

## ■ INNOVATIVE & TARGETED METHODOLOGY MEANS MORE MEANINGFUL RESULTS.

For tight gas sands, fundamental questions are more difficult to answer: How much gas is present? How much of it is recoverable? Will the reservoir be economically viable? **Weatherford Laboratories** has customized procedures and advanced protocols to yield the answers that offer improved meaning and usability to operators. It's how we ensure that more accurate decision-making occurs.

Our integrated processes include the measurement of routine rock properties, special core analysis, and fluid phase behavior to give greater insight into reservoir optimization strategies. Tight gas sands are evaluated with improved techniques for electrical properties, capillary pressure and completion fluid analysis data related to field production optimization. For tight gas sands, these are defining analyses, enabling the more precise estimation of how much gas is in place. In fact, the value we deliver in these plays is quantifiable. Our customers get measurably improved accuracy in reported data.

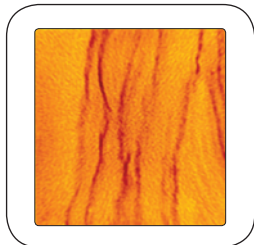
If accuracy is one of **Weatherford Laboratories'** advantages, innovation is another. We have developed unique processes to overcome limitations within the laboratory – like the high-pressure, 1,000-psi plate / membrane and vapor desorption for capillary pressure. At **Weatherford Laboratories**, these and other proprietary practices provide unparalleled understanding of tight gas sands.

### ■ HISTORY

#### Papers

"Laboratory Analysis of Electrical Rock Properties and Capillary Pressure in Tight Gas Sands with Low Water Saturations" (Vapor Desorption and Electrical Properties), CWLS, Issue 2 Vol. 2, 2005

"Water and Oil Based Fluid Retention in Porous Media", Canadian International Petroleum Conference, 2006



"Gas Condensate Reservoir Performance", Canadian International Petroleum Conference, 2006

"Use of Vapor Desorption Data to Characterize High Capillary Pressures in a Basin-Centered Gas Accumulation with Ultra-Low Connate Water Saturations", SPE 84596, 2003

## ADVANCED PROTOCOLS IDENTIFY GAS IN PLACE, AMOUNT RECOVERABLE AND COMPLETION STRATEGIES.

#### Electrical Properties

→ Provides reliable saturation exponent data from low permeability core plugs that are used to calibrate resistivity logs

#### Vapor Desorption for Capillary Pressure Characterization

→ Builds excellent saturation transforms with high pressure HgPc data sets

#### Reservoir Segregation by Gas Isotopes

→ Identifies contribution of individual zones in stacked gas reservoirs

#### Permeability Studies

→ Targets increased understanding of gas flow in low permeability and nano-Darcy range reservoirs

#### Tracer Analysis

→ Accurate assessment of Swi and gas in place

#### Fracture Fluid Leak Off and Regain Permeability

→ Optimizes selection of completion fluid to mitigate formation damage

#### Capillary Pressure Studies

→ Describes saturation response to different rock matrices

#### Constant Volume Depletion Studies

→ Establishes production strategies for reservoirs with gas condensate issues

### ■ INNOVATIONS

#### Processes

Vapor Desorption for Capillary Pressure Characterization



#### Technologies

Developed porous plate membrane system specially designed to reach 1000 air-brine capillary pressure and achieve low water saturation values in tight rocks. Designed to be used in conjunction with electrical resistivity measurements.

#### Equipment

Proprietary Mixer for Field Completion Fluid Preparation

## TURNKEY SERVICES SUPPORT YOUR TIGHT GAS SANDS PLAYS.



### WELLSITE

- Wellsite Personnel for Core Stabilization, Packaging & Transport
- Aluminum 4x4x4 Core Transport Containers
- Portable Wellsite Gamma
- Wellsite Plug Drilling for Saturation Studies

### CORE PROCESSING

- Specialized Slabbing Techniques to Optimize Photography and Sedimentological Studies
- Specialized Plugging Techniques to Preserve As-Received Saturations
- Proprietary Procedures to Minimize Evaporation



### PHOTOGRAPHY

- High Resolution Core Photography in Multiple Formats

### CORE STORAGE & VIEWING

- Core Storage Facilities at 5 Temperatures Ranging from Ambient to Dry Ice
- State-of-the-Art Core Viewing Rooms



### PROJECT MANAGEMENT

- Secured Client Websites for Data Retrieval & Archival
- CoreTrac™: Internal Management Information System for Project Tracking, Accessible Worldwide

## TIGHT GAS SANDS LABORATORY TESTS

### GEOLOGY

- CT Scanning and Evaluation
- Scanning Electron Microscopy (SEM)
- X-Ray Diffraction (XRD)
- Bulk & Clay Mineralogy
- Detailed Core & Fracture Descriptions
- Thin Section Preparation
- Thin Section Analysis
- EPI Fluorescence Microscopy

### GAS CHROMATOGRAPHY

- Gas Isotope Analysis

### ADVANCED CORE ANALYSIS

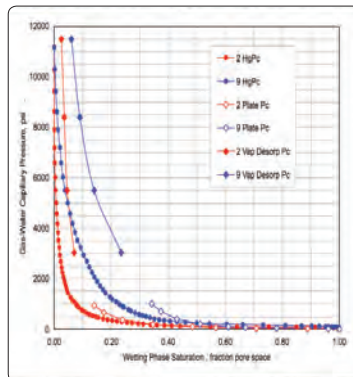
- Capillary Suction Time Test
- Mercury Injection Capillary Pressure Tests
- Incremental Phase Trap
- Phase Trap

### Critical Salinity Tests

- Formation Sensitivity Tests
- Proppant Crushing and Fracture Conductivity Tests
- Electrical Properties Analysis (a, m and n)
- Vapor Desorption Capillary Pressure
- 1000 psi Air/Brine Capillary Pressure
- Plate Membrane System

### ROCK MECHANICS

- Unconfined and Triaxial Compressive Strength Tests
- Static Young's Modulus and Poisson's Ratio
- Mohr-Coulomb Failure Analysis
- Acoustic (Ultrasonic) Velocity Test
- Compressional (P) and Shear (S) Wave Velocities (1MHz)
- Dynamic Elastic Parameters



## EXPECT MORE FROM WEATHERFORD LABORATORIES.

At Weatherford Laboratories, we hold fast to Higher Standards. Our purpose is to continually push past conventional solutions to find new and better ways to optimize oil and gas production.

With 38 laboratories around the globe, our team raises the bar for wellsite sampling, core management services, geochemical analyses, and evaluation of traditional and unconventional reservoirs.

**At Weatherford Laboratories, we expect more from ourselves so you can expect more from us.**

# 38

LABORATORY LOCATIONS

# 18

COUNTRIES

# 1

WORLDWIDE RESOURCE

## 38 LABORATORY LOCATIONS IN 18 COUNTRIES

### NORTH AMERICA

Canada  
United States

### EUROPE

Norway  
United Kingdom

### LATIN AMERICA

Brazil  
Mexico  
Trinidad  
Venezuela

### MIDDLE EAST / NORTH AFRICA

Kuwait  
Libya  
Oman  
Saudi Arabia  
United Arab Emirates

### ASIA PACIFIC

Australia  
India  
Malaysia  
Thailand  
New Zealand

For contact information, please visit our website:  
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