NuFIT™ Service – South Texas

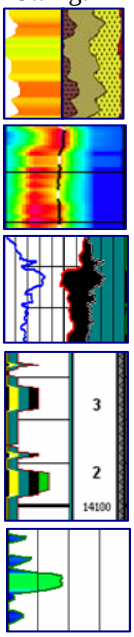
Operator Challenge:

A South Texas operator was questioning the **economic viability** of a completion in a **wildcat Wilcox interval**. The production capacity of the interval was unclear based on conventional logging responses alone. Internal debates over the completion of the interval were fueled by the **uncertainty regarding the reservoir quality**. More data was needed in order to make an economically sound decision regarding completion of the interval. The well would not flow prior to stimulation, so a buildup test could not be performed.

NuTech Solution:

NuTech Energy Alliance applied its **NuLook Textural Vision™ (NTV)** and **NuFIT™ (NuTech Fracture Injection Test) processes** to the data set to properly evaluate the Wilcox interval and assist the operator in making an informed decision.

First, the NTV analysis was employed to provide a **textural reservoir description**, shown in Fig. 1, which included the following:



- Clay volume determination
- Textural pore distribution
- Bound and movable fluid quantification
- Gross and net feet of productive sand
- Average pay quality ranking
- Textural permeability

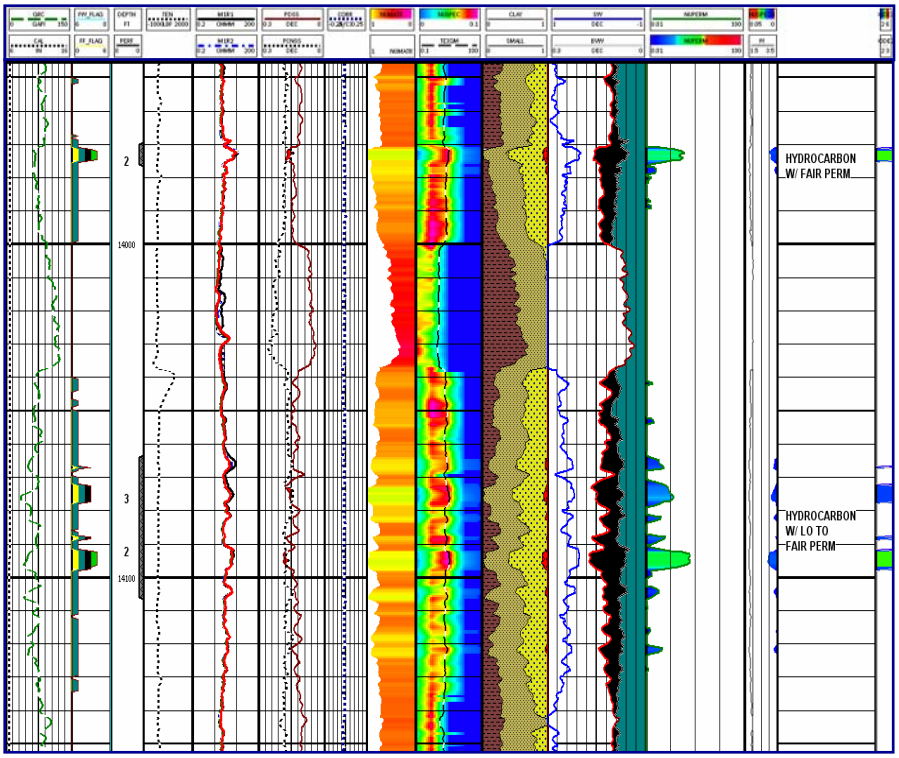


Figure 1: NuLook Textural Vision analysis of the Wilcox interval.

NuList Parameters: *Wilcox*				
Depth	Pay	AVE Rank	$PHIE_{AVE}$	$Perm_{ABS}$
13,920 - 14,140 Ft	17 Ft	2.6	15.70%	0.243 mD

After reviewing the NuLook, the operator was able to identify the **net pay intervals** and properly **define the reservoir**, but was still uncertain regarding the **economic feasibility** of applying a costly stimulation treatment to the interval.

In order to provide the operator with a direct **measurement** of the in-situ **permeability, pore pressure,** and closure **stress,** a NuFIT **(NuTech Fracture Injection Test)** was designed and executed for this zone. The NuLook evaluation enables proper design of the NuFIT to ensure a good measurement of these properties is obtained. After perforating, a treated water breakdown of a specified volume was injected into the formation at a constant rate. The well was then shut-in and the pressure was monitored for 24 hours with a surface memory gauge.

The test was designed in order to ensure that the shut-in period was long enough not only to observe the formation closure pressure, but also to observe a measurement of the **effective permeability**. An adequate shut-in time is required to properly obtain a measurement of pore pressure and permeability which was estimated from the interval's parameters as described by the NuLook evaluation.

There are **four components to the NuFIT** test:

1. **Job Data Analysis**
2. **Step Rate Analysis**
3. **Before Closure Analysis**
4. **After Closure Analysis**

The **Job Data** includes the injection fluid type, volume, rate, and the pressure data for both the injection and shut-in. The analysis of the Job Data leads to identification of the **frac gradient** and an estimation of the pore pressure. **Step Rate Analysis** was not performed in this particular case due to the small injection volume. However, when implemented, analysis of the rate and pressure data during a step rate test will quantify **near wellbore** and **perforation friction**. The **Before Closure Analysis** involves identifying the formation closure pressure, leak-off mechanism **(G-Function analysis)**, fluid efficiency, and recommended pad percentage. The **After Closure Analysis** identifies the **effective kh** and the **pore pressure**.

While other tests can identify some of these same properties, such as breakdowns, FETs, and pressure buildups, the NuFIT allows measurement of all of these properties prior to fracturing. Often, intervals will not flow unstimulated, eliminating the option of a lengthy pre-frac pressure buildup. Breakdowns and FETs are often performed when it is not feasible to shut the well in for an adequate time to allow observation of formation closure. Additionally, there are many cases when misdiagnosis of the closure pressure leads to improperly designed stimulation treatments. FETs are often **performed the day of** the stimulation treatment, which does not allow time for significant changes to be made to the planned treatment, as equipment and materials are already on location. FETs are typically performed using a fracturing fluid which builds a filter cake, controlling leak-off. This is beneficial for fracturing, but hampers the attempt to determine permeability. Also, the FET analysis focuses on the Before Closure Analysis, which is very much **dependent on the fracture area created** to determine a relationship between leak-off and permeability. The NuFIT allows for After Closure Analysis, yielding a permeability measurement **independent of the created fracture**. By performing the NuFIT the same day as the interval is perforated, adequate time is allowed to **tailor the stimulation treatment** to the interval based on its measured properties.

THE RESULTS:

In this case, the primary leak-off mechanism identified was **height recession** (Fig. 2). This leak-off characteristic is impacted by the fracture area changing after shut-in and before closure. Since the frac area is changing, any permeability measurement obtained from the before closure data is skewed. The Before Closure Analysis results are highlighted in Figure 3.

Analysis of the after closure leak-off yielded a **reservoir pore pressure of 11,609 psi**, as well as an **effective kh of 0.659 mD-ft** (Fig. 4). This is independent of the fracture area created and provides a direct measurement of the permeability.

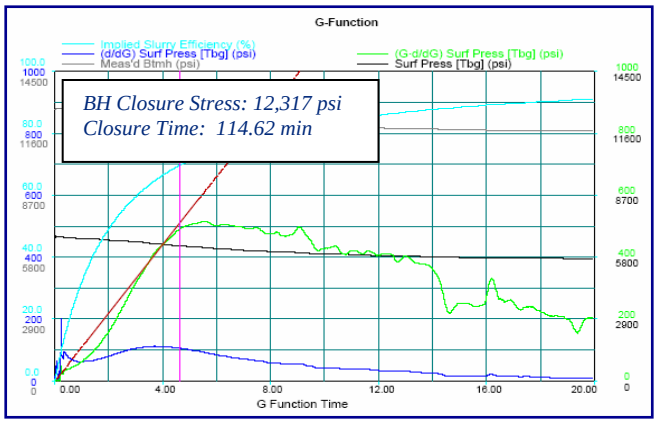


Figure 2: G-function plot identifying closure.

Before Closure Analysis Results	
Primary Leak-off Mechanism:	Height Recession
Closure Time (min):	114.62
G-Time Closure:	5.7
BH Closure Pressure (psi):	12,317
Closure Gradient (psi/ft):	0.877
Fluid Efficiency (%):	69.76
KANE Pad (%):	9.1
Nolte Pad (%):	14.1
Shell Pad (%):	17.8

Figure 3: BCA Results.

CONCLUSIONS:

By utilizing the NuFIT, as designed with the support of the NuLook petrophsyical analysis, the operator was able to easily **identify the true characteristics** of the wildcat reservoir prior to completion. Based on the results of the NuFIT analysis, the operator was able to confirm the interval as **non-commercial and aborted a proposed $278,000 stimulation treatment**, moving uphole to more lucrative zones.

After Closure Analysis Results	
Reservoir Pore Pressure (psi):	11,609
Effective Permeability Feet (mD-ft):	0.659
Net Height (ft):	15
Reservoir Effective Permeability (mD):	0.044

Figure 4: ACA Results.

For more information about how NuFIT and NuLook Textural Vision can impact your bottom line, contact your local NuTech representative.