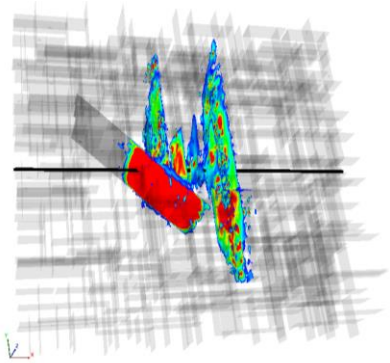
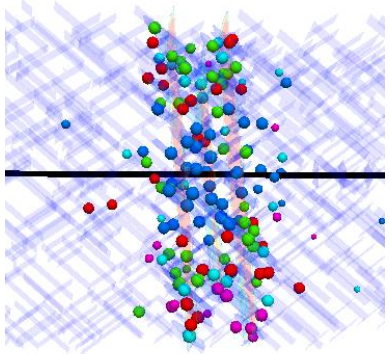
What Have We Learned About Hydraulic Fracturing Shales After 15 Years Of Microseismic Imaging?

April 30, 2015

IMaGE™

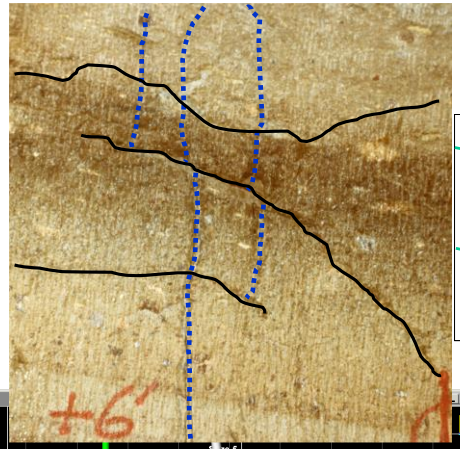
ITASCA Microseismic and Geomechanical Evaluation

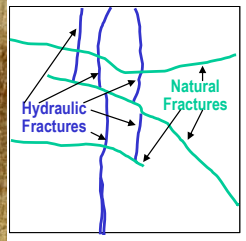


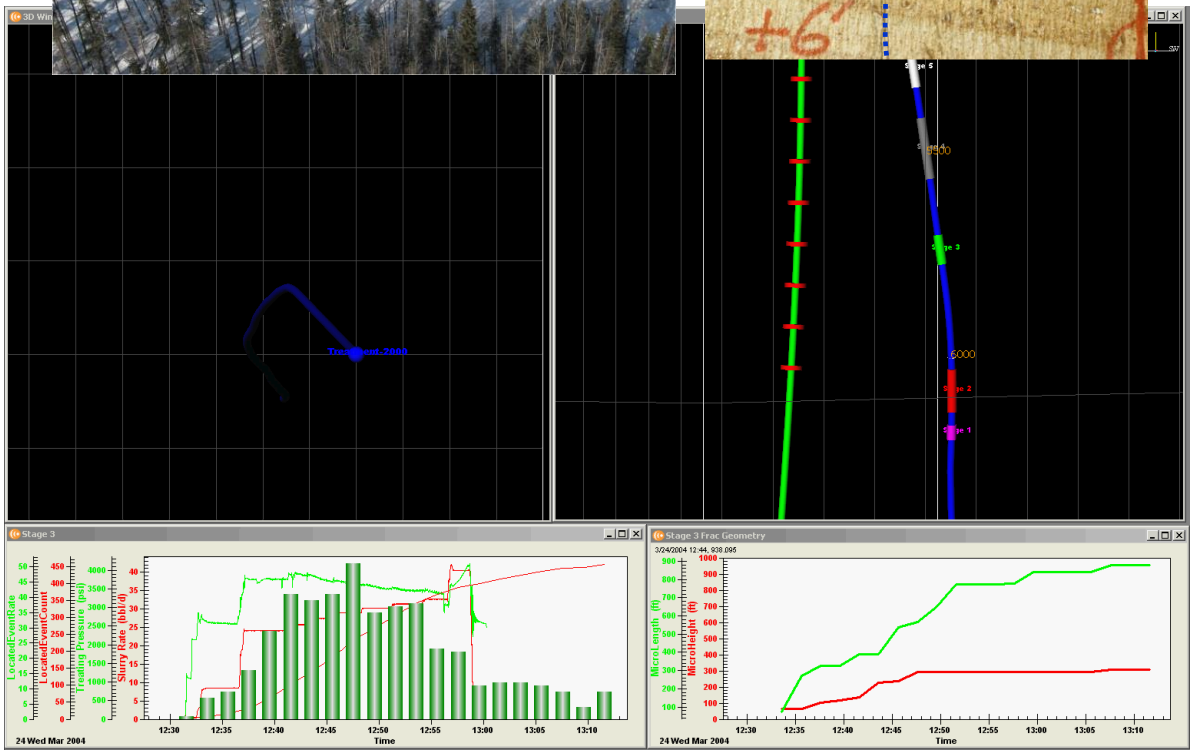


Microseismic Geomechanics: Increased understanding; reduced risk

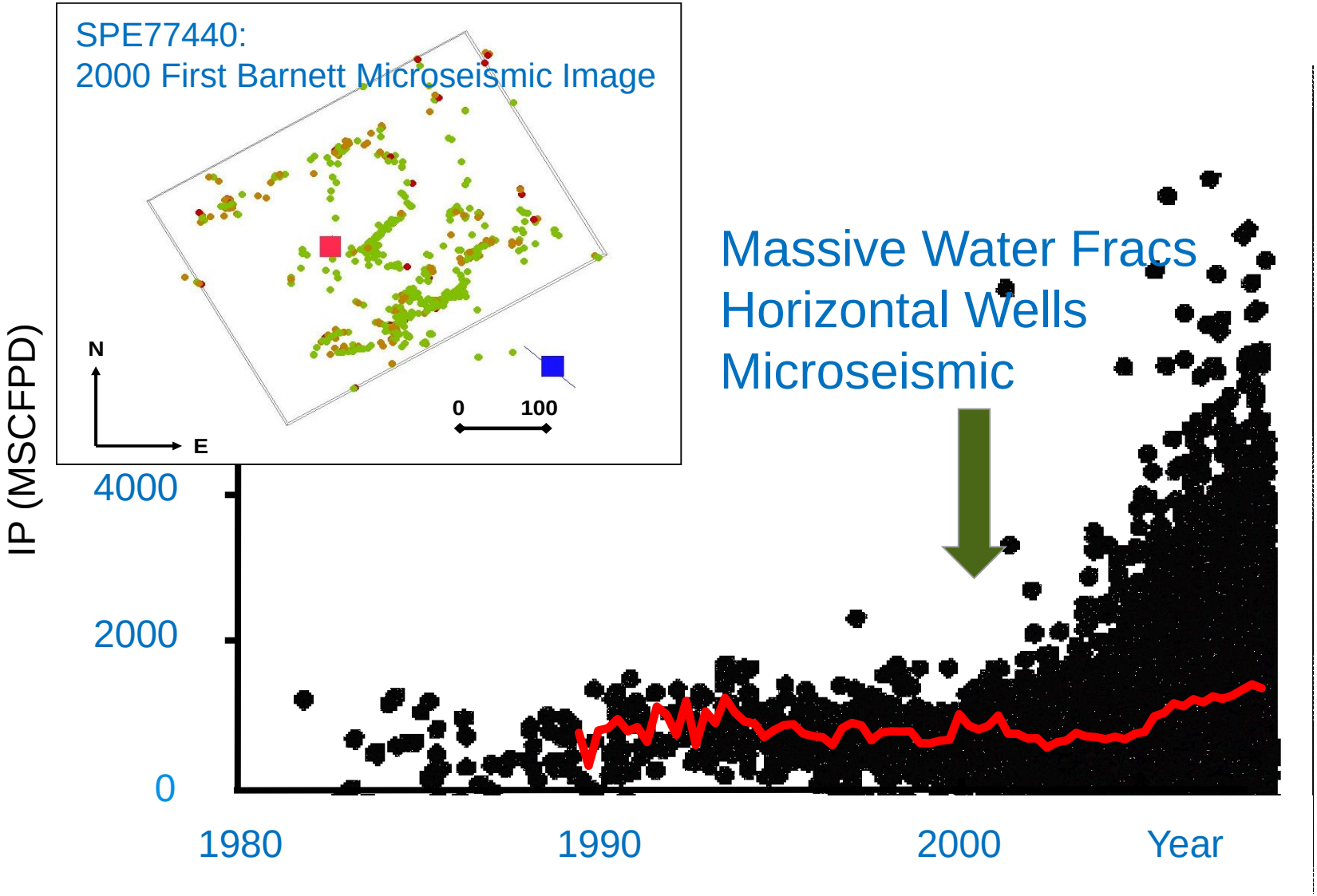
Hydraulic Fracturing: Where Does It All Go?



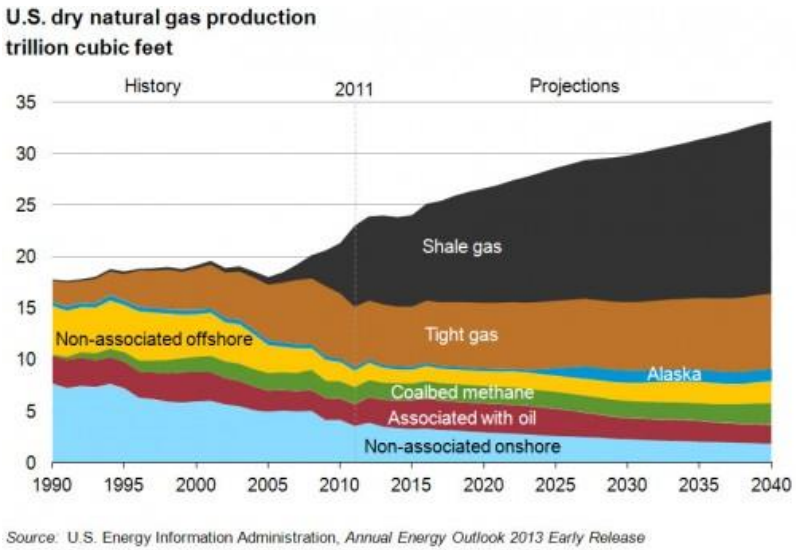


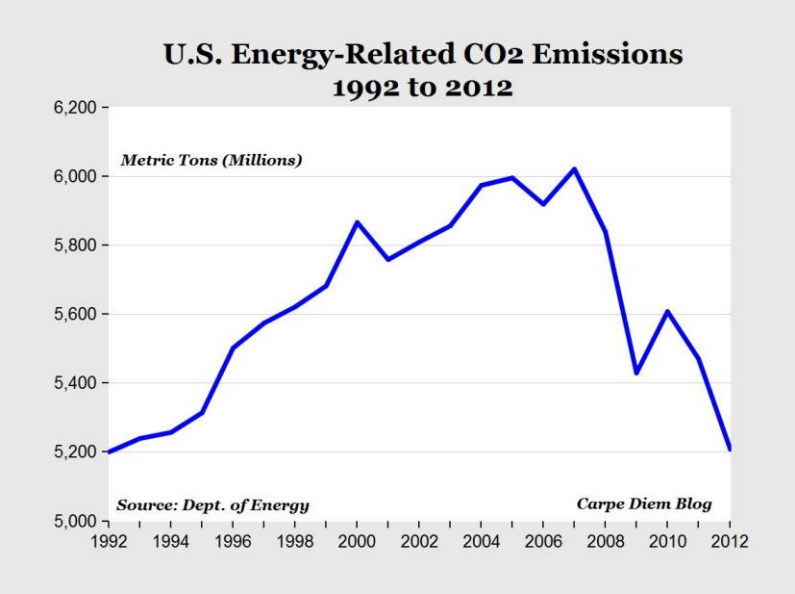


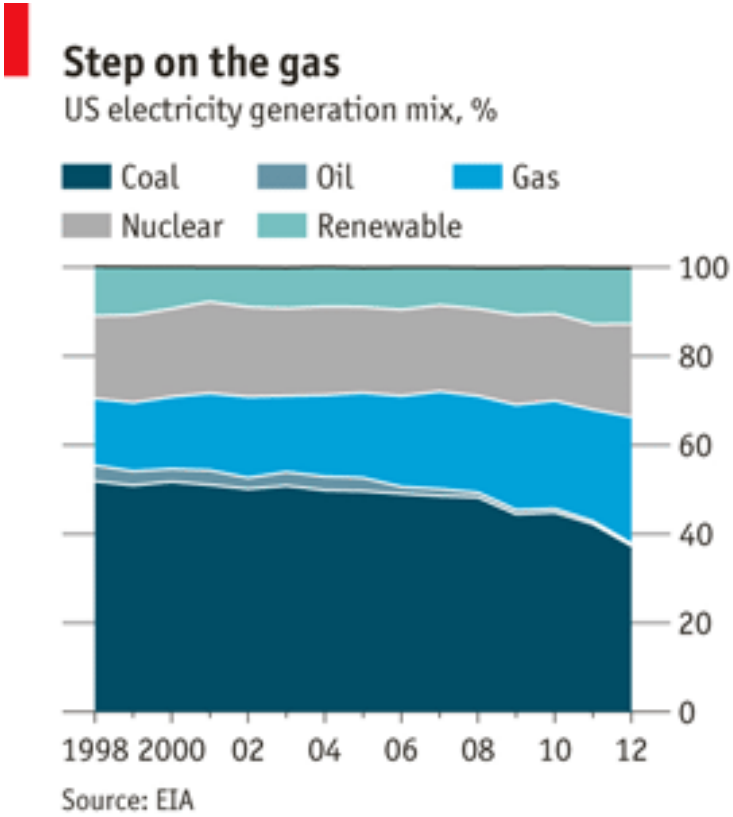
Barnett Shale Development



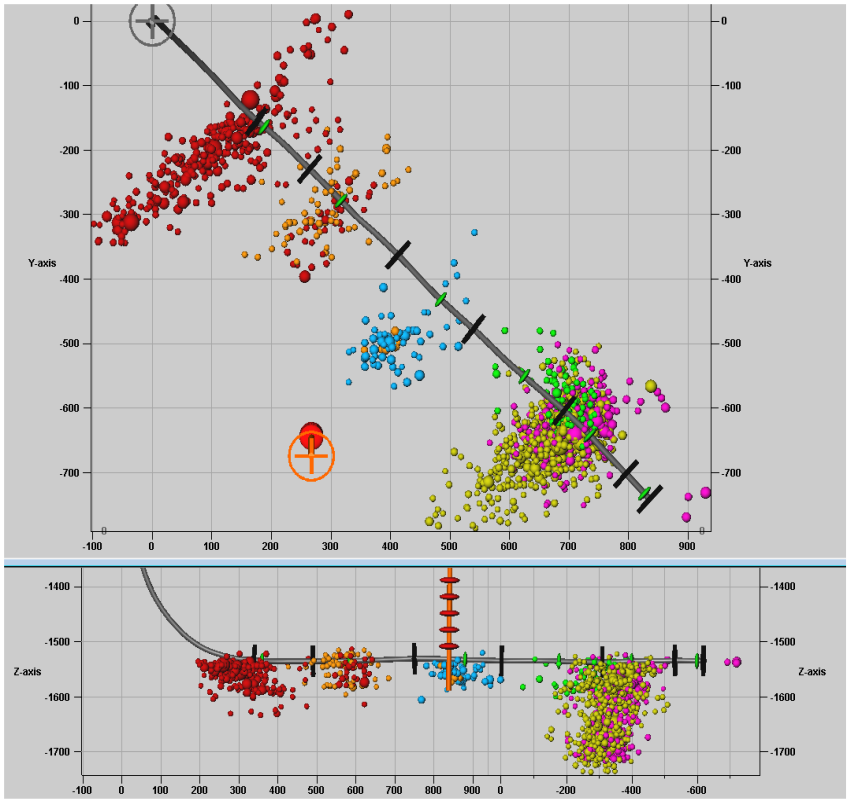
Reducing Carbon Emissions







Microseismic Hydraulic Fracture Applications



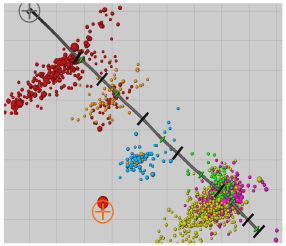
✓ Fracture direction
✓ Height
✓ Length
✓ Complexity

Optimize Stimulation Design

- height growth
- injection rate and volume
- fluid type, additives, and diverters
- proppant placement

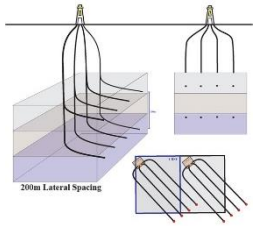
Validate Completion Design

- completion types and designs
- stage isolation
- stage sequencing
- refracturing



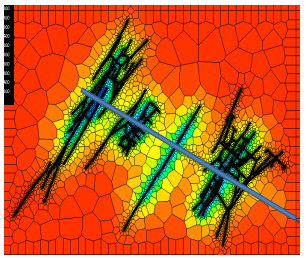
Refine Well Plan

- well orientation
- landing point
- well integrity

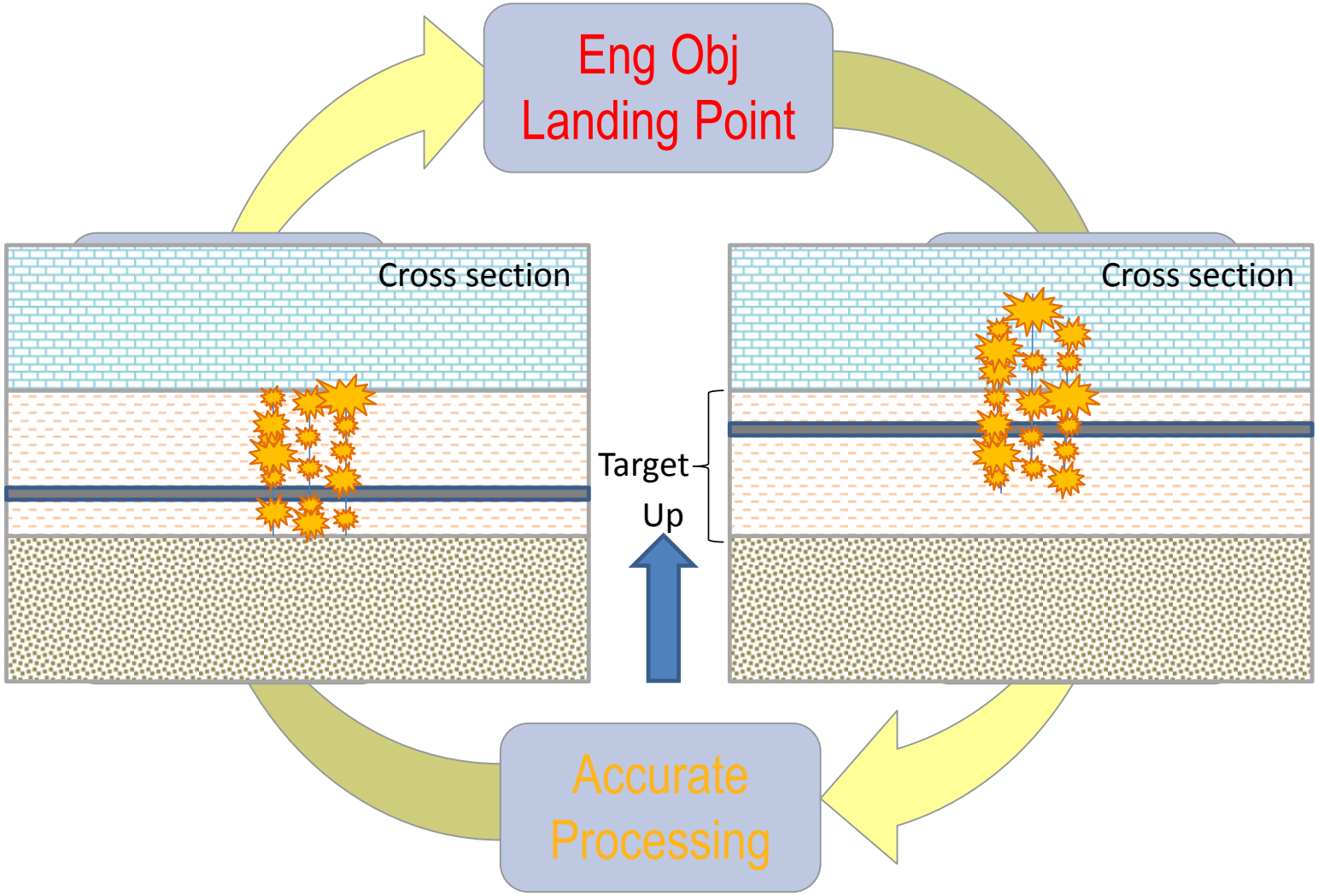


Improve Reservoir Management

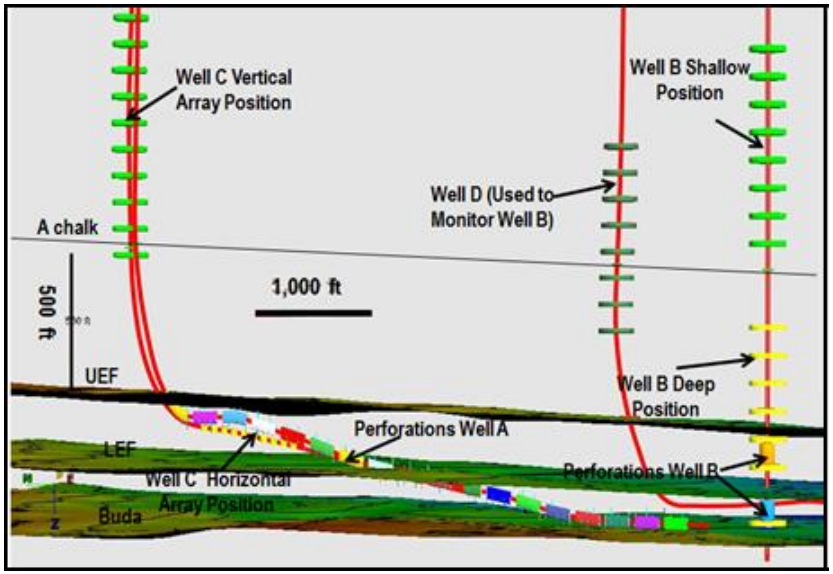
- well spacing
- well placement
- induced seismicity and fault activation
- reservoir characterization
- production optimization

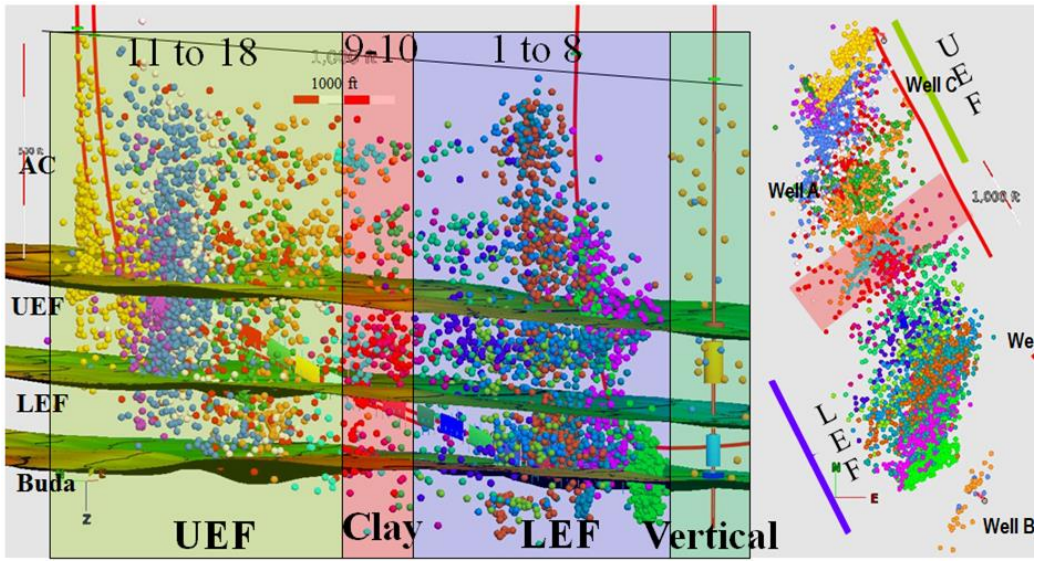


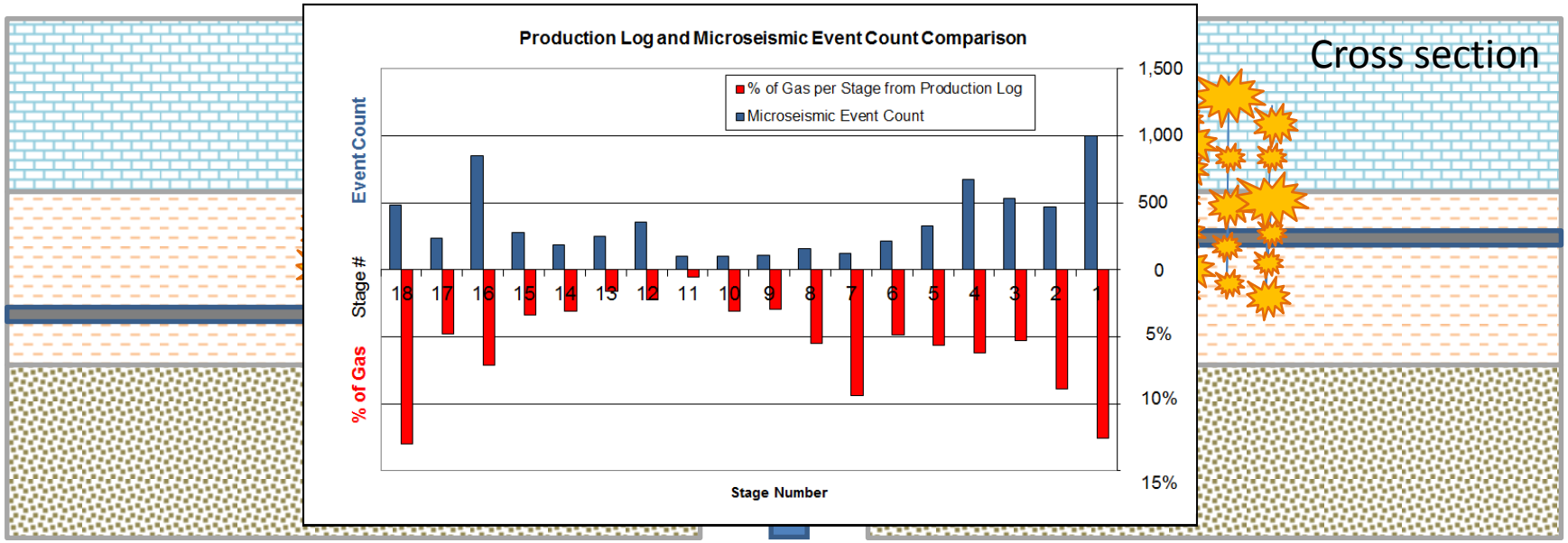
Project Design for Value



Eagle Ford Example (Patel, 2013)







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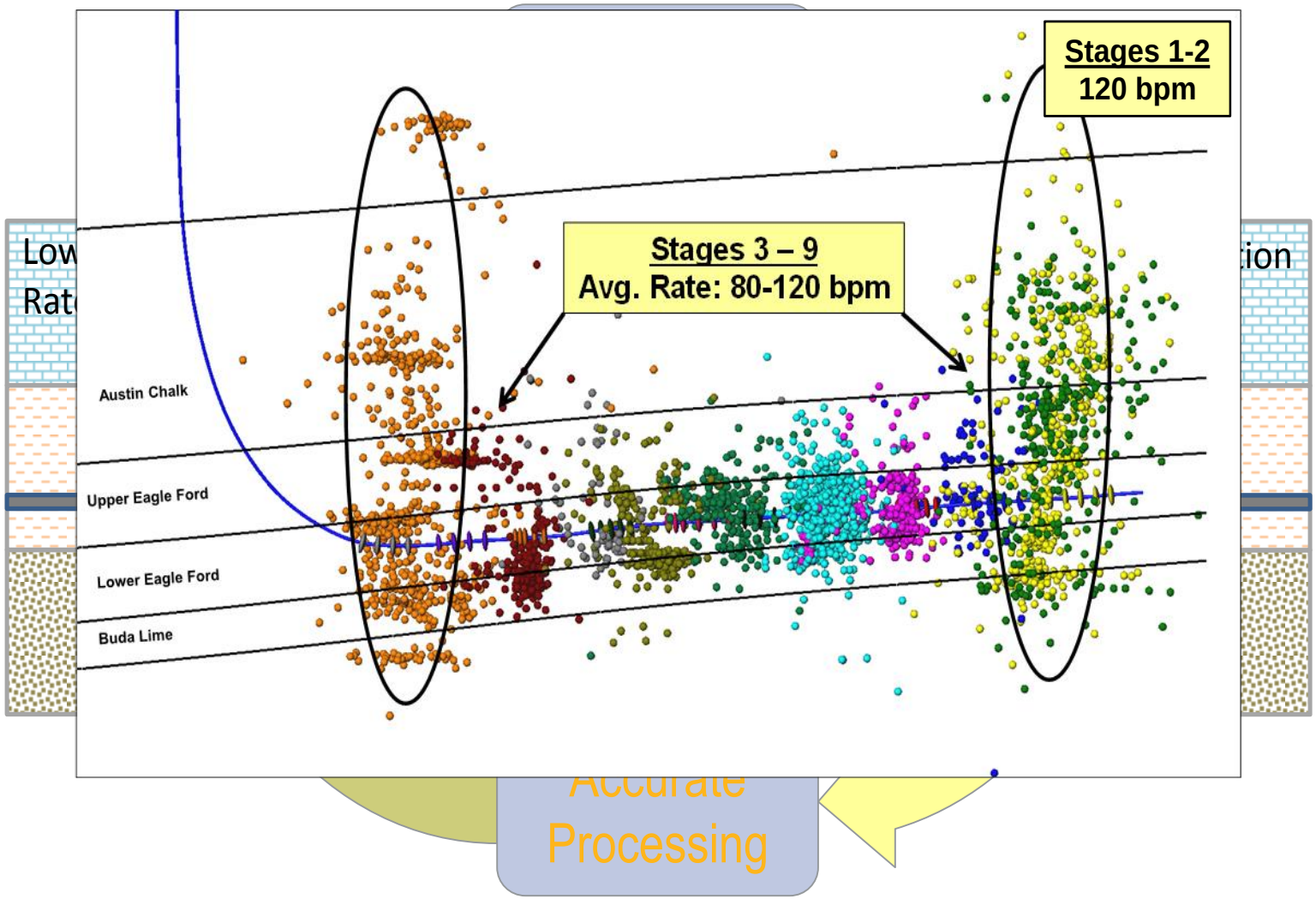
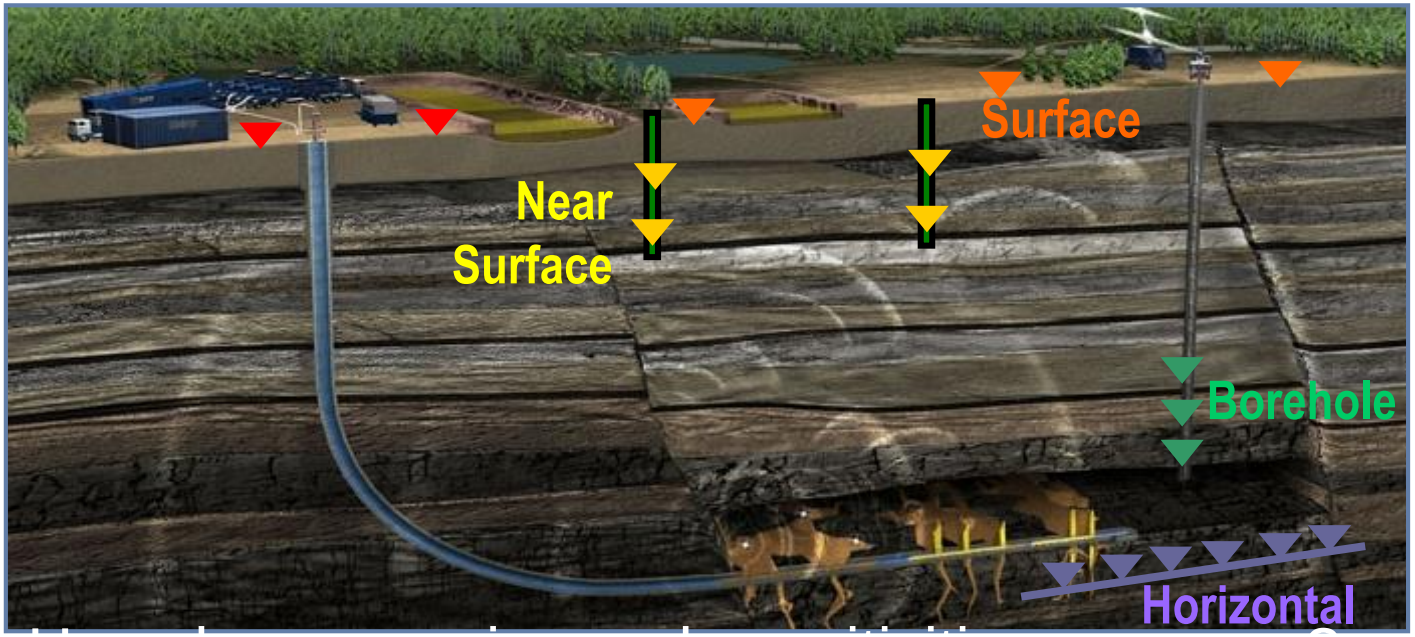
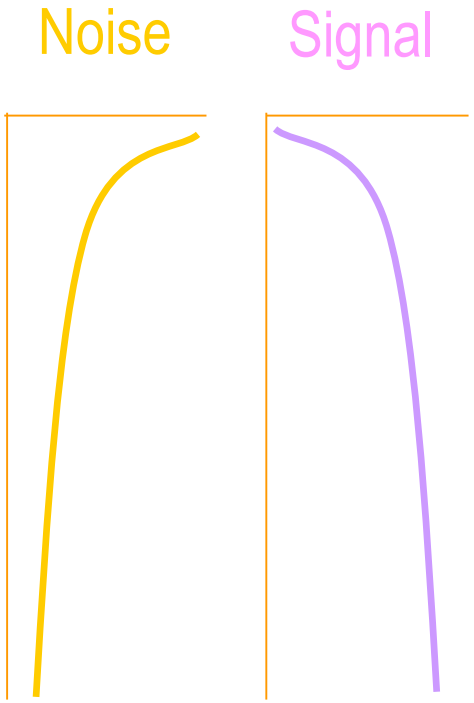


Evolution of Monitoring Geometries



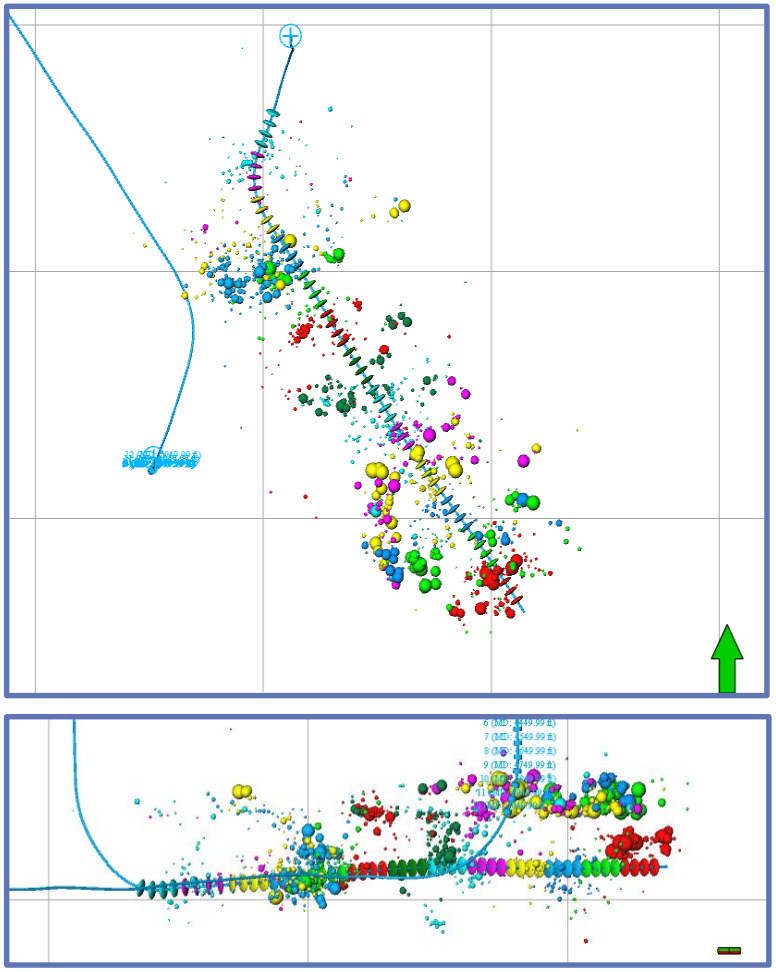


How do you decide which option?

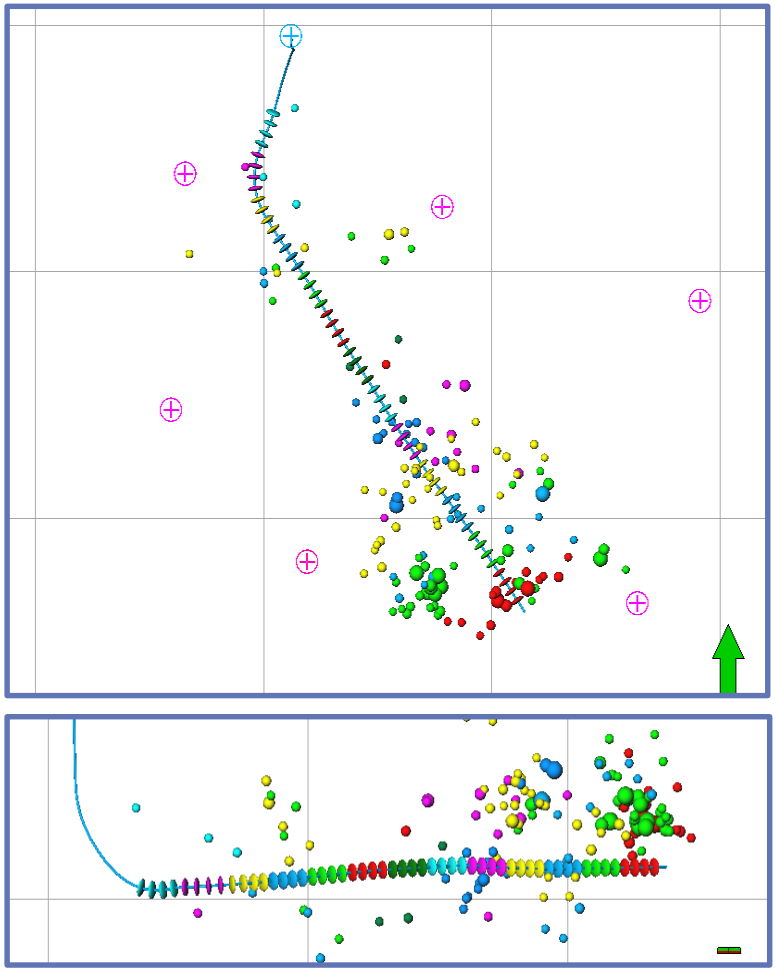
SPE159670

Acquisition Footprint

Downhole Array

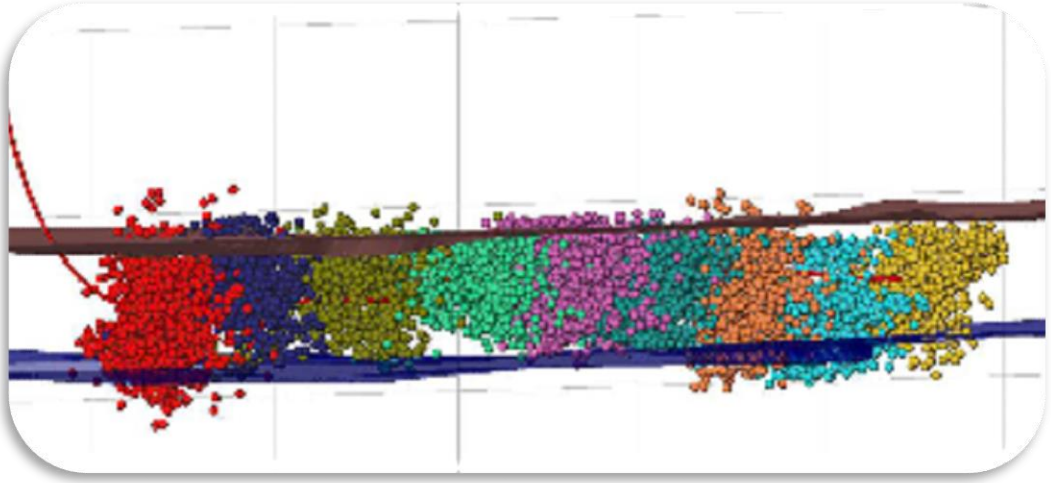


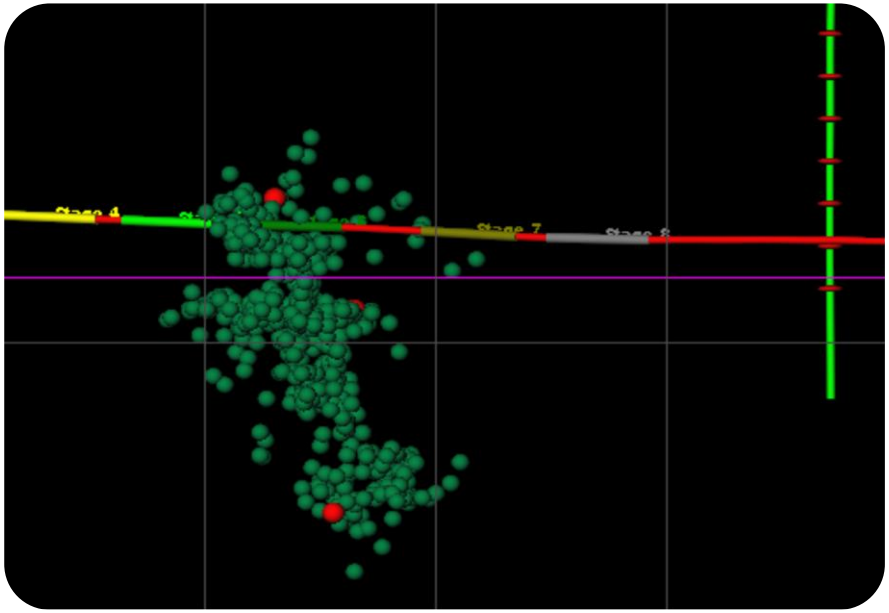
Shallow Grid

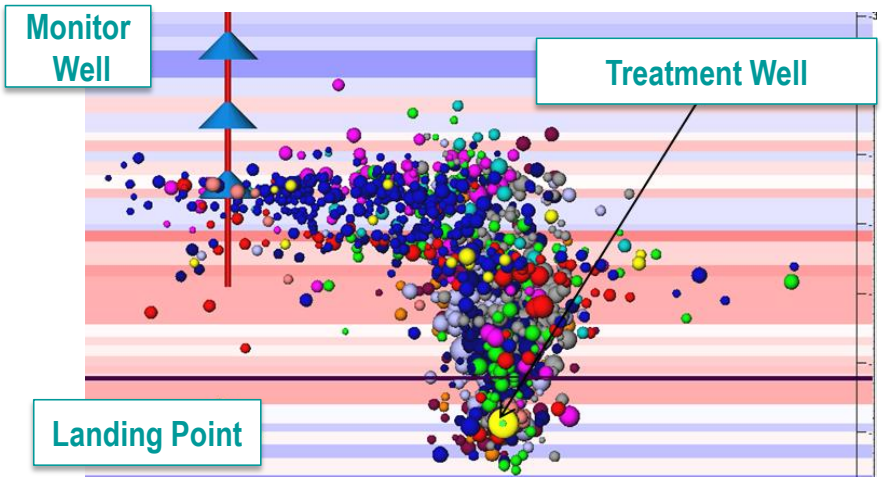


Shale Lessons: Containment

1. Depth Containment

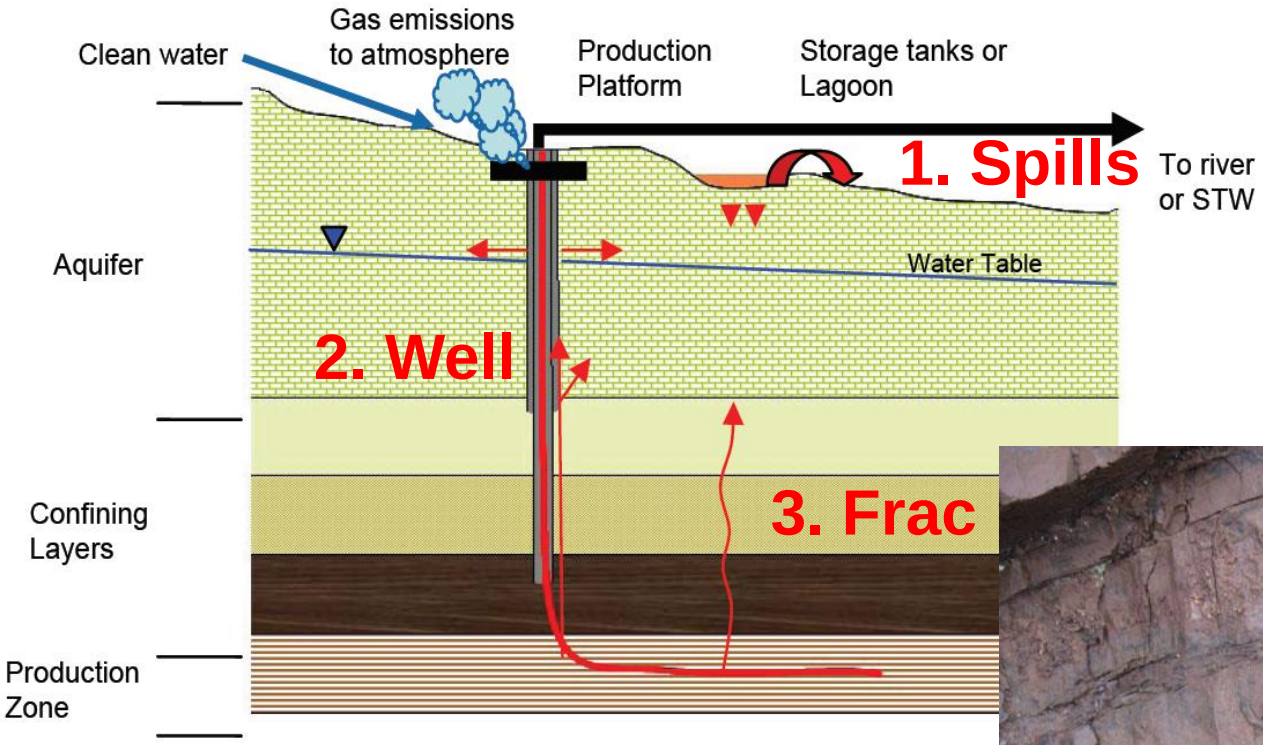






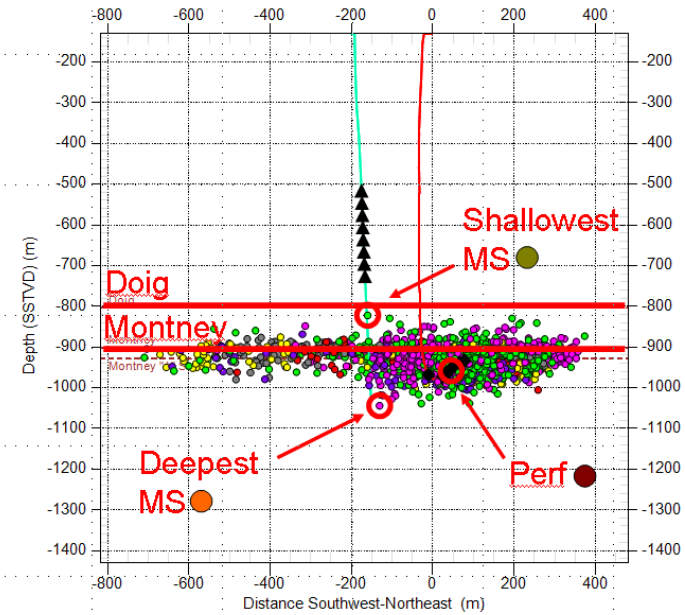
Environmental Concerns

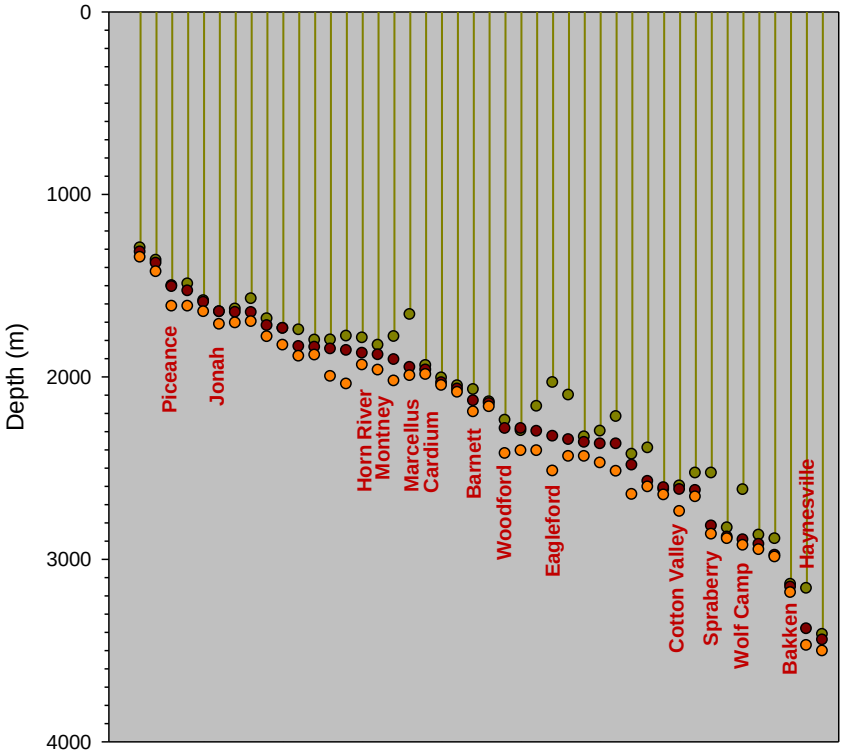
Aquifer Protection

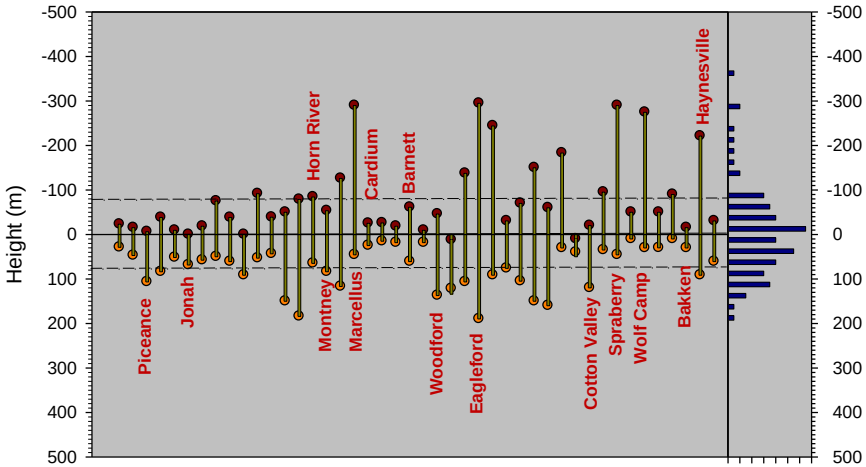


IEA

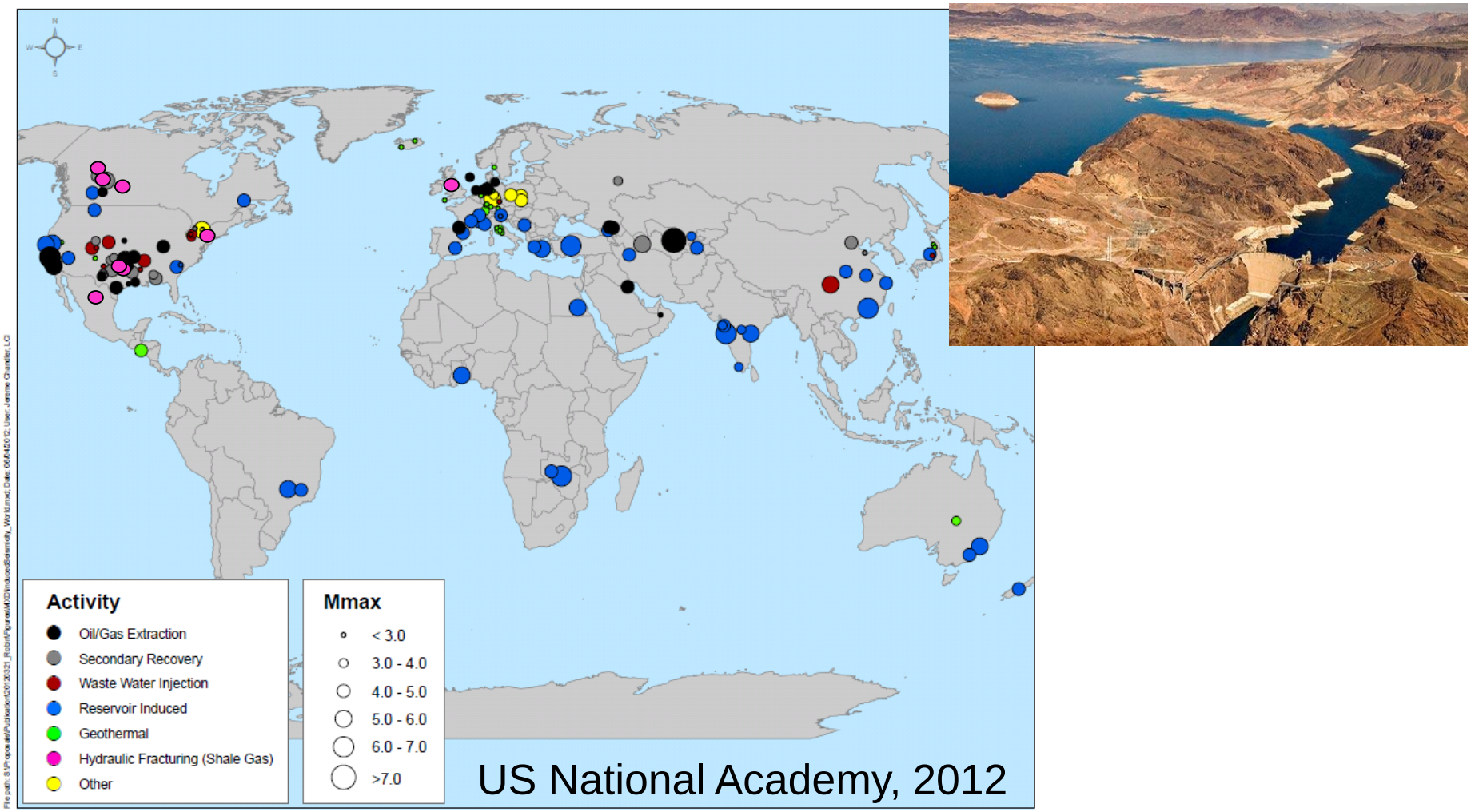
Fracture Height Growth







Induced Seismicity

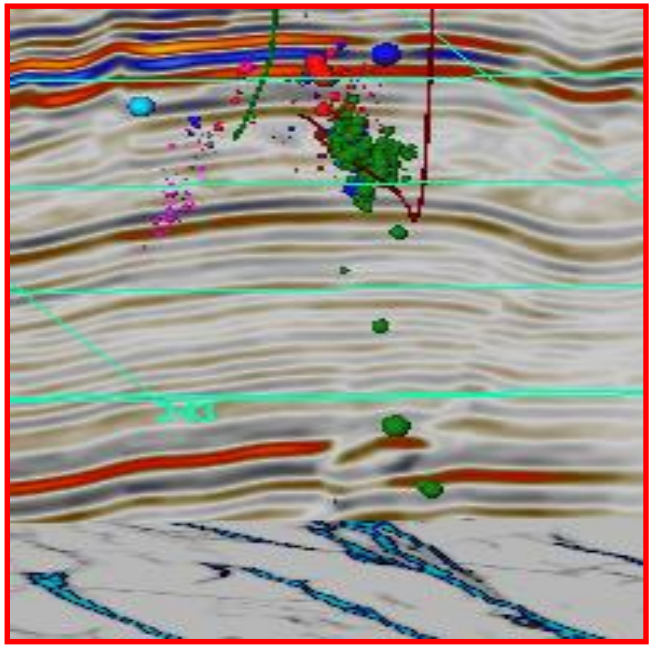


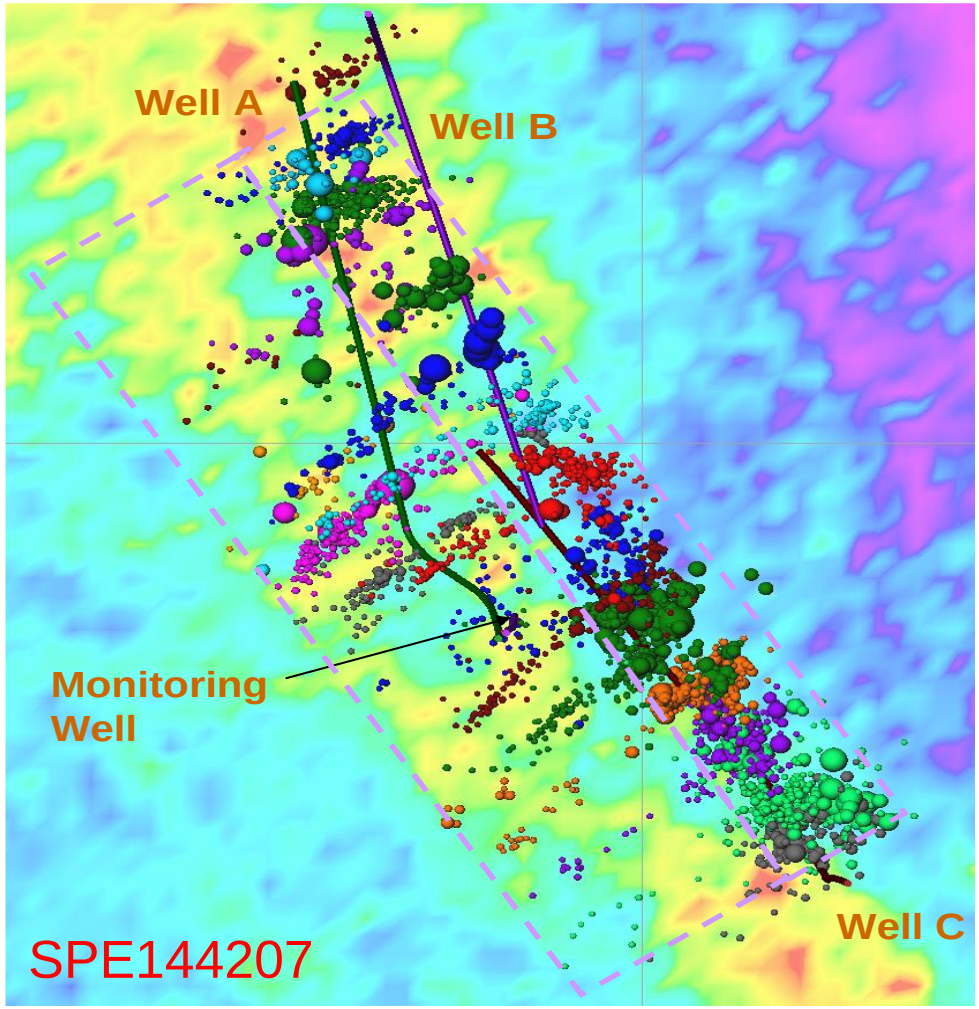
No damage and rare

(several sites and about 70 felt events from 3,000,000 fracs)

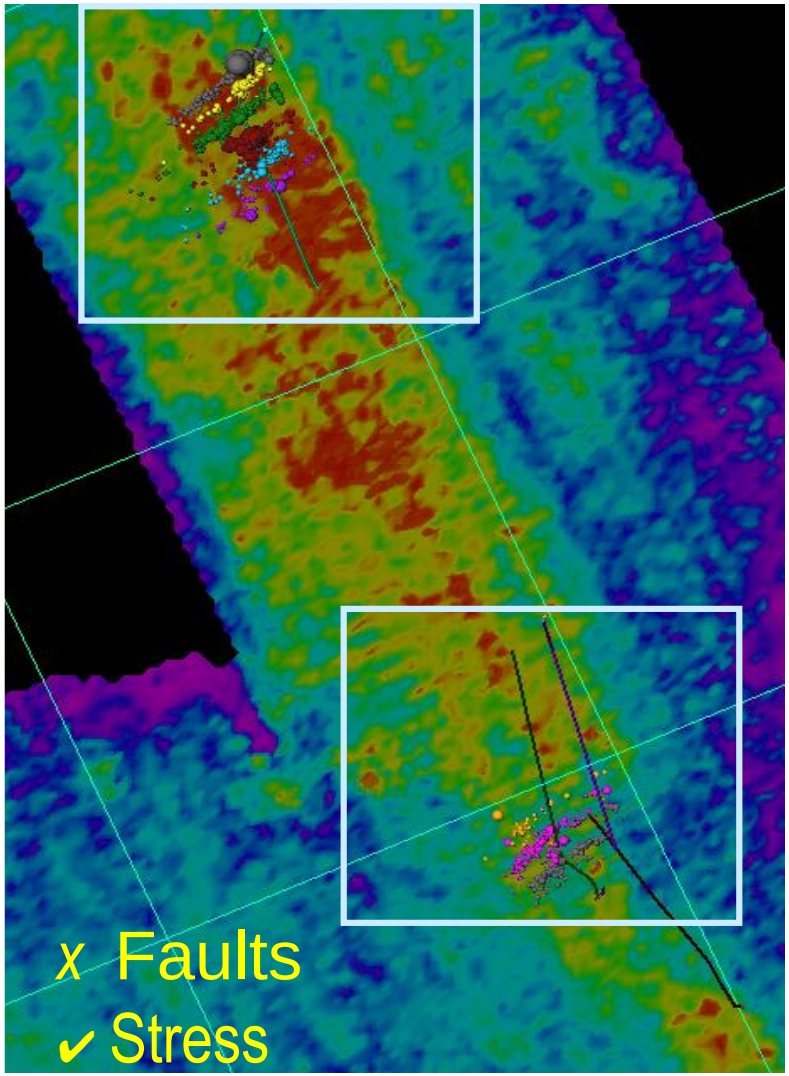
Shale Lessons: Heterogeneity

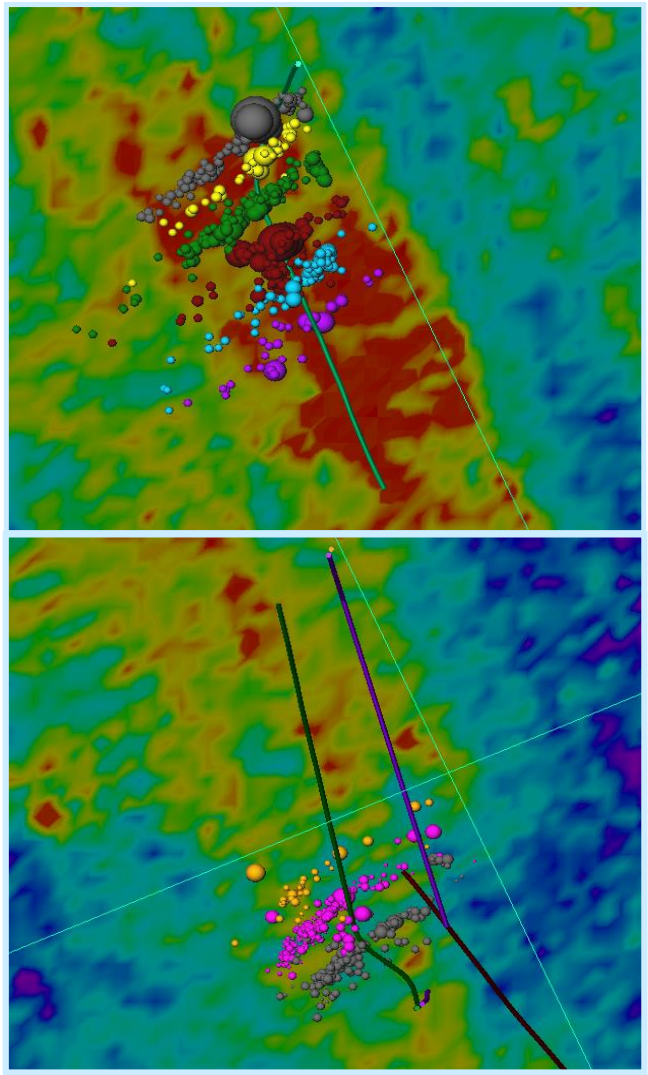
1. Depth Containment
2. Fracture Variability





Geomechanical "Sweet Spots"

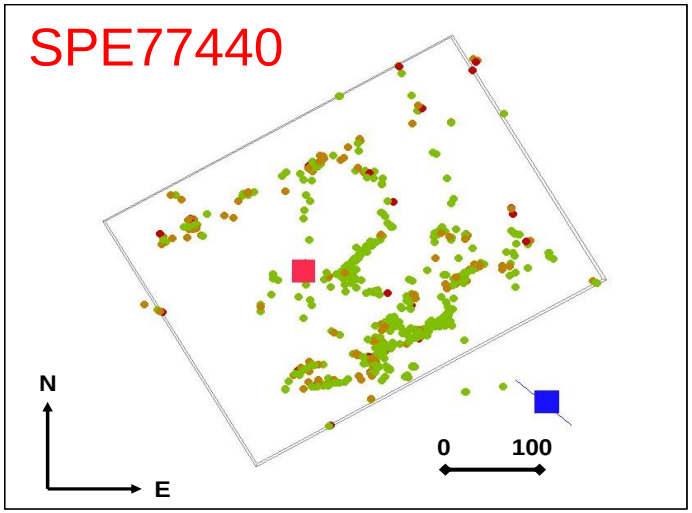


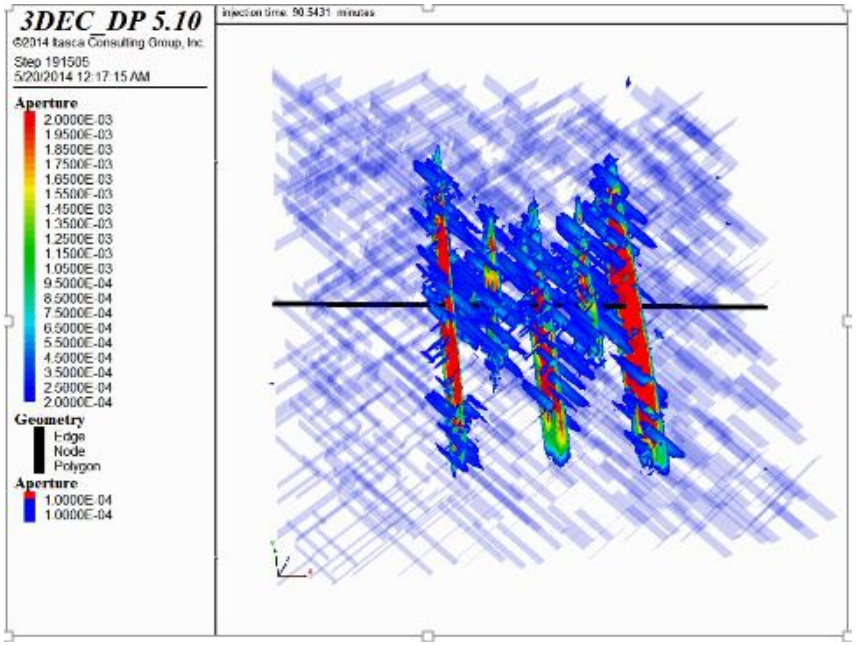


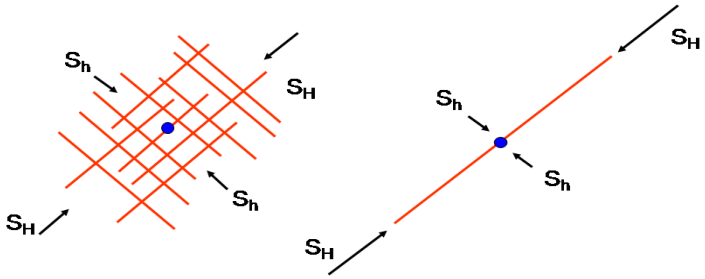
Improved well placement using integrated reservoir characterization and microseismic

Shale Lessons: Complexity

1. Depth Containment
2. Fracture Variability
3. Fracture Complexity





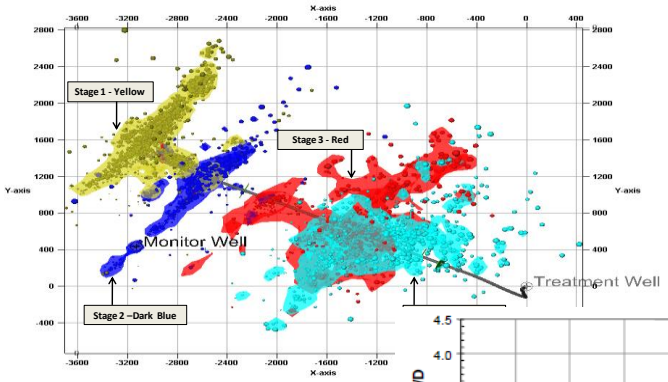


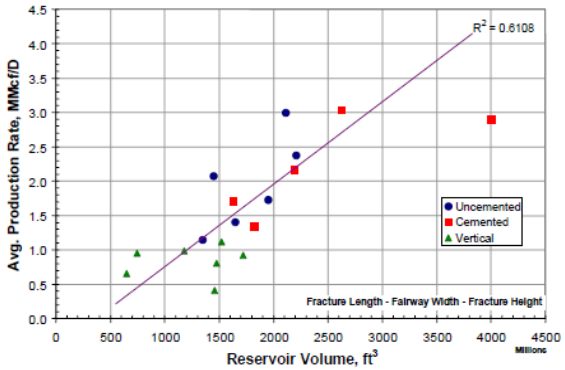
- Low stress anisotropy
- Wide fracture fairway
- Lower seismic anisotropy

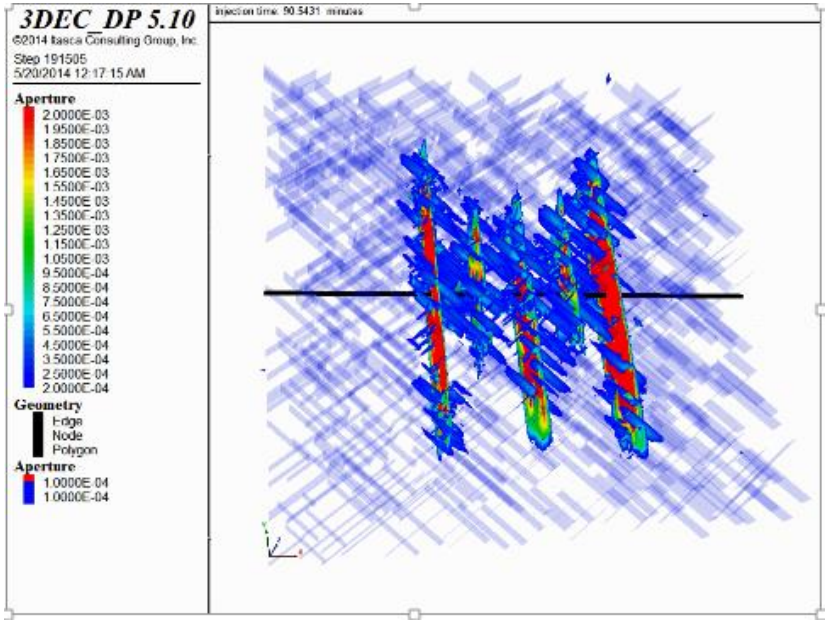
- High stress anisotropy
- Narrow fracture fairway
- Higher seismic anisotropy

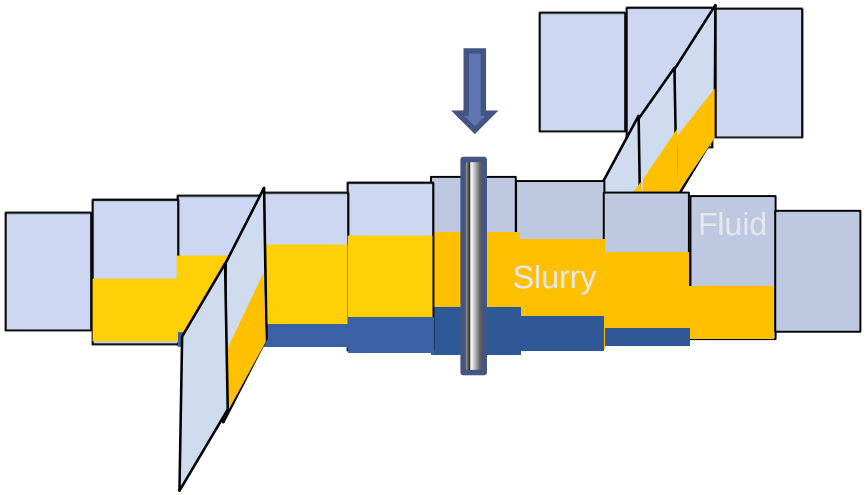
Sayers 2010

1. Depth Containment
2. Fracture Variability
3. Fracture Complexity
4. Stimulated Reservoir Volume

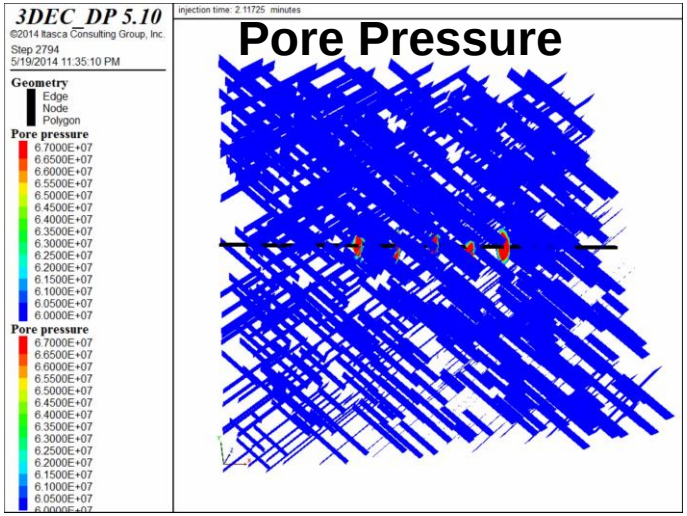


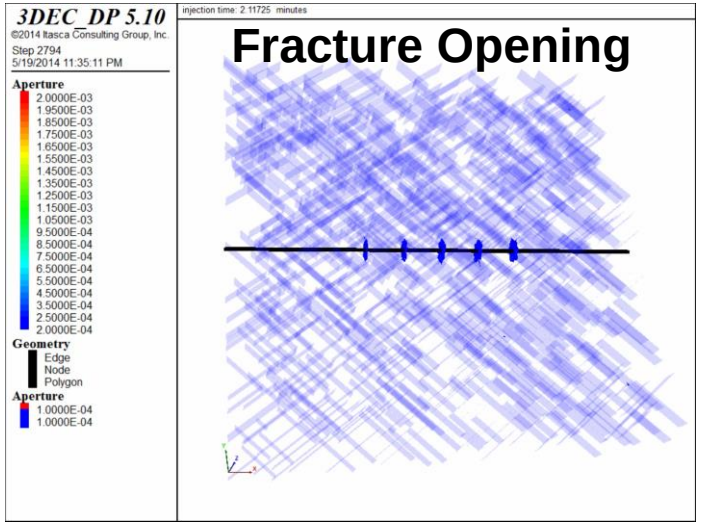


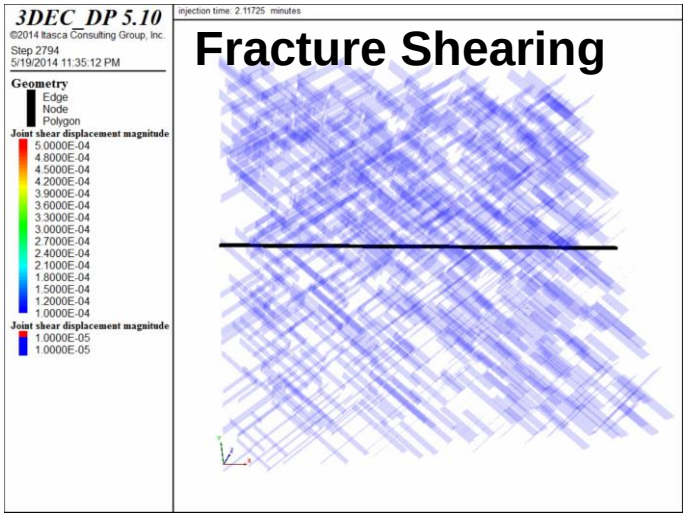


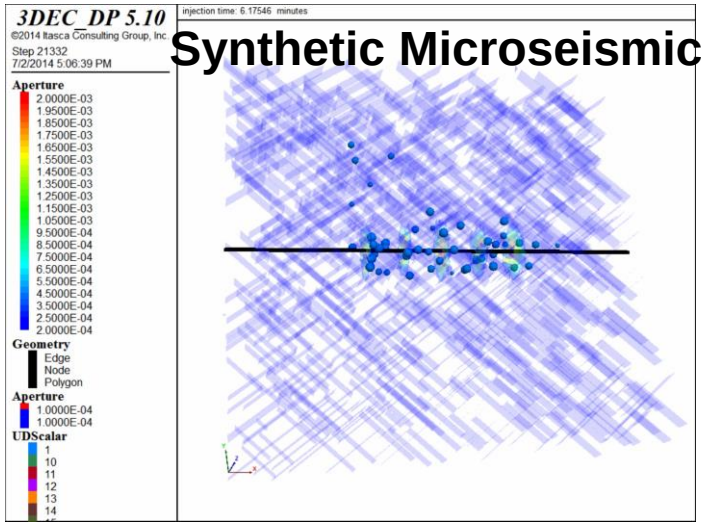


Complex Hydraulic Fracture Growth

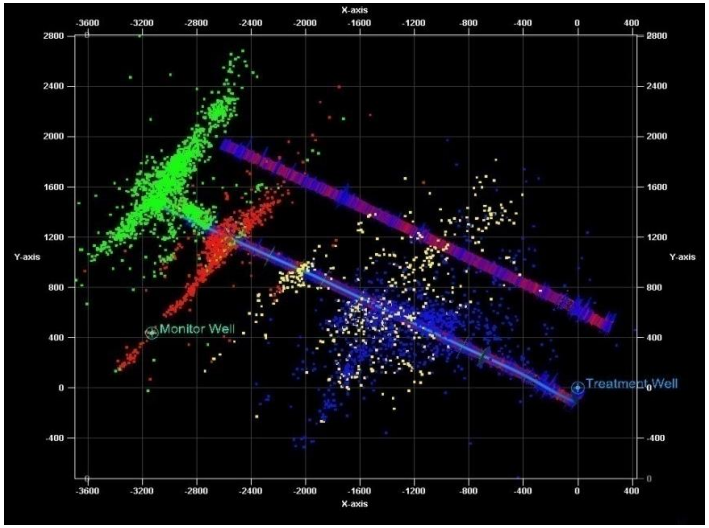


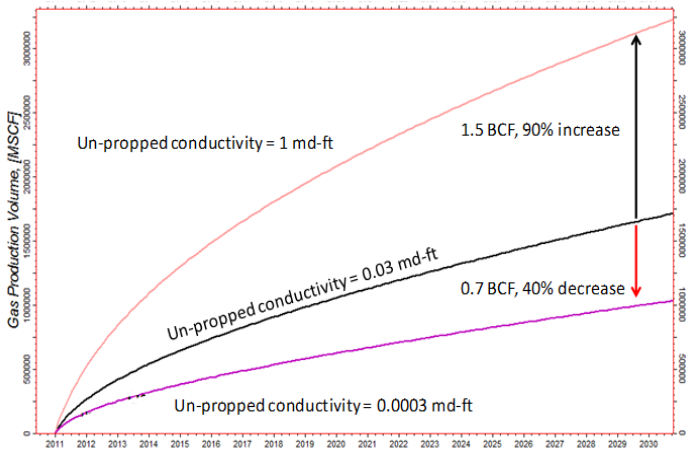




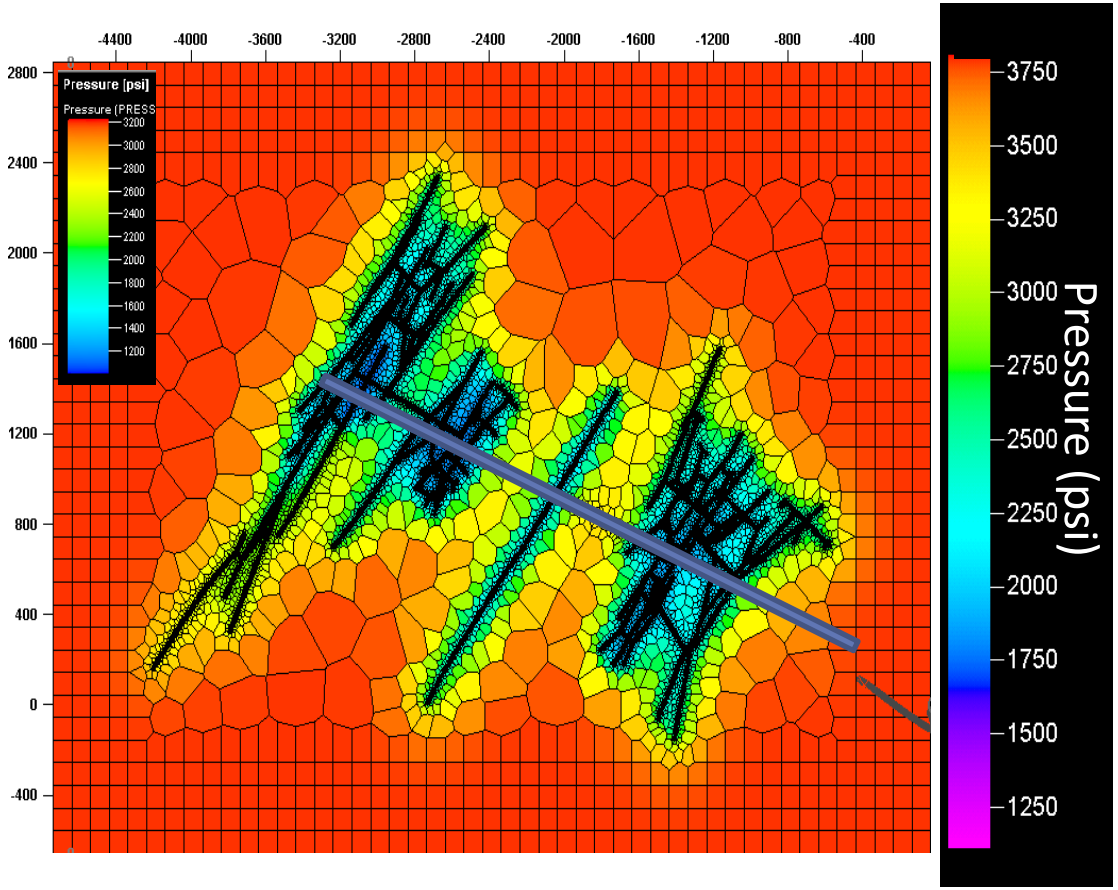


Reservoir Drainage





Production Forecast 20 Years



Geomechanical interpretation tools key to realize the full value from microseismic

- Microseismic demonstrated complex fracture networks
- Microseismic volume oversimplification
- Microseismic calibration of complex geomechanical fracture model
  - Enables reservoir simulation of well performance
  - Estimates drainage for well spacing