mesh, 40/70, 30/50
Fluid Types	Slick Water	Slick Water	Slick Water, 10# & 15# Linear Gel
Maximum Proppant Concentration (PPA)	2	2	3

Well Stacking

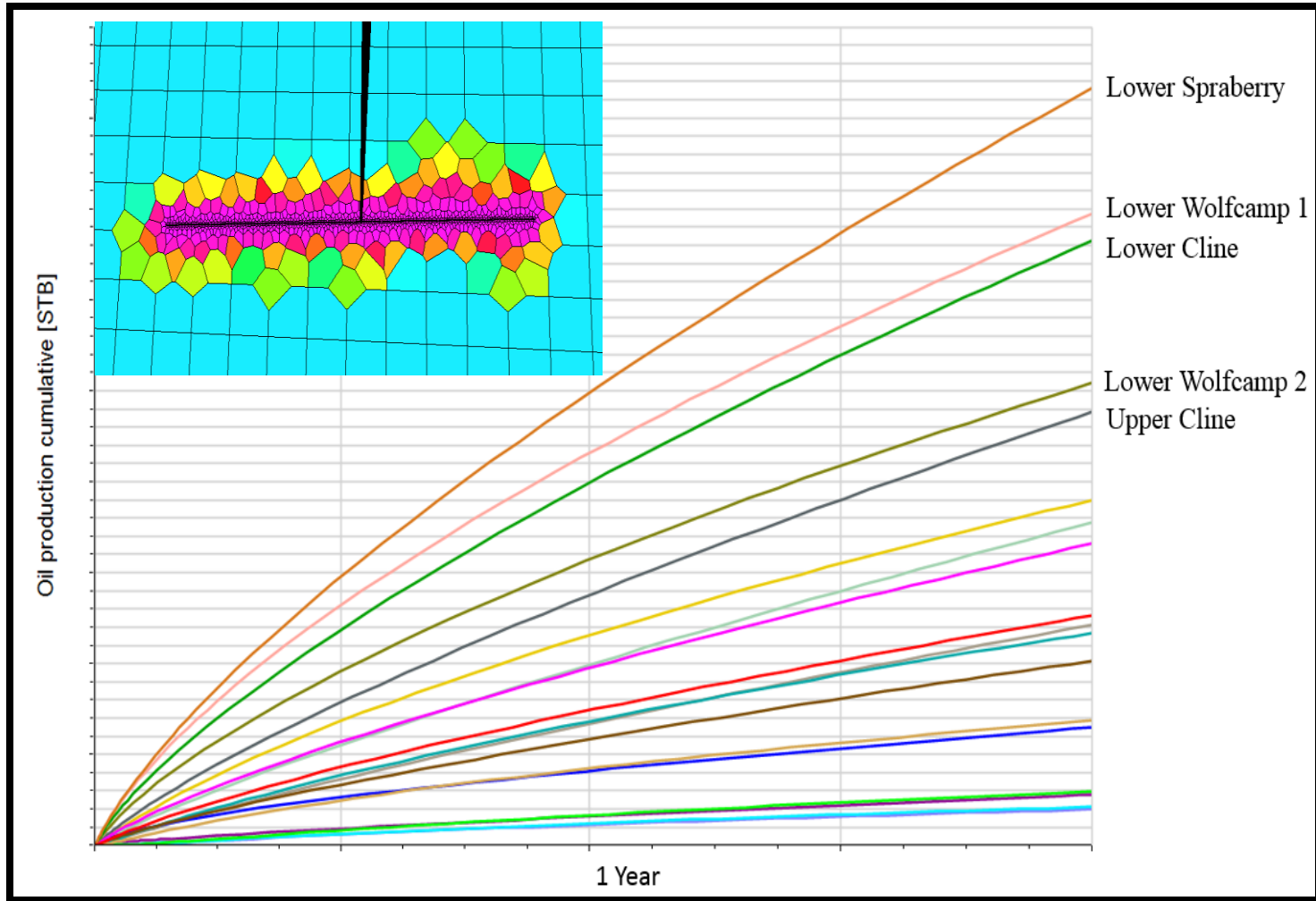
Fully 3D Planar Model



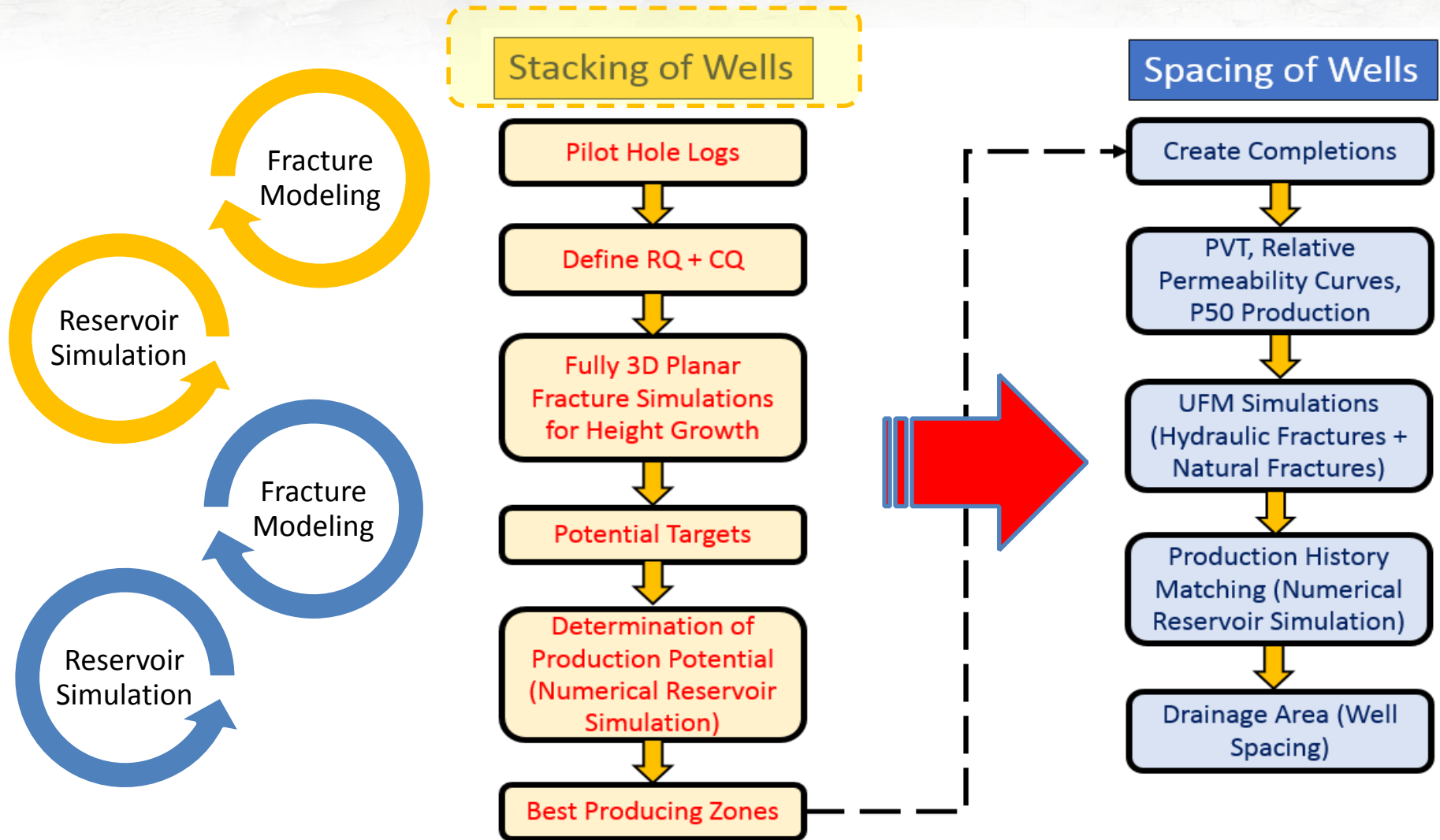
- Captures fine changes in vertical stress profile
- Pinch points determination
- Fracture overlap



Well Stacking

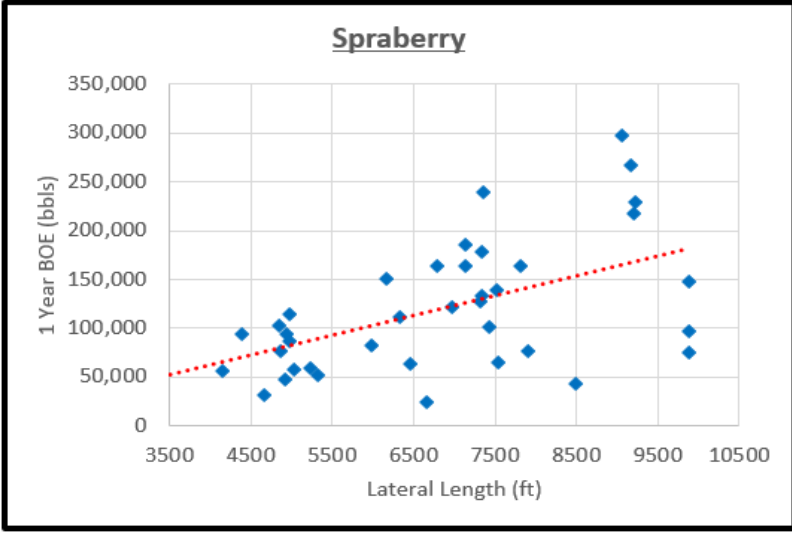
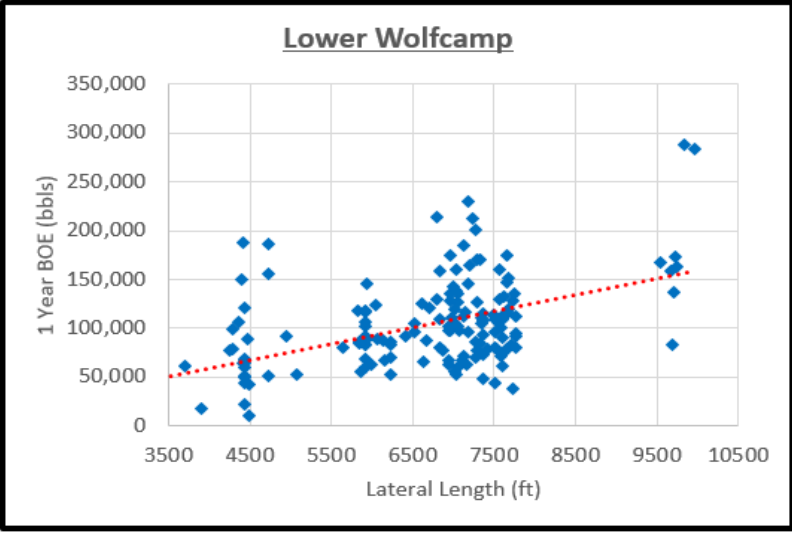
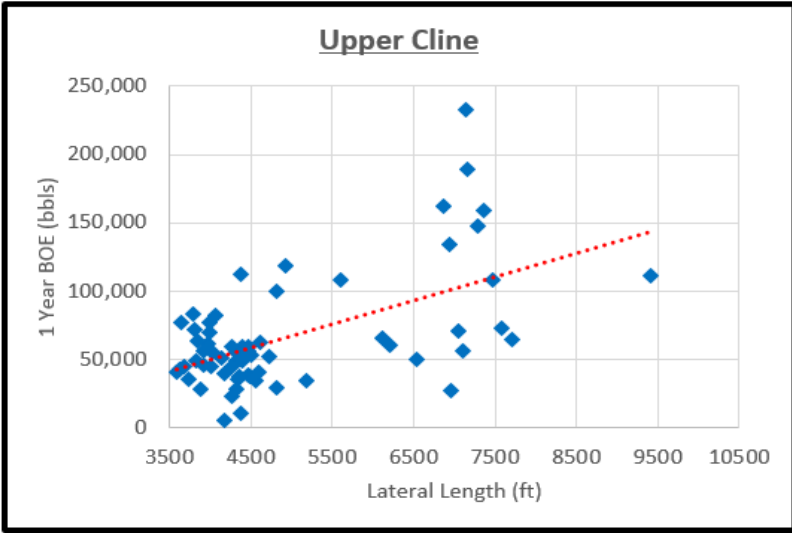
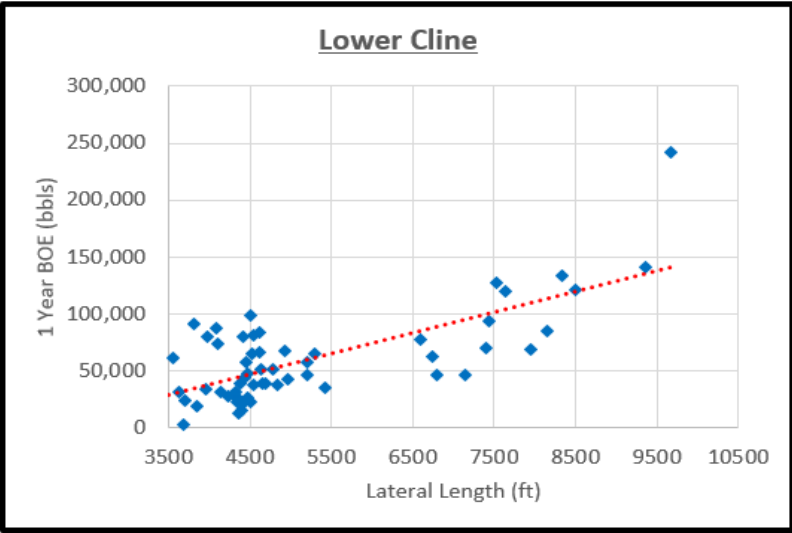


Stepwise Workflow



1-Year BOE vs Lateral Length

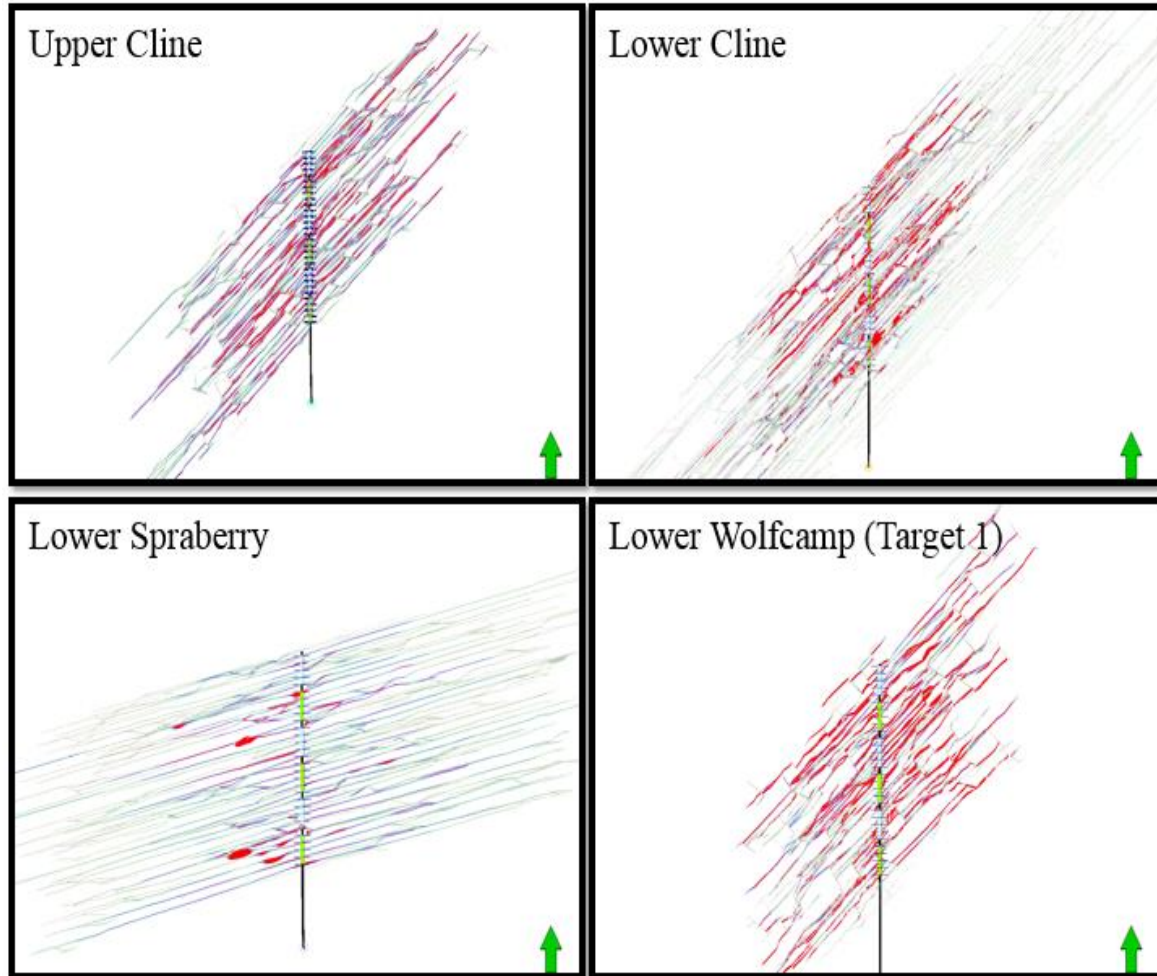
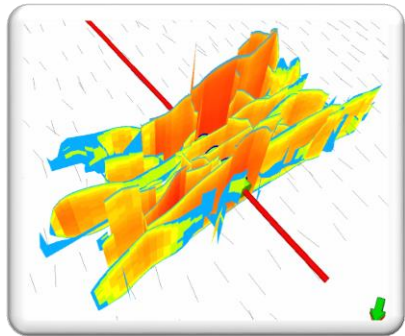
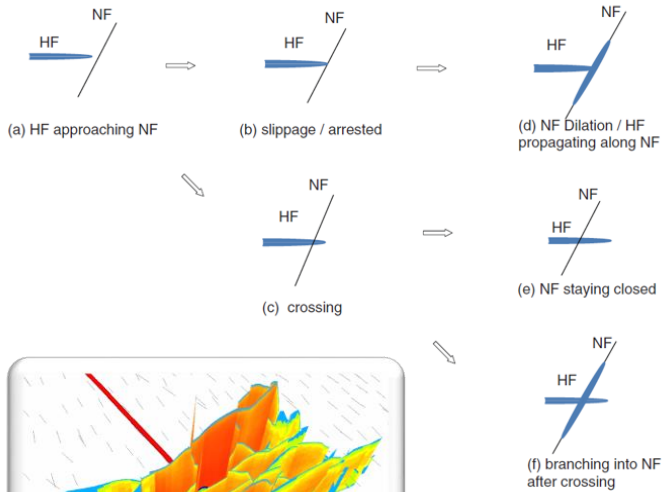
(Data provided by IHS)



Complex Fracture Modeling

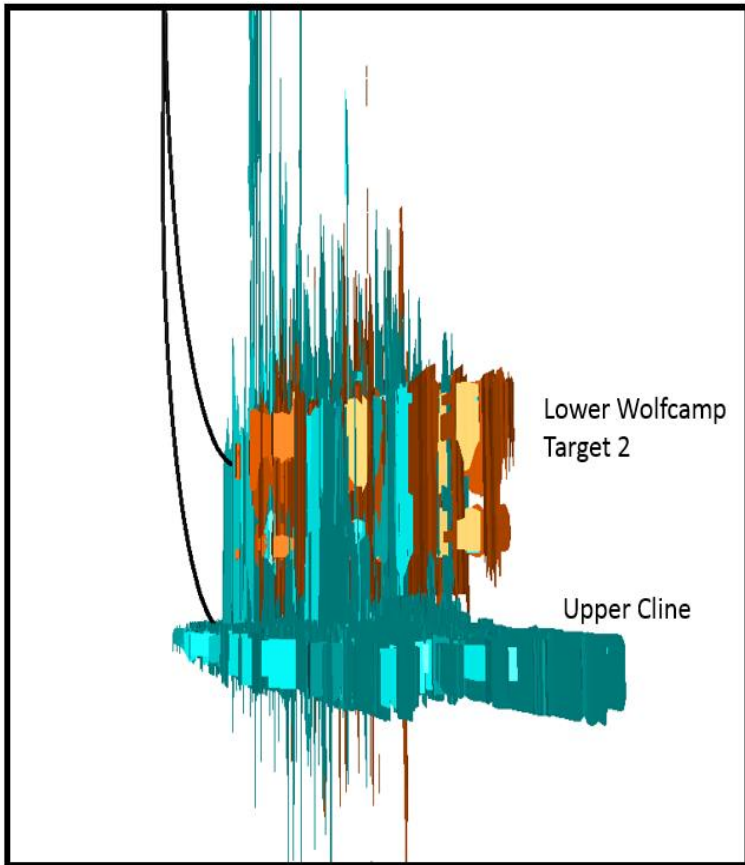
SPE-139984-MS

Unconventional Fracture Model (UFM)

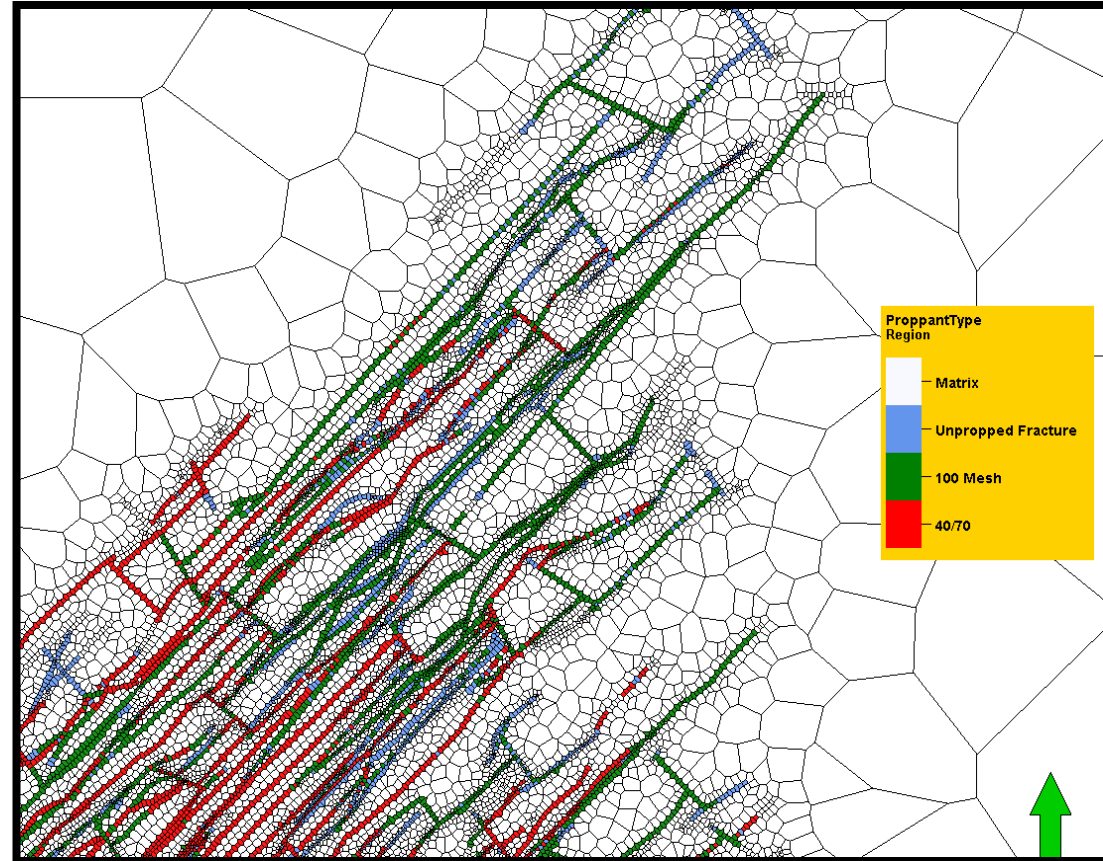


Complex Fracture Modeling

Fracture Overlap

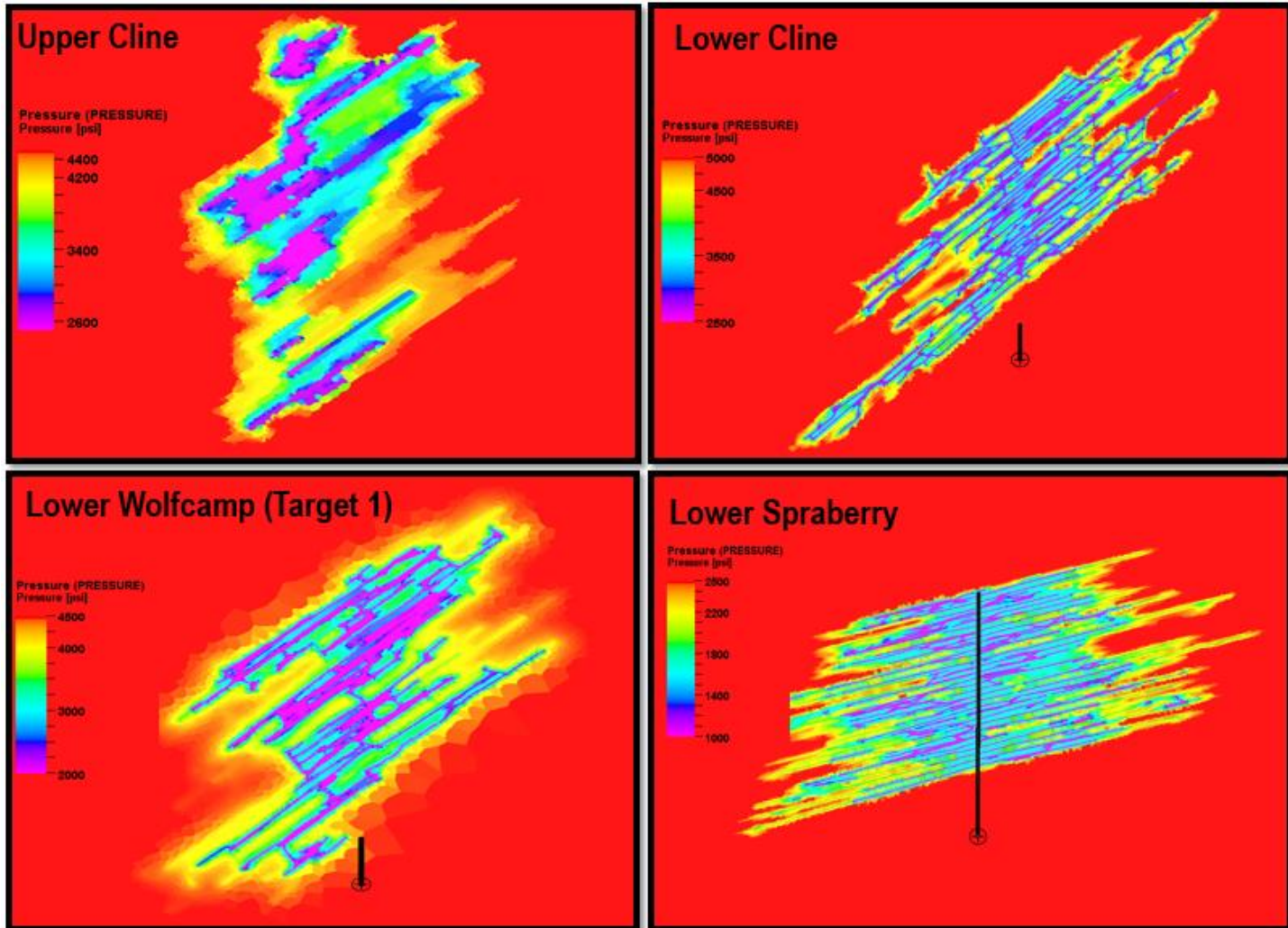


Unstructured Gridding



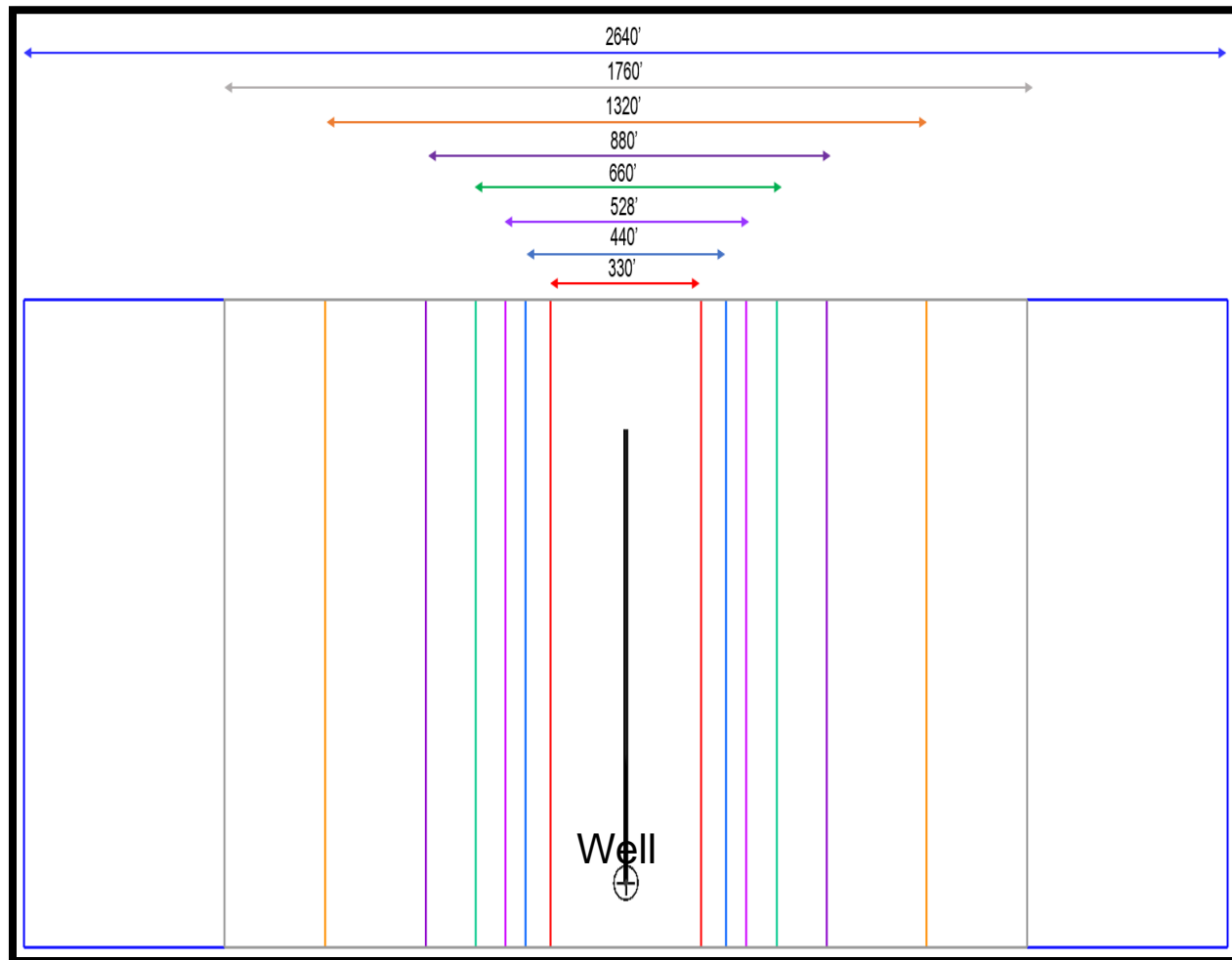
Depletion Profile

5 years of production history matching performed on P50 type curve for each zone



Model Constraints

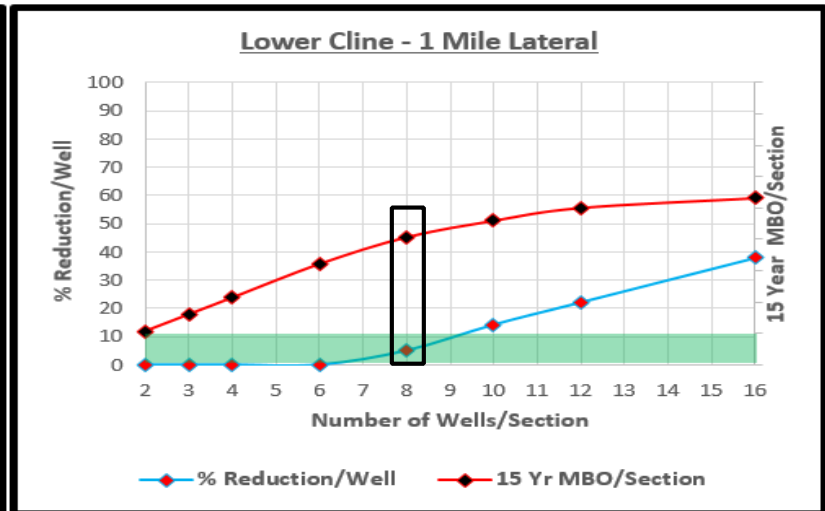
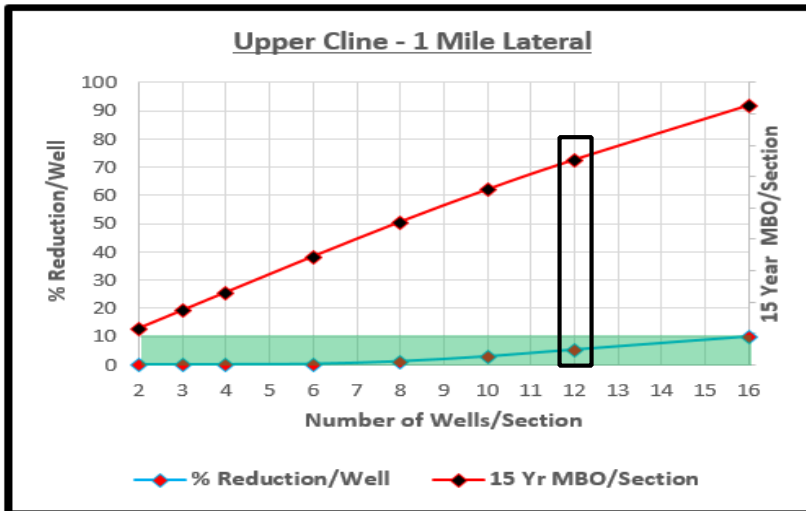
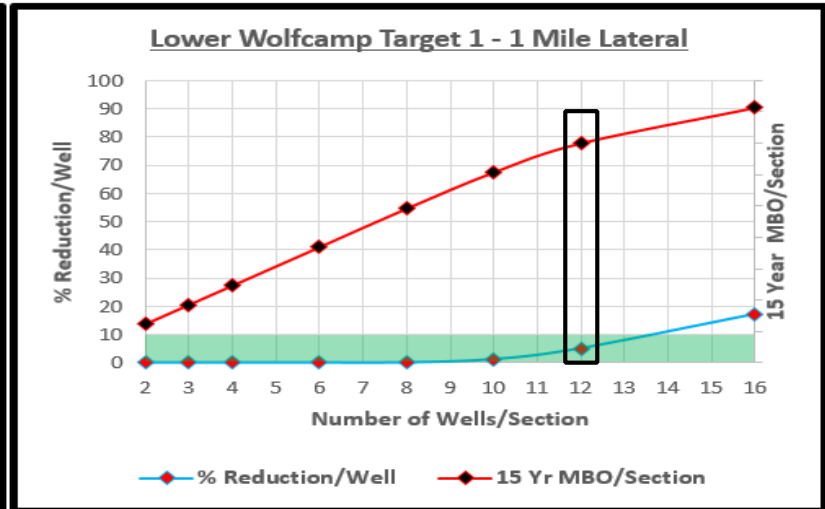
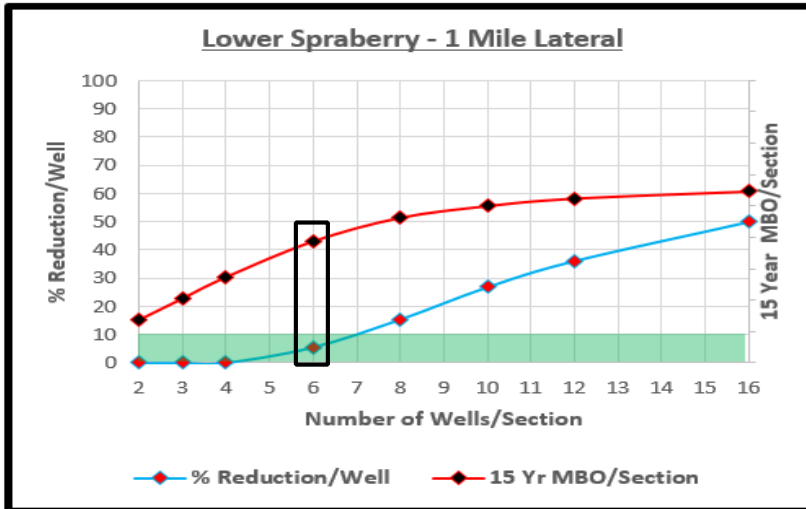
# Wells/Section	Well Spacing (ft)
2	2,640
4	1,320
6	880
8	660
10	528
12	440
16	330



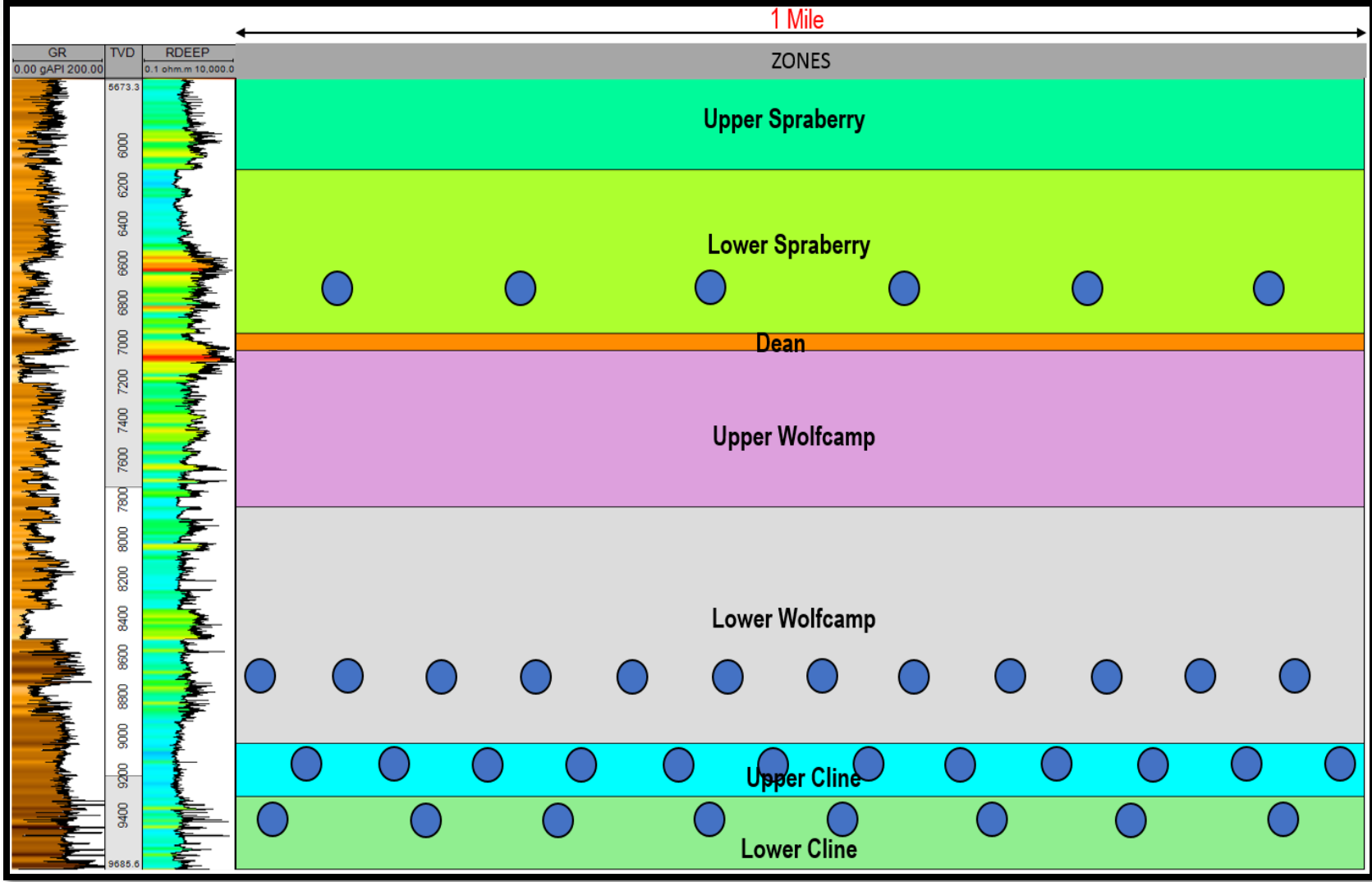
Well Spacing Results

Red Line – 15 Yr MBO/Section

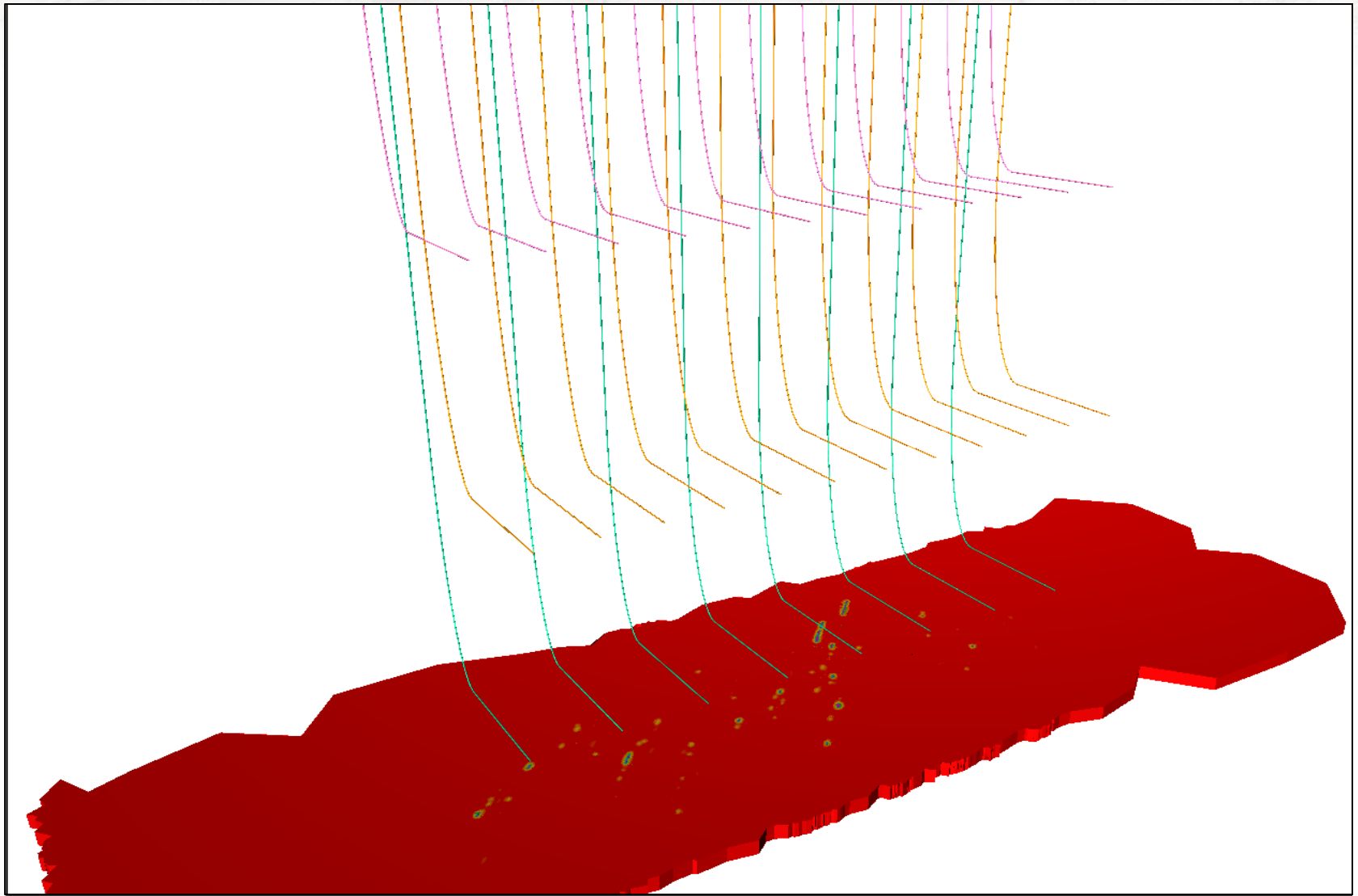
Blue Line – % Production Reduction/Well



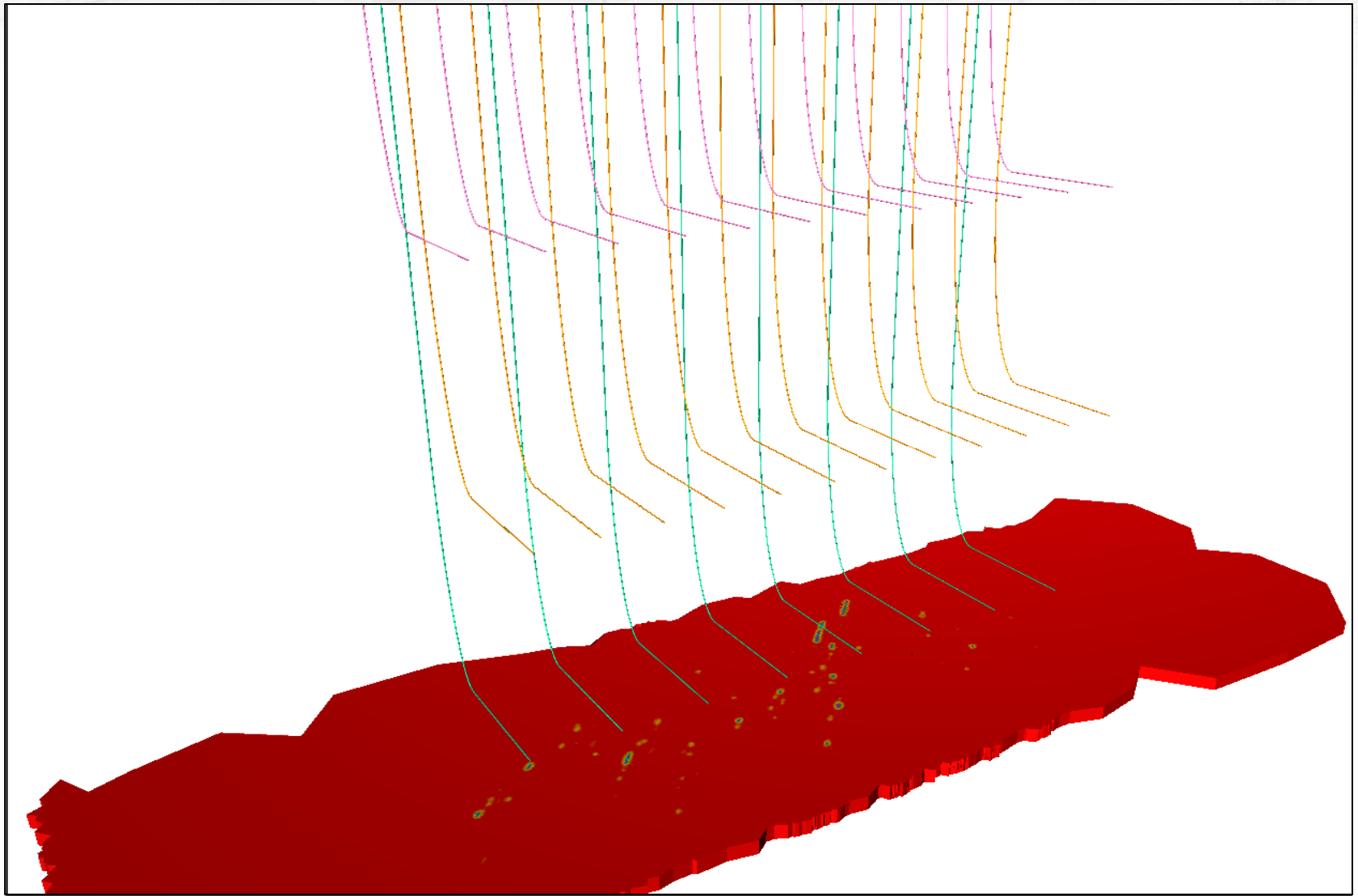
Gun Barrel View (38 Wells)



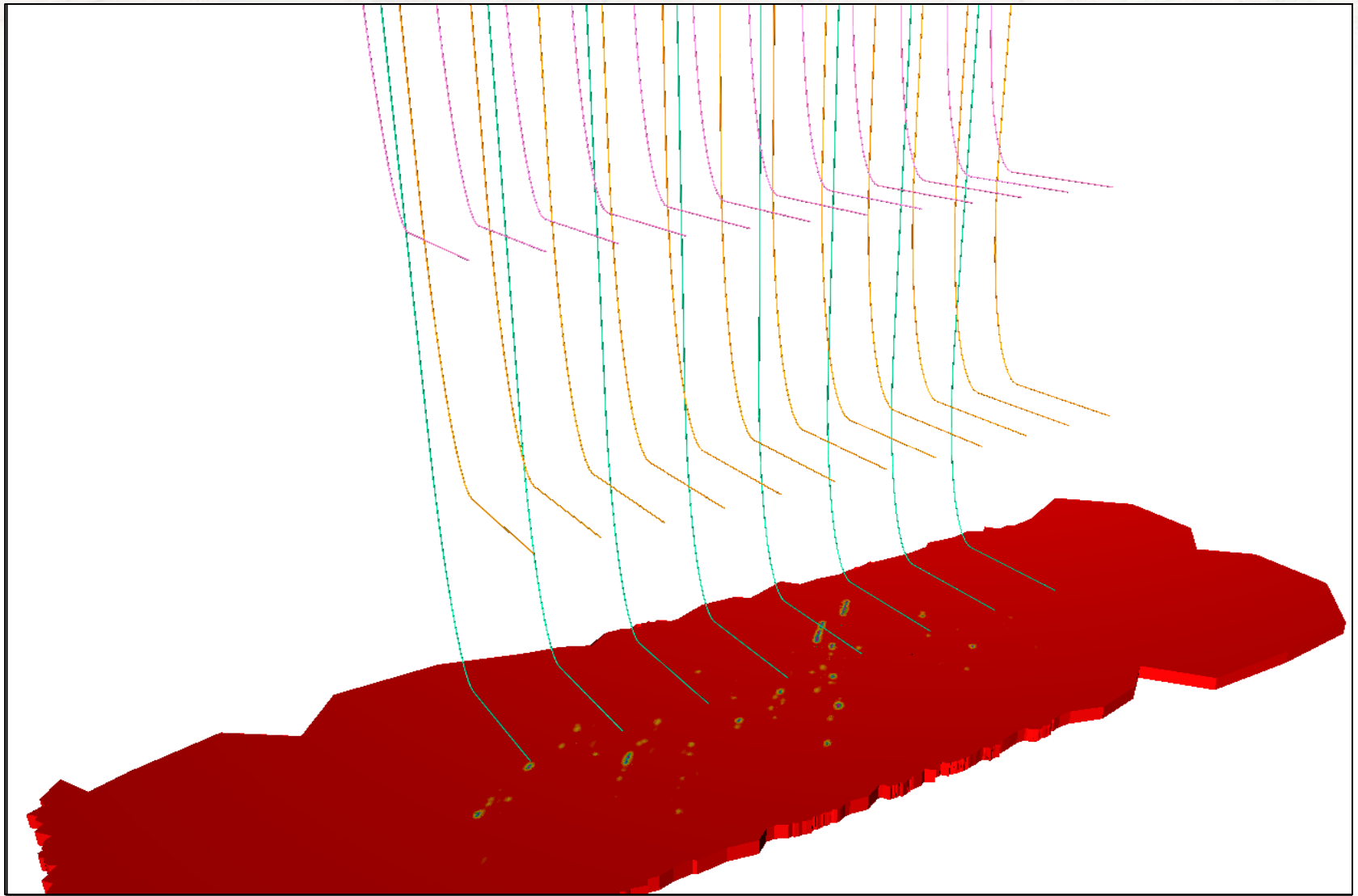
Lower Cline



Lower Cline



Lower Cline

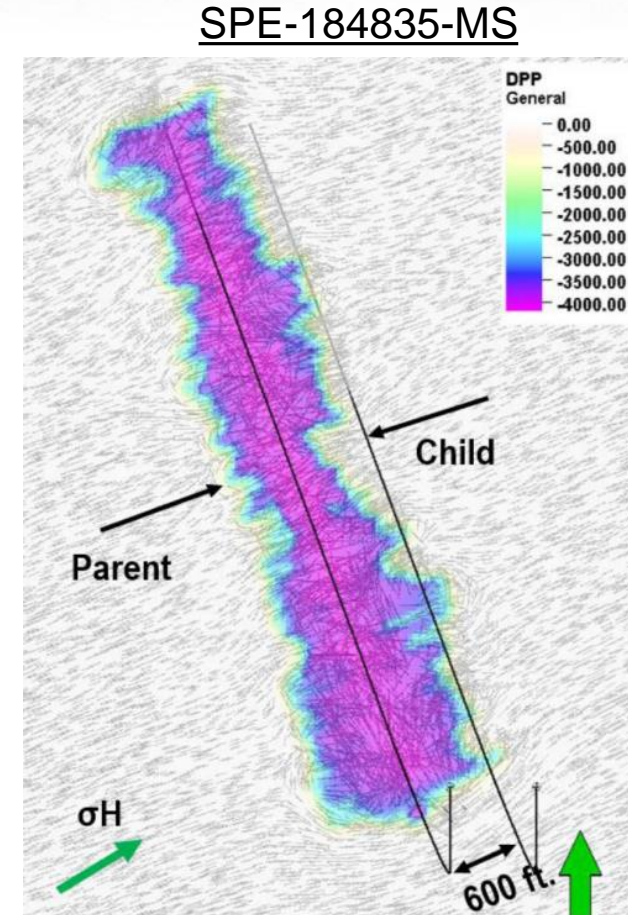


Conclusion

- A reservoir centric approach was used to determine optimum **stacking** and **spacing** of wells in the Midland Basin.
- Pilot well log suite included advanced logs such as the **NMR, Dipole Sonic, Elemental Spectroscopy and Images**.
- Well stacking modeling indicated **FIVE zones** that were highly productive.
- Fracture **overlap** was observed between the **Upper Cline** and the **Lower Wolfcamp (target 2)**.
- Optimum well spacing exercise indicated a total of **38 wells in a section for 4 zones**:
 - Lower Spraberry – 6 wells (880 ft)
 - Lower Wolfcamp – 12 wells (440 ft)
 - Upper Cline – 12 wells (440 ft)
 - Lower Cline – 8 wells (660 ft)

Way Forward

- Effect of Completion Design on Well Spacing
 - Proppant/ft
 - Proppant/fluid ratio
 - Cluster spacing
 - Number of clusters/stage
- Parent-Child Interaction
 - Depletion & Stress perturbation
 - Timing of in-fill drilling
- Completion Sequencing
 - Which zone to complete first?
 - Creating artificial stress barrier? Does it work?



Thank You Questions

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