Importance of Modern Logs and Accurate Mudlogs: An Example of a New Field Discovery*

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Abstract

Numerous new field discoveries may be missed by explorers who fail to use a full suite of modern logs and correctly calibrated mudlogs. A recent new field discovery in the Red Fork Sandstone and the Viola Limestone provides an excellent example of an ‘easy-to-miss’ field. The initial well was drilled on a 3D seismic structure. The primary objectives were tested as non-commercial. Before plugging, an errant 4-foot section of Red Fork Sandstone was perforated. The well flowed at a rate of 50 BOPD from natural perforations. Subsequently, the second well encountered a section of the Viola Limestone that was very similar to that in the first well (questionable porosity). However, the microlog suggested permeability in the middle Viola section and the mudlog indicated hydrocarbon presence. The mudlog shows and porosity intervals were identical to those not tested in the first well; the first well did not have a microlog. Consequently, the Viola interval was perforated in the second well and began flowing 200 BOPD with no treatment. The Viola flowed more than 15,000 BO in the first 100 days and produced no water. Presently, the field contains three wells producing from the Red Fork Sandstone and one well produces from the Viola Limestone all as a result of close examination of the logs and accurate mudlogs. Existing old style logs in the area would not have predicted the discovery in the Red Fork nor did the old style logs suggest a permeability zone in the Viola.
Importance of Modern Logs and Accurate Mudlogs: An Example of a New Field Discovery

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A FAMOUS STUDY

Stephenson, G. R. (1967)

Cultural Acquisition of Specific Learned Response Among Rhesus Monkeys
Strategy – Find More Oil/Gas

KNOW YOUR POTENTIAL TARGET RESERVOIRS

Look at cuttings – they are coming out of the ground.

Run a mudlog
  There are things that the cuttings may not show
  Be sure to calibrate *and test* the mudlog unit

Run Logs
  Learn all you can about what you encountered
  The bulk of the money to drill the well to find potential reservoirs has already been spent.
As a minimum, run DIL, CNDL, and a real Microlog (not computer derived).
  If possible, run repeat section over potential pay !!!
A FAMOUS QUOTE:

I always avoid prophesying beforehand.

It is a much better policy to prophesy after the event has taken place.
Why - Geological Setting – Bromide Structure
Why - Geological Setting – Viola Structure
TR DULL YEL FLU, NO VIS UV CUT, NO STN, NO ODOR

TR DULL YEL FLU, V/SLOW LT MILKY CUT, NO STN, NO ODOR

TR BRT YEL SPOTTY FLU, SLOW LT MILKY CUT, NO STN, NO ODOR

Caliper in gauge, spotty weak shows, low porosity

VIOLA LM:
Geological Results – Matthews #1-6

TR DULL YEL FLU, NO VIS UV CUT, NO STN, NO ODOR

TR DULL YEL FLU, V/SLOW LT MILKY CUT, NO STN, NO ODOR

TR BRT YEL SPOTTY FLU, SLOW LT MILKY CUT, NO STN, NO ODOR

VIOLA LM: Nothing exciting - DID NOT TEST
Red Fork Sandstone - Old Style (nearest log)

Poor Resolution and Definition
SS – CLR FROSTY VF-F GRN, W GD POR
SM BRT YEL EVEN FLU, OIL STN, STRMING CUT

Red Fork Sandstone
(Uphole Potential Target)
Geological Results – Matthews #1-6

SS – CLR FROSTY VF-F GRN, W GD POR
SM BRT YEL EVEN FLU, OIL STN, STRMING CUT
20% Porosity with 8+ Ohms (logs + show)

*Red Fork Sandstone:* To be Tested
A FAMOUS QUOTE:

However beautiful the strategy, you should occasionally look at the results.
Evaluate Results

What we do know

Be Honest…

**RISK** - There will always be things we do not know going into a project.

**$$$$** - There will be scientific milestones that have to be objectively examined.

**Evaluate** – Things may not turn out as expected
Evaluate Results
First Well

Red Fork Sandstone
Matthews Field - T6N R2E s06
Pottawatomie County, Oklahoma

Evaluate Results
First Well

Red Fork Sandstone
Matthews Field - T6N R2E s06
Pottawatomie County, Oklahoma

Red Fork Discovery: Matthews #1-6
Perforated: after swabbed 4 pulls began flowing
Initial Production Rate: Flow 50 BOPD
As of 7/01/2012 producing 19 BOPD with no water
Cumulative Production (7/01/2012) 18,200 BO
Offset = Matthews #2
Evaluate Results: Offset Well(s)

Matthews #1-6 swabbed oil from the top of the 2nd Bromide Sandstone.

With actual tops, we re-examined/re-interpreted the seismic.

Determined that we could possibly get 10 feet higher.

Interesting things below the 2nd Bromide prompted an Arbuckle test.

Drilled Matthews #2-6

Ran logs that included Microlog, Sonic log, CNDL, and DIL

Ran High resolution over areas of interest:
Bromide, Viola, Woodford, and Red Fork
Other zones of interest: Arbuckle – perforated w/ show of gas
VIOLA LM:
No sample shows reported, gas chromatograph had suggestion of hydrocarbons
Geological Results – Matthews #2-6

VIOLA LM:
No sample shows reported, gas chromatograph had suggestion of hydrocarbons. Microlog indicated potential zone.
VIOLA LM:
No sample shows reported, gas chromatograph had suggestion of hydrocarbons. Microlog indicated potential zone. Decided to Perforate Viola (5708 – 5720).
Evaluate Results

Viola Limestone (5708 – 5720’)
During fifth swab run well began to flow
(recovered 3700’ fluid during first 4 runs)

Flow well 3 hrs before beginning production tests. Instant SITP 500 psi. SITP 775 psi in 20 min.

3 hr test avg 10 BO/HR @ 475 FTP on 12/64” choke
5 hr test avg 13 BO/HR @ 475 psi FTP on 12/64” choke
4.5 hr test avg 11 BO/HR @ 495 psi FTP on 11/64” choke
3.5 hr test avg 9.4 BO/HR @ 525 psi FTP on 10/64” choke
5.5 hr test avg 11 BO/HR @ 580 down to 500 psi FTP on 10/64” choke

300+ BO in tank after first 24 hours.

24 hr test avg 9.5 BO/HR @ 525 psi FTP on 9/64” choke
= 228 BOPD
Evaluate Results

Viola Limestone
Matthews Field - T6N R2E s06
Pottawatomie County, Oklahoma

- first 100 days = FLOW 15,000+ BO with no water
A FAMOUS QUOTE:

Personally, I am always ready to learn,

Although I have not always enjoyed the lessons.
Evaluate Results

Matthews #1

- Missed $$$
- No Microlog, good mudlog

Matthews #2

- $1,500,000 in 100 days
- Good Microlog, good mudlog
Evaluate Results - **VIOLA**

Matthews #3
Matthews #1
Matthews #2

Matthews #3-6
Matthews #1-6
Matthews #2-6
Evaluate Results - VIOLA
OTHER FAMOUS STUDIES

How to learn and motivate success “carrot or stick”

B. F. Skinner experimented with dogs, levers, and rewards (carrot)
Basset Hounds do not make good test subjects.

Seligman & Maier experimented with dogs, levers, and shock (stick)
Group 1 put into harnesses for a period of time – no shock
Group 2 either dog could press a lever to stop the electrical shock
Group 3 only one dog (A) could press the lever to stop the shock while the other dog’s (B) lever did nothing

Only 3A dogs learned to act. Group 3B dogs exhibited the “learned helplessness response” and had symptoms similar to chronic clinical depression.

Subsequent experiments using dogs, monkeys, and rats point to the same conclusion. Subjects that have a mechanism of control (lever) over their destiny do learn to act to create positive results. Subjects that have no mechanism of control do not learn to create positive results.
Evaluate Results – Red Fork

Red Fork Sandstone
Matthews Field - T6N R2E s06
Pottawatomie County, Oklahoma

Red Fork Discovery: Matthews #1-6
Perforated and swabbed 4 pulls began flowing- no stimulation.
Initial Production Rate: Flow 50 BOPD
As of 7/01/2012 producing 19 BOPD with no water
Cumulative Production (7/01/2015) 18,200 BO
sample shows reported, gas chromatograph had suggestion of hydrocarbons. **High Resolution Logs show potential zone**
Evaluate Results – Red Fork

Red Fork Sandstone
Matthews Field - T6N R2E s06
Pottawatomie County, Oklahoma

Red Fork:
Matthews #3-6
Perforated - Acid breakdown.
First Month Production
July 2012 = avg 28 BOPD

Engineering on wells suggests more reserves
Evaluate Results – Red Fork

Red Fork Sandstone
Matthews Field - T6N R2E s06
Pottawatomie County, Oklahoma

- Decline Rate of Matthews #1 plus Matthews #3
- Decline rate of Matthews #1
- Matthews #3-6 Increase of reserves by approximately 40,000 BBLs (primary recovery)
Geological Results – Red Fork – Continuity of Sand

Matthews #3-6     Matthews #1-6     Matthews #2-6
Evaluate Results – Red Fork

Red Fork Sandstone
Matthews Field - T6N R2E s06
Pottawatomie County, Oklahoma

FRAC Matthews #3-6

Effect of Fracture Stimulation on Production Rate

3X increase in production rate.
Geological Results – Red Fork – McBee #1-6
Evaluate Results – Red Fork

Red Fork Sandstone
Matthews Field - T6N R2E s06
Pottawatomie County, Oklahoma

Red Fork: McBee #1-6
Perforated with Frac Stimulation.
First Month Production
December 2014 = avg 20+ BOPD
Using old style logs, the field would not have been detected.
Evaluate Results – Red Fork

McBee #1-6
Matthews #1-6
Matthews #2-6
Matthews #3-6

1
6
Evaluate Results

What we do know

Be Honest about everything...

- RISK -
- $$$ -
- Evaluate –
  Flexible – *Do not* repeat the same thing with the expectation of different results.
    Conduct “mini” experiments along the way (tweak things)
    *(expect that sometimes they go wrong)*

What is the best option on logs/information?

*Typically one needs to determine* Porosity, Permeability, Resistivity, and using a good gas chromatograph that is tested while drilling increases the chances of not overlooking a reservoir.

Using modern logs and accurate mudlogs, did we find appreciable amounts of OIL/GAS that otherwise might have been missed?

Yes, approximately 185,000 BO on primary recovery
A FAMOUS QUOTE:

For myself, I am an optimist,

It does not seem to be much use being anything else.
Summary

Examine the cuttings – but they are not always conclusive.
A well run and calibrated/tested mudlog is a valuable tool – but
the conditions may not be optimal for the tool to be conclusive.
Summary

Matthews #1
65 unit mudlog shows
Slight milky cut
No suggestion of permeability
Not Tested

Matthews #2
50 unit mudlog shows
No cut mentioned
Permeability indicated
Producing

Missed $$$
No Microlog, good mudlog

$1,500,000 in 100 days
Good Microlog, good mudlog
Summary

Red Fork
Vintage logs are useful – New logs provide definition
Summary CONTINUED

This field would not have been tested with old style logs – modern logs provide more resolution and definition.

Run enough logs to thoroughly evaluate the reservoirs – keep in mind there may be mineral, rock, drilling fluid, and/or hole conditions that cause less than optimal results.

Each tool “or methodology” on its own has merit. Using several tools can increase the value of each of the individual tools.

You may be the last monkey in the cage. Climb the ladder and get the bananas before you starve to death.

Remember the Group 3B dogs…

Prevent bad behavior and helplessness - Empower your team with good logs and mudlogs.

GET BETTER RESULTS
Thank You for your time and attention.

QUESTIONS???
ALL OF THE FAMOUS QUOTES

WINSTON CHURCHILL