

# ProTechnology

COMPLETION DIAGNOSTICS NEWS FROM PROTECHNICS

PROTECHNOLOGY IS A REGULAR TECHNICAL REVIEW FOR CLIENTS OF PROTECHNICS, A DIVISION OF CORE LABORATORIES, L.P. FOR MORE INFORMATION, OR TO COMMENT ON THIS NEWSLETTER, PLEASE CONTACT US AT 713-328-2320, OR VISIT OUR WEBSITE AT WWW.CORELAB.COM/PROTECHNICS.

## IT'S WORTH IT TO KNOW

### DIAGNOSTICS FOR THE HEALTH OF YOUR WELL

Medical diagnostics and completion diagnostics have one thing in common—in each process, knowledge is critical. Whether it's your health or your well, it's worth it to know what's going on.

When we feel poorly or have a nagging ailment, most of us don't hesitate to book an appointment with a physician for an immediate diagnostic examination. We know there's value in getting an early jump on a serious problem.

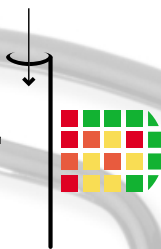
The same holds true with another valuable asset you own—your well. An early understanding of why your completion succeeded or failed is critical to the health of your well (and future wells). Near-wellbore completion diagnostics are the only direct measurements for many important aspects of completion performance.

As the accompanying graphic depicts, a successful completion is an iterative process that requires three steps: **Plan Strategically, Engineer Success and Measure Results.**

Planning strategically requires gathering all the necessary geological, petrophysical, geomechanical, and reservoir data. True 3D planar fracture models then use this data

to simulate the best-engineered completion procedure to achieve the most economic outcome.

#### SPECTRASTIM™



Then without warning or notification, Mother Nature takes over and the laws of physics reign supreme. Throw the human-error factor and Murphy's Law into this equation and you have all the ingredients needed for your completion to under-perform expectations.

When this happens, the third step in the iterative process—Measure Results—becomes invaluable. If you don't understand what's happening in your completion, you don't have the knowledge to build on best practices or fix problems that may have occurred.

Without completion diagnostics, post-production performance is typically the only measurement you have to determine if the completion went as planned—it either made a well or it didn't.

Completion diagnostics provide the necessary direct measurements that help you understand what you're doing right. These measurements validate many of your engineering assumptions and resulting fracture design models, including:

- Perforation strategy
- Zonal coverage/staging strategy

- Fluid system selection (how well did the fluid perform and—equally important—how well did it clean up?)
- Wellbore/fracture connectivity (is there high proppant concentration across all perforated intervals?)
- Mechanical integrity (both outside and inside the wellbore)
- Production estimations

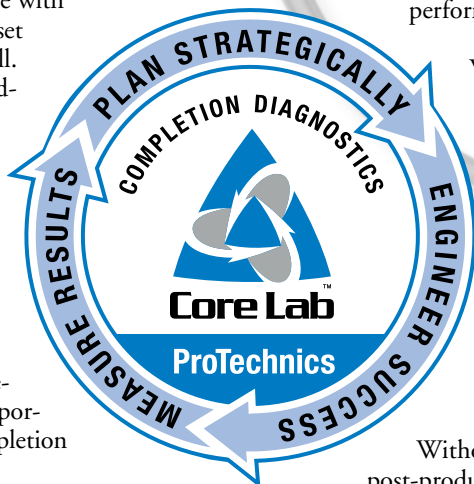
#### SPECTRASCAN®



Completion diagnostics are also invaluable in determining what didn't go as planned. Of the long list of potential problems, completion diagnostics provides quantifiable information about many of the key culprits, including:

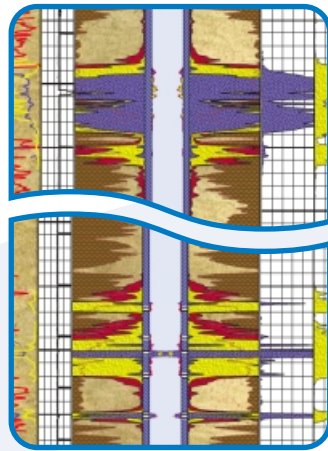
- Unrestricted frac height growth
- Unanticipated frac height barriers (restricted height growth)
- Failed staging device performance
- Poor cement containment
- Well mechanical failures
- Perforating off depth
- Perforating effectiveness
- Excessive proppant flowback issues
- Ineffective treatment fluid cleanup
- Close-spaced offset well interference

**ON THE FOLLOWING PAGES, IMAGES FROM REAL JOBS SHOW HOW PROTECHNICS COMPLETION DIAGNOSTICS BRING LIGHT TO AN OTHERWISE DARK HOLE.**



# DID YOU KNOW?

## MECHANICAL FAILURE

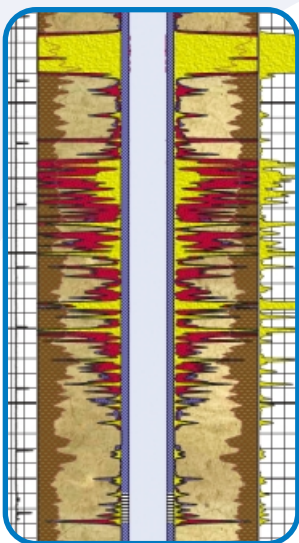


DV Tool  
(4700' Uphole)

Target Zone

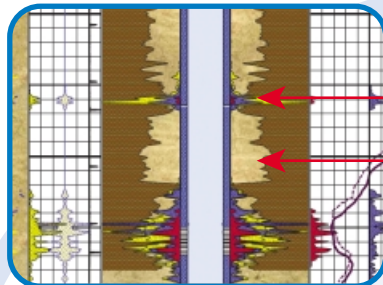
**Did you know** that the frac went through an uphole DV tool?  
**RESULT:** Ineffective stimulation of intended pay zone  
**ACTION:** Refrac the well down-tubing

## CEMENT CHANNEL



**Did you know** that the cement job didn't isolate the formation?  
**RESULT:** Ineffective stimulation of target interval  
**ACTION:** Squeeze and restimulate

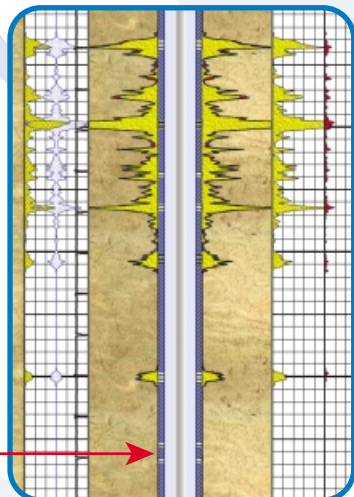
## FRAC HEIGHT CONTAINMENT



Squeeze Perforations  
Intended Pay

**Did you know** that fracture height growth was contained?  
**RESULT:** Lost reserves due to unstimulated pay  
**ACTION:** Isolate lower perforations, perforate missed pay and re-frac

## PERFORATION EFFECTIVENESS



Downhole Video Revealed no Perforations

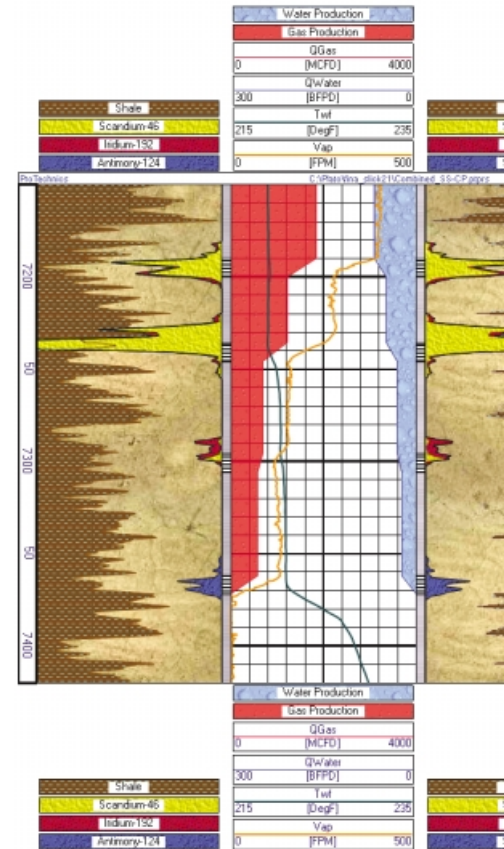
**Did you know** that the lower perforations did not treat due to ineffective perforating?  
**RESULT:** Bypassed reserves  
**ACTION:** Improve perforation QA/QC

There are plenty of reasons why that well didn't perform as expected. A lot of them have nothing to do with its potential design — there are too many ways things can go wrong.

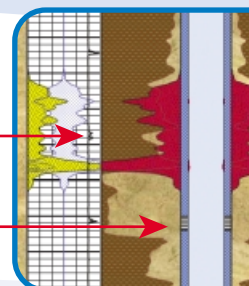
Here are some ways you can know what works. The surrounding tracer logs highlight real-time data, showing the options available to the engineer.

Equally important, the center tracer and completion logs show what went right, confirming your design.

Good news or bad, with measured results from the well, you can plan strategically and engineer a better outcome.



## PERFORATED OUT OF



Collar Locator Indicates Actual Perforations

Intended Perforations

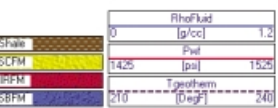
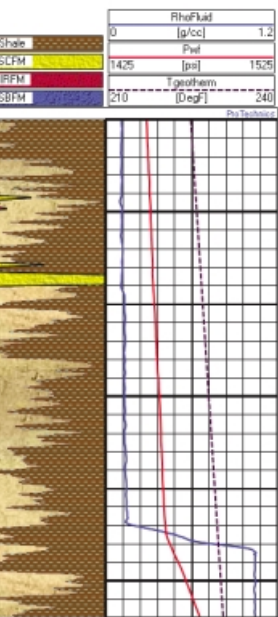
**Did you know** the perforations were higher than intended?  
**RESULT:** The reservoir never fully treated  
**ACTION:** Squeeze, re-perforate, and restimulate the target zone

It didn't perform.  
 al. Tools, measurements,  
 wrong. If you only knew.

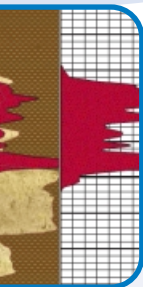
ed — and what didn't.  
**Completion cases and  
 operator.**

tion profiler log shows  
 a and completion.

ProTechnics, you know —  
 engineer success.

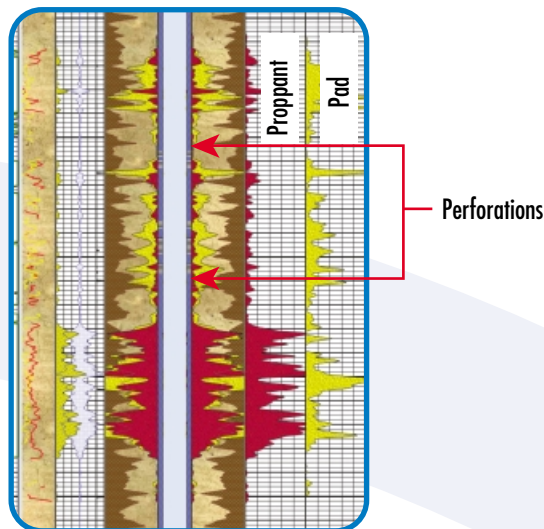


## OF ZONE



re shot off depth?  
 had a chance to perform  
 ate on depth and re-frac

## EXCESSIVE UNCONTAINED FRAC HEIGHT

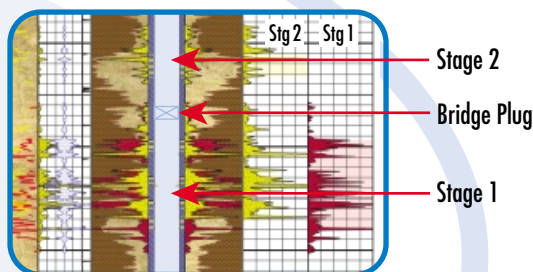


**Did you know** that there was extensive downward frac growth?

**RESULT:** Ineffective stimulation with shorter than planned frac length

**ACTION:** Use tracer data to recalibrate 3D frac model for the next well

## STAGE ISOLATION FAILURE

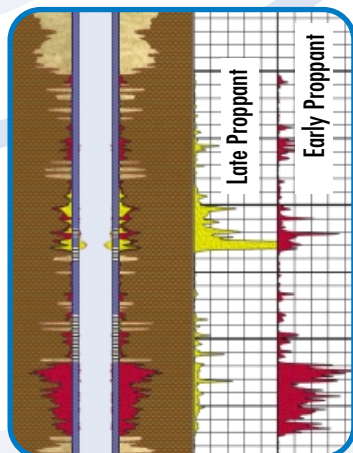


**Did you know** that the stage isolation device failed during pumping of Stage 2?

**RESULT:** Ineffective stimulation of Stage 2 and possible damage to Stage 1 fracture

**ACTION:** Re-frac Stage 2

## PROPPANT FLOWBACK



**Did you know** that the wellbore connection flowed back?

**RESULT:** Damaged connection to the wellbore resulting in decreased production potential

**ACTION:** Refrac the well down-tubing

## GROWING TO MEET DEMAND

### PROMOTIONS AND MOVES

- Steve Reeder – promoted to Q/A Training Supervisor, Houston, TX
- Ken Bullard – promoted to Sales Representative, Fort Worth, TX
- Kelly Bryson – promoted to District Manager, Oklahoma City, OK
- Tim Oswald – promoted to District Manager, Rock Springs, WY
- Brian Goulette – promoted to District Manager, Sidney, MT
- Darrell Nelms – promoted to Sr. Technology Services Manager, SpectraChem product line
- Scott Justice – named SpectraScan Group Leader
- Mark Warren – named CompletionProfiler Group Leader
- Dick Kingery – named Special Projects Group Leader
- Derrick George – promoted to Log Analyst
- Darla Fogie – promoted to Senior Chemist

### NEW ADDITIONS

ProTechnics continues to increase service capabilities and add to its technology prowess.

### Welcome aboard:

#### HOUSTON LABORATORY SERVICES

- Arthur Bettis – Laboratory Manager
- Phin Dinh - Chemist

#### SALES REPRESENTATIVES

- Scott Renfro – Denver, CO
- Brian Arnold – Houston, TX

#### LOGISTICS COORDINATORS

- Cole Hutchings – Houston, TX

#### SENIOR TECHNICAL SERVICE ENGINEER, COMPLETION PROFILER

- Maynard Johnson – Houston, TX

#### FIELD SERVICE REPRESENTATIVES

- Darrin Minett – Kilgore, TX
- Russell Wolf – Kilgore, TX
- Tim Schmitz – Oklahoma City, OK
- Dustin Broton – Oklahoma City, OK
- Chad Daniken – Oklahoma City, OK
- Loren Healy – Farmington, NM
- Douglas Gumfory – Grand Junction, CO

#### IMAGING SERVICE ENGINEERS

- Jeff White – Grand Junction, CO
- Aaron Wostrel – Rock Springs, WY

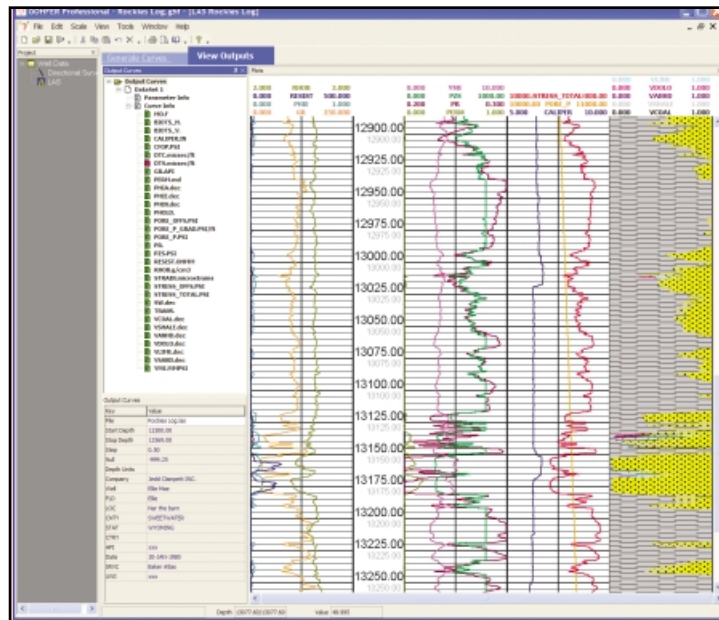
#### INTERNATIONAL SERVICE ENGINEERS

- Eric Elrod
- Kyle Talley

*Congratulations and Good Luck In Your New Positions!*

# NEW LOG PROCESSING FOR GOHFER 2007

Improve your reservoir characterization with GOHFER 2007 software's new log processing package. You'll have infinite flexibility in generating mechanical grid properties, whether you have a little data or a lot. The latest version of the venerable 3D fracture stimulation



software supports easy integration of core data, and multiple LAS and CSV files. If data is sparse, multiple built-in correlations help maximize the information you have, so you'll have greater confidence in your reservoir parameters, less tuning and better fracture designs.

## GOHFER Hydraulic Fracturing Courses

In October, join industry experts (including GOHFER author Dr. Bob Barree, Barree & Associates) for hydraulic fracturing courses in Calgary, Alberta, and Houston, Texas. Designed to provide an in-depth understanding of hydraulic fracturing, the courses examine state-of-the-art fracturing concepts from theory to design strategies from a GOHFER perspective, with hands-on training applied to individual stimulation projects.

VISIT [WWW.GOHFER.COM](http://WWW.GOHFER.COM) FOR MORE INFORMATION, OR CALL KEVIN SVATEK AT 713-328-2304.



# TIGHT GAS STUDY SETS NEW SIGHTS ON INTERNATIONAL RESERVOIRS

International tight gas sands are the next objective of the popular multi-client geo-engineering study being conducted by Core's Integrated Reservoir Solutions division.

For the past four years, the division's Fracture Stimulation Optimization technical teams have been analyzing and evaluating tight gas sands in North America to develop a very large and comprehensive database. This database consists of the characterization and evaluation of numerous conventional cores taken from multiple, tight gas sand formations and integrates these data with the stimulation design and production characteristics. The resulting case histories serve as analogs and performance benchmarks for future wells.

Each company joining the project contributes conventional cores from wells for analysis, evaluation and inclusion into the project. The conventional cores must be through a tight gas sand reservoir and can be from existing wells, as well as cores from future exploration and/or development wells.

The project will provide international operators with valuable information not only on their own contributed wells, but also on other operator's wells in tight gas sand formations worldwide.

FOR MORE INFORMATION, PLEASE CONTACT WAYNE SEALEY, SENIOR TECHNICAL ADVISOR AT [WAYNE.SEALEY@CORELAB.COM](mailto:WAYNE.SEALEY@CORELAB.COM) OR RANDALL MILLER, DIVISION PRESIDENT AT [RANDY.MILLER@CORELAB.COM](mailto:RANDY.MILLER@CORELAB.COM).

## NORTH AMERICAN SUCCESS STORY

The international study expands a highly-successful database developed for North American tight gas sands. That study, in its fourth year, includes the following participants:

- BP
- Cabot Oil and Gas
- Devon Energy
- El Paso Production
- ExxonMobil
- Marathon Oil Company
- Swift Energy
- Kerr McGee
- Burlington Resources
- ChevronTexaco
- Dominion E&P
- EOG Resources
- Forest Oil
- Noble Energy
- Talisman Energy
- Encana Oil and Gas
- Samson Resources
- Anadarko Petroleum
- Pioneer Natural Resources
- Canadian Natural Resources
- Vintage Petroleum
- Ultra Resources
- ConocoPhillips
- Newfield Exploration
- Occidental Oil & Gas
- Bill Barrett Corporation
- Williams E&P
- Questar E&P
- J-W Operating Company
- Apache Corporation
- Whiting Petroleum
- ENI Petroleum