Discovering Oil and Gas "Sweet-Spots" in Fractured Reservoirs of the Austin Chalk and Eagleford Shale of South Texas

An EFP Presentation



Our Basic Question

How do we Select our Best Places to Drill?

We Need to Explain the Whole System



Reservoirs in South Texas - All are Fractured to Some Degree

We Need to Go Beyond Finding Good Reservoir Example: Maverick Basin Glen Rose and Georgetown Plays 20 Miles



3D shows the Linear Dolomites, But NOT Hydrocarbon Saturated Reservoirs

The Answer is Complex A Geologic Approach Solves Some Issues

- An Engineering Approach Manages
 Some of Our Other Risks
- A Higher Level Approach <u>Also</u> Look at Fluid-Migration and Permeability Development.
 - This Solves Problems in a New Way, But it is Rarely Used, Until Now....

The Pearsall Play Two Wells, Two Approaches



- Cannan (Left) is a Natural Sweet-Spot Well
 - Unfortunately, only 2 of the 10 wells in the 3D Program were Successful
 - Big Kahuna (Right) is a "Best Practices" Well of the Early 1990's
 - An inexpensive well (\$600K) with Precision Targeting in the Austin "E" Zone

For All Fractured Reservoirs What is Needed is a Combined Strategy



 Goal: Is to Hit the Well on the Left in Most Cases, but Fall-Back on the Well on the Right. EFP has the Technology to Manage Both Scenarios and Push the Results to the Right Side of the Distribution Curve. Let's Look at That Curve...

Distribution of Pearsall Wells



- Blue Line is the CUMs for All Horizontal Wells (Allocated by IP)
- The Red Line is the Distribution of Fracture Apertures in Core
- The Squares and Triangles are the EURs of Wells from Two Different Companies

Distribution of Pearsall



Explanation

- Upper Triangles Recent Sage Operated EURs
- Large Squares Recent CML Operated EURs
- Blue Line Hz Pearsall Wells (CUM, Low to High)
- Red Line BEG Fracture Aperture Size (Core, Low to High, Left to Right)
- Note Correlations Especially at the 90th %ile

Some Major Points

- Sage Strategy Multiple Laterals and Fracing in a Better Area for Natural Fractures
- CML Strategy Using 3D to Image Find Large Faults
- Note on Distributions There is an Amazing Correlation of Fracture Width to Performance.
 Notice the change in Slope Occurs at the Same Percentiles in the Distribution Curves.
- Only 10% of Wells have the Large Open Fractures, BUT these Wells Bring the Average Up to Almost Double the Median! Let US Investigate Why...

The Best 10% versus The Average



Mosaic 1

Two Wells, Two Types of Fractures Left Photo: Vein Fracture Right Photo: Hairline Fractures

Oil and Casinghead Gas Production Monthly Production Volume (Logarithmic) vs. Time

Lease Number: 13942 - District: 1; Dimmit County, Texas

Hairline-Fractures

Geologically Younger

Now, Let's Explore • 3D Seismic - Good, but Not "Magic" Basic Mapping of Fracture Trends and Structures Geologic and Production Mapping Use Good Engineering Practices • But... We Need More!

We Need to Find Perm! Log Petrophysics - Finding Fractures · Good Geo-Navigation (HNAV with EFS) Surface Mapping Detail Geology Surface Minerology Surface Geomorphometrics Developing and Applying a Good Model

"Magic Methods" - Ways to Find Perm



Using Petrophysics to Ascertain a Measure of Fracture Intensity

Surface Geomorphometrics



Using Surface Mapping to Find Migration Chimneys and Faults

Warm Colored Areas Correlate to Better Production

The Wide Aperture Fractures Can be Seen on the Surface



Wide Aperture Fractures in the Eagleford Shale at Outcrop

Summary

- Oil and Gas "Sweet-Spots" CAN be Identified
- Fracture Systems CAN be Mapped
- Begin with the Basics of Recognizing Two VERY Different
 Fractures Types and What Causes Them
- Basic Geologic Field Mapping is Critical
 - Question: So Why Are Most Companies Ignoring It?
 - Answer: There is Huge Pressure to Show Homogeneity and Completion Technologies that are "Magic Bullets."
- Integrate Your Field Mapping with a Super-Regional Tectonic Picture (Plate Tectonic History) as Some Trends are Better than Others