Know Your Reservoir
As the exploration and production of oil and gas moves into more-challenging environments, E&P companies face more-complex reservoirs.

Rock and fluid analysis performed at Schlumberger Reservoir Laboratories provides the information you need to address increased complexity and better understand your reservoir. This improved understanding can add to drilling and development effectiveness and efficient, enhanced production.

Today we’re expanding and adapting our services to provide you with even more-comprehensive information. We know your success depends on more than just large amounts of data; it requires quality data and analysis that can actually deepen your understanding and enable better decision making.
Integrated Laboratory Services for Better Reservoir Understanding
Individual analysis of reservoir rocks and fluids provides unique perspectives on their respective properties and behaviors. We’re committed to bringing you additional insights through integrated rock and fluid analysis for even better reservoir understanding.

To expand the potential of this integrated approach and bring you its benefits, we’re adding services and capacity to our analysis capabilities. This includes colocating rock and fluid laboratories in “hubs” around the world, supported by local expertise, deployment of new technology, standardized operating procedures, quality control, quality assurance and reporting processes, and the cross-training and development of our staff.

The result is a truly global reservoir characterization services organization, complete with industry-recognized expertise in reservoir, rocks, and fluid sampling and analysis, and backed by our extensive research, development, and engineering capabilities.

**Advantages of integrated laboratories, integrated analysis**

Our integration of rock and fluid laboratories and analysis capabilities provides a range of benefits.

- **Dependable results**: Standardized procedures and equipment support consistent delivery of reliable data.
- **Reduced risks**: Comprehensive information supports better decision making.
- **Faster analysis**: Expanded hub laboratory facilities require less shipping of samples to various laboratories.
- **More meaningful results**: Reports match and easily integrate with your own workflows.
- **Trusted advice**: Industry-recognized expertise and experience contribute to better outcomes.
- **Simplicity**: Benefit from one contact for rock and fluid analysis.
Rock Analysis
Built on the long experience and leadership of the TerraTek* center in Salt Lake City, our full range of rock mechanics and core analysis services for both conventional and unconventional reservoirs is available across our global network of laboratories. We provide timely measurements that are fundamental in characterizing your reservoir.

**Wellsite services**
Our specialists process, catalog, preserve, and stabilize whole and sidewall cores at the wellsite to maintain their integrity during transport to our facility for laboratory testing. Core management ensures proper handling, identification, and storage in the laboratory. Services include canister desorption to measure evolved gas, content, and composition for reliable prediction of the gas in place.

**Geomechanics services**
TerraTek geomechanics services lay the foundation for a complete understanding of the most effective stimulation treatments and the production potential of conventional and unconventional reservoirs. Services include
- single or multistage triaxial tests
- uniaxial strain tests
- thick-walled cylinder tests
- continuous strength measurements along the core length to assess heterogeneity (scratch testing)
- indentation tests.

These tests reveal a variety of geomechanical properties, including unconfined compressive strength, tensile strength, compressibility, fracture toughness, thermal properties, and complete shear failure envelope, including compactant cap and static and dynamic elastic moduli.

**Routine core analysis**
Measurement of basic properties helps you determine if a rock contains a fluid-filled space (porosity) and hydrocarbons in that space (saturation), and the ability of those hydrocarbon fluids to be produced (permeability). Core gamma logging links core depth to logging depth. Computed tomography (CT) scans indicate core heterogeneity.
Special core analysis
Detailed understanding of a reservoir requires additional measurements obtained in the special core analysis laboratory (SCAL). Examples include:
- calibrating electrical logging measurements of porosity and saturation
- determining a formation-specific cutoff value for the relaxation time from a nuclear magnetic resonance (NMR) log
- determining capillary pressure measurements to indicate distributions of pore throats and evaluating saturation distribution as a function of height in a formation
- measuring multiphase flow character of the formation
- evaluating wettability.

Formation damage testing
Tests evaluate return permeability after mud invasion, fluid-rock interactions, fluid-fluid interactions, and damage caused by pressure and temperature changes in the reservoir.

Petrology services
Key parameters to aid in the determination of reservoir quality (RQ) and completion quality (CQ) are obtained through detailed evaluation of rock texture and composition using core description, X-ray diffraction, Fourier transform infrared spectroscopy (FTIR), X-ray fluorescence (XRF), laser particle size analysis (LPSA), thin sections, and scanning electron microscopy. In our viewing room, your core can be examined in detail to help you understand the optimal way to develop and produce a field.

Tight rock analysis
TerraTek TRA* tight rock analysis provides a comprehensive representation of reservoir quality for the various rock classes present in the core, and a ranking of these from best reservoir quality to the nonreservoir units. Reservoir quality in challenging tight shales and other unconventional
reservoirs is defined by hydrocarbon-filled porosity, permeability, organic content, degree of maturation, and pore pressure. An assessment requires comprehensive TRA measurements of porosity, adsorbed gas, pore fluid saturations (water, oil, and gas), permeability, matrix mineralogy and microfabric, organic content, organic maturation, and permeability for each of the principal rock classes in the system.

Infrared spectroscopy services
Our rapid infrared spectroscopy technique provides both mineralogy and total organic carbon (TOC) simultaneously on small samples of the formation. The method can also be used on cuttings from legacy wells to help you understand differences in productivity between existing wells.

Heterogeneous rock analysis
TerraTek HRA* heterogeneous rock analysis is a workflow designed to improve the representation of core sampling in heterogeneous reservoirs and facilitate the integration of core, log, and seismic data. It is rooted on a foundational quantitative, unbiased classification of log data to determine zones of consistent or differing log response. The classification then facilitates the selection of samples for core testing upfront and the integration of both quantitative and qualitative data across multiple disciplines (e.g., petrophysics, geomechanics, and petrology), and multiple scales (e.g., core, log, and seismic) when testing is complete. This leads to more accurate identification of target zones and the prospect for spreading knowledge across future wells using log data alone. It may also make possible extending this knowledge to regions (that lack log data) through upscaling and integration with seismic data.
Fluid Analysis
Our mercury-free laboratory services provide timely and accurate measurements and expert interpretation of fluid phase behavior and fluid properties—all essential for characterizing your reservoir. Areas of expertise include hydrocarbon fluids, flow assurance, organic solids, enhanced oil recovery, heavy oil, hydrates, aqueous and organic geochemistry, and trace element analysis such as sulfur and mercury species.

**Wellsite sample acquisition**
We have an unsurpassed record in successfully acquiring representative reservoir fluid samples in even the most challenging deepwater, HPHT, heavy oil, and hostile high-H₂S reservoirs. Our industry-leading downhole and surface sampling technology combines with extensive sample management expertise to ensure reservoir samples arrive safely at the laboratory in the shortest time frame.

**Sample restoration and validation**
Our unique sample-quality focused approach and detailed workflows ensure only the most representative samples are analyzed, therefore assuring accurate and reliable data delivery. Integration with subsurface and surface data acquisition further supports quality control for the entire process, from sample acquisition to final laboratory analysis results.

**Phase behavior studies**
Our mercury-free phase behavior (PVT) systems analyze all fluid types, including challenging volatile and heavy oils, gas condensates, black oils, waxy and asphaltic fluids, and hydrates. You receive accurate, quality-controlled data, including equation of state (EOS) modeling, which enables calculation of in-place reserves and the design and optimization of production plans.
Reservoir fluid composition analysis
Accurate compositional data for reservoir modeling and design of processing facilities is one of the most critical sets of information generated from reservoir fluid analysis. We apply a full range of routine, high-temperature, high-resolution, sulfur speciation, and advanced gas chromatography and mass spectrometry techniques. Best-in-class calibration and data quality assurance and quality control processes also contribute to delivery of the most reliable data.

Flow assurance services
Industry-recognized domain expertise and laboratory services support flow assurance risk measurement. Services include:
- solids detection
- high-pressure microscopy
- rheology analysis
- live oil emulsion stability testing
- live and stock tank oil viscosity measurements
- particle size analysis technology at pressure and temperature.

RealView* technology for live solids deposition studies is used to obtain data for simulation and modeling of wax and asphaltene deposition in wellbores and pipelines.

Geochemical analysis
Geochemical fingerprinting using high-resolution gas chromatography for production back-allocation and compartmentalization studies is supported by best-in-class Malcom* interactive fluid characterization software and a global team of experts providing integrated interpretations of fluid data sets. Organic geochemistry studies for oil and source rock characterization include a full suite of
biomarkers and gas and liquid isotope analysis.

**Water properties and analysis**
We provide full water-sample acquisition and analysis services, supported by experts who advise on sample capture, preservation, shipping, and analytical methodologies. Services include quality routine and high-end analysis at our reservoir laboratories and performing measurements at the wellsite.

**Wellsite chemistry services**
State-of-the-art services across our global operations help you meet challenges related to hydrogen sulfide and sulfur species, and radionuclide and mercury characterization in reservoir samples at the wellsite.

**Sample management**
Adhering to strict global standards on sample and information security management—covering sample capture, unique bar code labeling, identification, dangerous goods transportation, regulatory compliance, tracking, analysis, storage, and disposal—offers you the confidence that your reservoir samples and analysis data will be managed carefully.
Integrated Analysis in Action
Laboratory analysis is an important part of Schlumberger EOR services. Understanding rock and fluid properties helps engineers and geoscientists develop and update static and dynamic reservoir models, and simulate the effects of different EOR scenarios.

Selecting the best EOR development path requires studying the dominating factors that affect oil displacement efficiency in the reservoir. These factors include capillary, gravity, and viscous forces. A successful EOR program blends an understanding of these forces and the interaction of the injected fluid with the rock and reservoir fluids.

Laboratory services and other capabilities contribute to evaluating the full array of flooding methods. Core-flow and sandpack studies can be performed for any scenario. Slim-tube and rising-bubble methods are used to evaluate miscibility conditions, while multiple-contact miscibility, interfacial tension, contact angle, and viscosity measurements complete our offering. Chemical flooding includes polymer, surfactant, alkali, and combinations of those media. Our laboratories are geared to evaluate different combinations of chemicals, the optimal salinity, and surfactant adsorption onto the matrix.
Throughout our laboratories, the quality of analysis is ensured by highly trained and qualified technologists, including subject matter experts on a growing range of rock and fluid specialties. Our approach of hiring the best people and providing them with advanced training enhances our development of engineers and specialists with expertise in both rock and fluid analysis. The result is analysis with uniquely valuable perspectives.

Standardized processes built on industry best practices further support data quality and efficient, accurate analyses.

Scientific rigor and attention to detail enable Schlumberger to provide accurate and insightful information that can help you better understand your reservoir. This improved understanding is a proven path to better drilling, development, and production decisions.

More than 25 Schlumberger Reservoir Laboratories across the globe support a wide range of customer reservoir characterization projects. Laboratories are equipped with both advanced, industry-standard equipment as well as advanced technologies designed by Schlumberger.