NuFIT™ Service – East Texas

Operator Challenge:

Seeking assistance with **Cotton Valley Taylor completions** in an unfamiliar area, an operator utilized NuTech Energy Alliance's NuLook and NuFIT analyses in order to characterize the sands and **predict performance prior to fracturing**.

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 Cotton Valley Taylor sands and assist the operator in making an informed decision. NuTech's NuLook analysis is a **deterministic** petrophysical process with which well log data is normalized through a **global well log database** and that yields a description of the effective porosity, bound and free fluid saturations, and **pore size distribution** of the reservoir. This process allows for a consistent evaluation of well performance and an **accurate determination of permeability.**

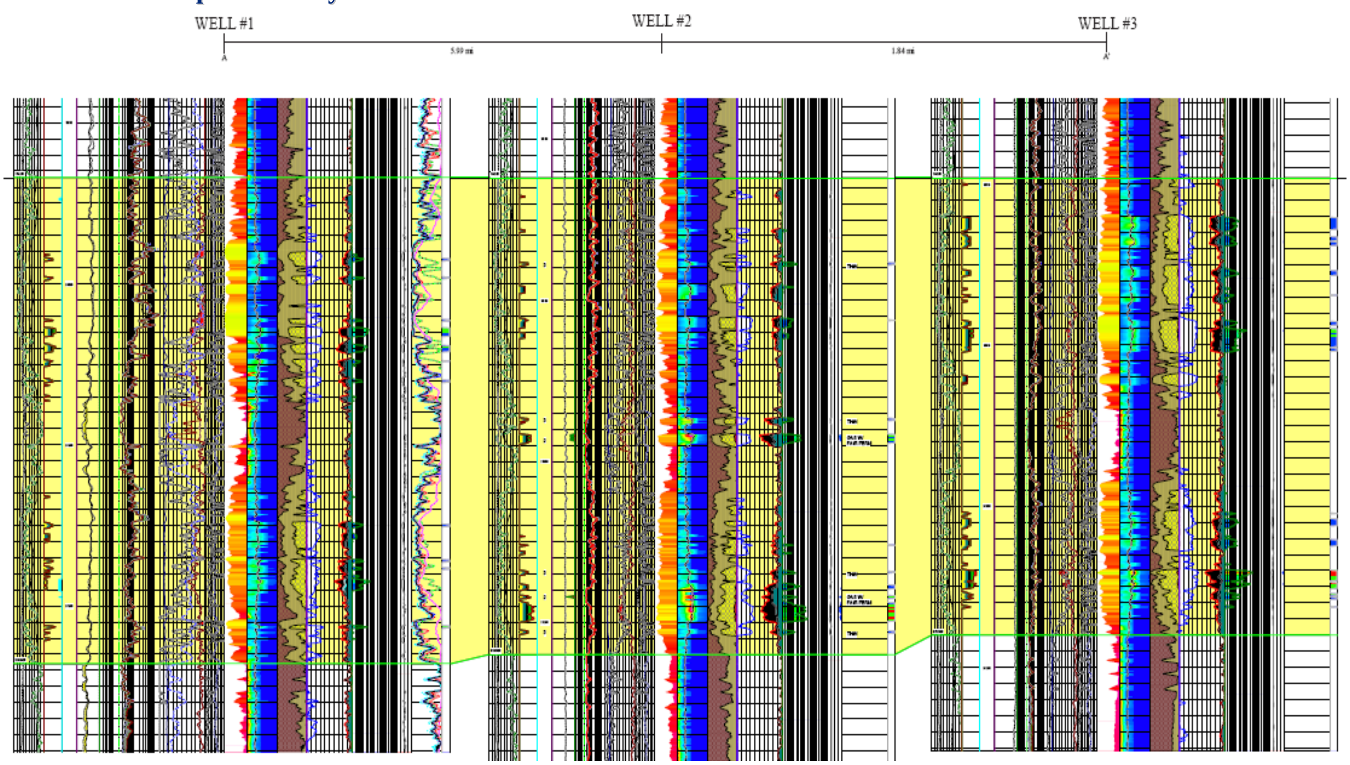

Figure 1: NuLook Textural Vision analyses of the Cotton Valley Taylor intervals in three wells.

NuTech's NuStim process then enables **completion evaluation** and **optimization** by linking the consistent reservoir evaluation provided by the NuLook to observed well behavior, allowing new completion predictions to be made within a field. When past well behavior is not available, or is difficult to ascertain, pre-frac measurements can be made with which to calibrate this process and allow for accurate predictions through a **fracture injection test** (NuFIT). NuFIT is an analysis oriented product in which NuTech aids in the development of a specific injection test procedure and provides the analysis of the test data in order to achieve direct **measurements** of the formation **permeability**, closure **stress**, and **pore pressure**.

In this case study, the operator collected data for three Cotton Valley Taylor wells, which were broken down with similar injection procedures of 25 bbls of treated water pumped at 1.5 bpm. All three wells were observed to have similar fracture and closure stress gradients, and were shut-in for 2 to 4 days while the **pressure** leakoff was observed at the **wellhead**.

There are two primary methods of determining permeability from an injection test: before closure analysis (**BCA**) and after closure analysis (**ACA**). Before closure analysis is only valid when the pressure falloff is dominated by a normal leak off regime. Other types of leakoff regimes (such as pressure dependent leakoff, frac extension, height recession, or transverse storage) indicate that the fracture dimensions are continuing to change after shut-in. Because the permeability calculations from a BCA analysis are dependent upon the created fracture dimensions, this type of analysis is not suitable when leakoff regimes other than normal are observed. Poor estimates of the fracture dimensions will negatively influence the calculated permeability from BCA.

After closure analysis is a more reliable method for measuring the permeability to reservoir fluid and pore pressure. In this type of analysis, the permeability determination is **independent of fracture dimensions**. However, it can take tight reservoirs many hours or sometimes several days to reach the proper flow regime for permeability calculations. NuTech is able to design the duration of this test through its NuLook evaluation.

THE RESULTS:

Analysis of the leakoff data indicates that all three wells experienced continued fracture extension after shut-in, while two of the wells (Well #1 and Well #3) also experienced height recession and the third well (Well #2) experienced a brief period of pressure dependent leakoff. This indicates that the fracture area was complex and continued to change after shut-in in all three wells. Thus, a BCA would have been an unsuitable analysis on these wells since the changing rates of leakoff and fracture area violate the permeability calculation assumptions for that type of analysis. The ACA was utilized for the permeability and pore pressure measurement in these wells. With the fracture injection test, the well was **not required to flow** before stimulation in order to determine these values.

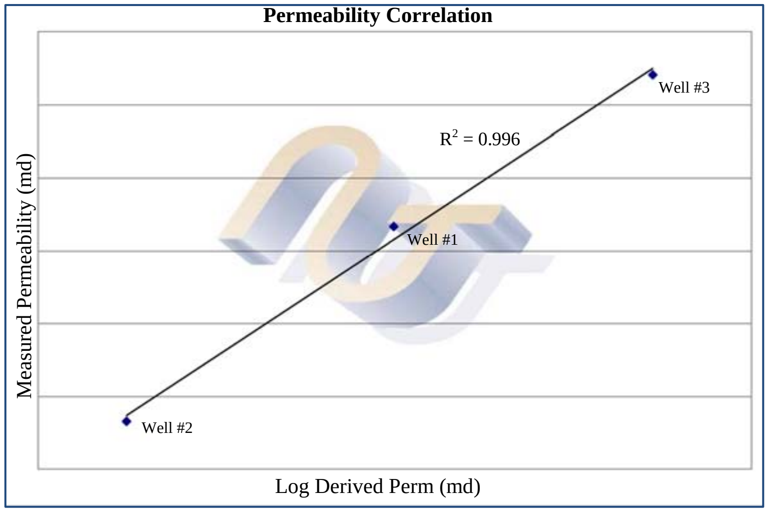

Figure 2: Correlation of measured permeability (NuFIT Perm) to log derived permeability (NuPerm).

The resulting measured permeabilities from the tests correlate to the log-derived permeabilities from the NuLook with **99% accuracy**, indicating that a strong correlation can be derived for this field and applied to other wells with log data only in order to make **accurate performance predictions**.

CONCLUSIONS:

The petrophysical analysis and the injection test results are in agreement. The ranking of productivity for only the sand intervals tested should be Well #3 > Well #1 > Well #2. However, based on the entire gross intervals actually planned for completion, the ranking should be Well #1 > Well #3 > Well #2 (see Table 1).

	Interval	PHIE	Frac Gradient (psi/ft)	Closure Gradient (psi/ft)	Shut-in Time (days)	G-time at Closure	Measured kh (md-ft)	Pore Pressure (psi)	Log derived kh (md-ft)	Hydrocarbon Pore-Ft
Well #1	A	0.08	0.735	0.604	2.02	8.8	0.080	5,350	4.783	1.683
	B	0.09	*Interval B not included in injection test.*						12.262	1.364
Well #2	A	0.08	0.690	0.610	3.81	23.0	0.034	5,424	2.574	0.955
Well #3	A	0.11	0.790	0.627	3.19	7.3	0.184	5,537	11.708	1.891

Table 1: Comparison of petrophysical and injection test parameters for each interval studied.

After stimulation, **the production results** (see Table 2) **confirmed the results of the petrophysical analysis** and the injection tests and gave the operator confidence in future performance predictions for wells in the field.

	Interval	Post-frac IP (MCF/D)
Well #1	A	1,300
	B	
Well #2	A	350
Well #3	A	1,000

Table 2: Comparison of post-frac production results for each interval studied.

For more information about how NUFIT and NULOOK TEXTURAL VISION can impact your bottom line, contact your local NUTECH representative.