

# **Stranded Pay Between the Laterals: New Technology to Identify and Recover Gas and Oil**

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## **Abstract**

The focus of this presentation is reservoir optimization, with an emphasis on bypassed and/or stranded pay. It addresses the emerging problem of bypassed and stranded pay in multi-stage hydraulically fractured wells where there are “sweet spots” (that is to say, preferentially enriched zones within the heterogeneous reservoir rock) that were not adequately produced due to a number of factors. Many of the factors have to do with the fact that the formations being produced are extremely heterogeneous and also that the actual well design and execution can be less than ideal, due to factors such as inadequate “plug and perf” stimulation, drilling out of zone when geosteering, proppant and fluid problems, fracture interference, and poor cluster efficiency. This presentation looks at how to identify and target the bypassed and stranded pay. It then reviews competing approaches to effectively targeting and producing the pay, ranging from whipstocking the laterals, sidetracking, refracturing, pinpoint perforating, and radial drilling. It also identifies the knowledge base required, and the team members needed in order to effectively analyze a reservoir, gather the correct data, build a model, and develop a drilling and production plan. The strategies addressed have been developed based on an extensive literature review, of which the key articles are provided as a reference.

## **Notes and Comments**

### **Stranded or Bypassed Pays: Between the Laterals**

Quick declines and variable production histories reveal inadequate drainage. The reasons for the inadequate stimulation often have to do with a fracturing design that attempts to avoid fracture interference. Incomplete drainage also occurs when there are attempts to quickly and efficiently fracture the well using “plug and perf” and geometrically spaced clusters. These are methods that are quick, but incomplete. Some significant points are:

- Not just for mature fields or uneconomic isolates
- Stranded pay in within the laterals: going back to the early laterals (the mainly depleted ones in order not to disturb ongoing production)
- Go in and redrill where the original lateral went out of zone (poor geosteering)
- Other factors that resulted in “bypassed pay” were incomplete initial stimulations or understimulated perf clusters

#### Types of Stranded and Bypassed Pay

- Between laterals
- On the edge of the outermost laterals (tangential “pod”)
- Behind embedded proppant
- Within stacked pay
- Along faults

#### **Re-Fracturing Horizontal Shale Wells: Effective but Expensive?**

- Refracturing may be necessary if original stimulation was not effective and conditions are amenable (no faults, low water).
- Plug and perf completions in long laterals in highly heterogeneous shales with lesser “fracability” are less likely to be effective (Woodford case by French, et al., 2014).
- Original hydraulic fracturing may be sufficient. Stimulated Rock Volume may be higher than microseismic indicates.
- Available porosity is good once perm barrier is penetrated.

#### Methods include:

- Sliding-Sleeve Inner-String Fracturing
- Coiled-Tubing Deployment
- Cemented Inner Liner

#### **Sweet Spot Optimization: Whipstocked / Sidetracked Laterals**

- Better integration with sequence stratigraphy, geochemistry, imaging, XRF, etc.
- Under-development: Whipstocking the Sweet Spots
- Whipstock directional drilling for better penetration of sweet spots
- Whipstock off the lateral where microseismic indicates a fracture pod; Packers or sliding sleeves to perf within the whipstocked part of the lateral?
- Technique tried in the Fayetteville Shale (Broussard, et al., 2009)

## **Interdisciplinary Team**

It is important to develop an interdisciplinary team that brings together geoscientists, engineers, and modelers in order to identify the location of the bypassed or stranded pay, and then to develop a team to retrieve it.

The teams should represent the following areas that require specialists:

- Microseismic interpretation
- Data integration (Khashmy, et al 2012)
- Data mining (identify important shale properties and then develop a model: shale property quality ranking) (Chorn, et al, 2014)
- Drilling engineers
- Geochemistry: fingerprinting & fluid design

Understanding the nature of the reservoir is absolutely the most imperative first step, although it does take time; it is important to integrate a great deal of information, and also to make sure that the information gathered is consistent. Information is used to develop an estimate of rock properties which include the following:

maturity  
TOC  
porosity  
brittleness  
thickness  
fluid saturation

## **Summary of Approaches**

- Re-stimulation by re-fracturing the depleted laterals
- Whipstocking or side-tracking within a depleted lateral to retrieve bypassed or stranded pay
- Pinpoint perforations / fracturing techniques (can include radial jet drilling in verticals)
- Use in aging fields as well (Cinelli and Kamel, 2013 – case study in Kansas)

## **Selected References**

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