Technical considerations for Hydraulic Fracturing and Groundwater Protection:

Overview of geology, depositional environments, thickness, and areas of major frack plays in TX

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GWPC meeting – Houston
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Leftover business:
Shallow flanks of basins in frac plays

• Frac targets are closer to groundwater
• Large operators may not be interested, but small ones might be...
• Anticipate and prevent a Pavillion, Wyoming situation
Marcellus Shale
Utica Shale

Sources:
NY DSGEIS;
Wrightstone, 2008
Geological Cross Section, Utica to Binghamton
No vertical exaggeration

10 miles
Why deeper is better

- Higher pressures = more reserves, higher rates
- Better geotechnical conditions for long horizontals; more wells per pad
- Chances of upward frac excursion extremely low
- 40,000 “lost” shallow wells in NY, more in other states
- Leaves a thick buffer zone between frac and GW
- Less experience with large-scale fracking at shallow depths
Texas frack plays
Oil migrates upward

Oil is trapped where reservoir rocks occur in trapping configuration

About 1.5 to 3 miles down...

Source rocks generate oil and gas

Tens of miles

Reservoir rock

Seal

Earth's surface
Petroleum Geology Basics, cross-section

Unconventional resources – poor reservoir rocks, in or near source rocks.

About 1.5 to 3 miles down...

Source rocks generate oil and gas

And they go nowhere!
>30,000 wells fraced in the past 5 years

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**SHALE BASINS**

- **Anadarko Basin**
  - Pennsylvanian shale and tight sand frac targets
- **Fort Worth Basin**
  - Mississippian shale and limestone frac targets
- **Gulf Coast Basin**
  - Jurassic and younger targets
- **Permian Basin**
  - Permian shale and tight sand frac targets
- **Permian Basin (Permian shale and limestone)**
- **Woodford Shale**

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**Key Locations**

- **Barnett Shale**
  - granite wash, Cleveland, Marmaton
- **Haynesville Shale**
  - Bossier Shale, Cotton Valley, Travis Peak
- **Eagle Ford Shale**
  - Pearsall Shale, Pea Shale
- **Permian Basin**
  - Wolfberry, Canyon Sands
- **Anadarko Basin**
  - Olmos, Vicksburg, Wilcox

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*JP Nicot, 2011*
Texas Frac Plays

- Wide variety of ages
- Many lithologies
  - Black shale, tight sandstones, tight limestones
- Varying thicknesses
  - Barnett, Eagle Ford, Haynesville shales ~300’
  - Wolfberry 100s of feet
- Commonality:
  - in or near thermally mature source rock
  - no flow unless fracked
Eagleford gets deeper towards the coast

Outcrop areas
Eagle Ford roadcut near Del Rio, Texas
Thickness of Lower Eagle Ford Shale

Most wells are drilled in this lower zone

Maverick Basin
Stuart City shelf margin

Tucker Hentz, BEG
“Wolfberry Trend” carbonate debris flow facies, seismic cross sectional view

Carbonate Debris Flows (blue and pink)

Shales (Green)

From DrillingInfo website
Questions/Discussion