

## FUNDAMENTAL ROCK AND FLUID ANALYSIS, COMPONENTS TO SUCCESS

Today, geologists and engineers push the technology envelope to find and develop more oil and gas. In the absence of conventional cores, valid and extremely useful data are possible through the examination of cuttings, percussion sidewall cores, and a variety of other small sample types. If properly implemented and interpreted, testing on these small samples can be useful in defining successful programs.

Percussion sidewall cores have been analyzed for over 70 years. Still today, percussion sidewall cores remain the best, first indicator of hydrocarbon presence at specific depths. With new technologies such as laser grain size analysis and capillary suction time testing, percussion sidewall cores serve as a timely guide to gravel pack, screen and rock/fluid completion decisions.

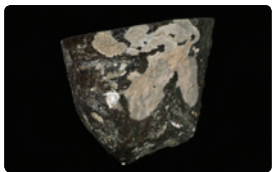
Analyses of drill cuttings have and continue to be essential to the petroleum industry as it exploits shale gas as a major resource for the future. Geochemical analysis on cuttings, once considered a second order data set, is now driving major lease block purchases and the location of the next well.

### INNOVATIONS

- QA Factor for improved PSWC analysis
- Source Rock Analyzer (SRA) for extended range programmed pyrolysis

#### Papers/Studies

- "Clay Minerals and Grain Size"; SPWLA Spring Seminar Houston Chapter May 8, 2002; Silt, Clay, and Sand – The Persistent Interpretation Problem.
- "Grain Size and Clay Mineral Evaluation from Cores"; SPWLA Westside January 12, 2005.



- "Petrographic Analysis of Drill Cuttings"; August 30, 2006.
- "Percussion Sidewall Core Analysis"; various oil and gas companies; March 2001 to March 2008.
- "Geochemical Risk Assessment of the Marcellus Shale – A Case Study of the Houser Unit #1 Well, Clearfield County, Pennsylvania," AAPG Eastern Section Meeting, Pittsburgh, Pennsylvania 2008

## ECONOMICAL ALTERNATIVES TO WHOLE CORE OFFER SPEED & ACCURACY

#### Routine Sidewall Core Analysis

→ Conclusive indicator of hydrocarbons. Direct measurement of reservoir quality

#### Petrology on Sidewall Cores

→ Accurate descriptor of reservoir quality. Assessment of anomalous log response. Predicts fluid sensitivity issues

#### Geochemistry of Drill Cuttings

→ Assess thermal maturity. Confirms organic content. Determines gas prospectivity

#### Production Line Filter Analysis

→ Early predictor of gravel pack failure

#### Produced Material Analysis

→ Identifies gravel pack and formation production and failure

#### Scale Identification and Analysis

→ Optimize production

#### Outcrop Analysis

→ Rank exploration. Basin evaluation

#### GeoJar™

→ Captures formation gas

### INNOVATIONS

#### Processes

- SEM grain size (with BP) for improved gravel pack design using PSWC samples
- Vapor desorption capillary pressure
- Stabilization of poorly consolidated and irregularly shaped samples, such as PSWCs



- Permeability calculated from Thin Sections, for perm estimation from PSWC, cuttings and other "difficult" sample types
- Electromagnetic separation for cutting analysis as a commercial service
- Multi rate separator sampling for rich gas condensates and volatile oils
- GeoJar™ sampling

## INNOVATIONS

### Technologies

- Core analysis results provided online via secure personalized client websites
- CoreTrac™ – customized software developed for improved project management and laboratory efficiency

### Equipment

- Source Rock Analyzer™ (SRA) - characterizes source rocks and/or reservoir rocks, measuring the amount of free hydrocarbons, the remaining potential to generate hydrocarbons and the total organic carbon content of the sample
- Robust instrumentation, readily available for field applications

## SMALL SAMPLE ANALYSES SUPPORT ALL OF YOUR OIL & GAS PLAYS.



### DEEPWATER

Percussion sidewall analysis – pay identification – anomalous log response

### UNCONVENTIONAL SHALE GAS RESERVOIRS

Geochemistry on cuttings drive the industry



### TIGHT GAS SANDS

GeoJar™ – recognize reservoir compartments

### COAL BED METHANE

Maceral typing on cuttings

### HEAVY OIL & BITUMEN RICH SANDS

Screen and liner selection based on grain size analysis

### ENHANCED OIL RECOVERY

Capillary suction time testing on sidewall cores identify rock/fluid sensitivity

## SMALL SAMPLE EVALUATION TYPE AND TESTING

### PERCUSSION SIDEWALL CORE ANALYSIS

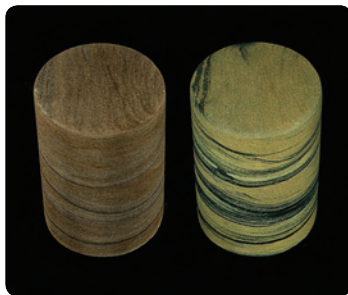
Routine Percussion Analysis  
Thin Section, SEM, XRD  
Capillary Suction Time Testing

### CUTTINGS

Geochemistry  
TOC/Program Pyrolysis/Vitrinite Reflectance  
Thin Section, SEM, XRD

### PRODUCTION FILTER ANALYSIS

Binocular Scoping/Photography  
SEM



### SCALE ANALYSIS

SEM/EDS  
Binocular Scoping/Photography  
XRD

### PRODUCED MATERIAL

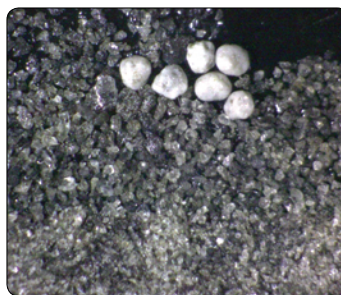
SEM/EDS

### OUTCROP ANALYSIS

Complete Geochemistry Characterization  
Thin Section, SEM, XRD

### GEOJAR™

Captures Formation Gas



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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

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Libya  
Oman  
Saudi Arabia  
United Arab Emirates

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