GeoFlex
Quantitative cuttings analysis and imaging service
Bring the cuttings characterization lab to the field with the GeoFlex* quantitative cuttings analysis and imaging service from Geoservices, a Schlumberger company.

Combining high-resolution digital microscopy, accurate mineralogical quantification, precise elemental composition, and total organic carbon (TOC) assessment, the GeoFlex service enables cost-effective, near-real-time formation evaluation in all drilling environments.

This at-surface modular service is especially advantageous in operations traditionally considered cost- or risk-prohibitive for conventional formation evaluation techniques.
Applications

- While-drilling formation evaluation and reservoir characterization in conventional reservoirs
- Assessment of reservoir quality (RQ) and optimization of completion quality (CQ) in unconventional reservoirs
- Onshore and offshore exploration and development

Benefits

- Conducts formation evaluation at surface, adding zero operational risk
- Characterizes lithology independently of wellbore geometry, temperature, and pressure
- Acquires reliable and repeatable data for near-real-time evaluation
- Integrates with LWD, wireline, and other available data sources to provide a comprehensive log
- Minimizes NPT through early remediation of the well path when necessary

Features

- Portable, modular devices and services for wellsite mobilization
- Integrated real-time transmission and visualization for wellsite and remote data monitoring and interpretation
- Automatic mineral recognition and quantification technology for fast and reliable wellsite analysis
- Synthetic total and spectral gamma ray (GR) for accurate depth matching and well-to-well correlation
Accurately determine lithology and mineralogy
The GeoFlex service makes it possible to conduct accurate and repeatable mineralogical evaluation from cuttings at the rigsite and outside of the critical drilling path. Using high-resolution digital microscopy (HRDM) and X-ray diffraction (XRD), the GeoFlex service enhances appraisal of rock texture, shape, and color and quantifies mineralogy with laboratory-quality accuracy.

Together, these technologies classify and quantify a wide range of minerals. As a result, describing cuttings is made easier, faster, and virtually error free for the wellsite geologist. The addition of synthetic total and spectral GR also ensures perfect depth matching to acquired information from other data streams, such as LWD or wireline logs.

Define geochemical fingerprint to assess production potential
Geochemical fingerprinting is performed using X-ray fluorescence (XRF), which quantifies up to 50 inorganic elements to part-per-million levels. Evaluation of elemental data to this degree enables highly accurate well-to-well correlation and identification of preserved organic matter, which both offer insight into production potential in unconventional reservoirs.

Quantify TOC to identify organic-rich formations
To optimize well placement in unconventional reservoirs, fast-field TOC quantification precisely identifies organic-rich formations in 7 minutes. This technique uses a patented process to directly measure TOC in cuttings regardless of mineralogy and mud type.

Enhance multidisciplinary collaboration
Information from the GeoFlex service is transmitted in real time and can be integrated with other available data sources for seamless collaboration between the operator’s drilling, geology, and geophysics teams. Integrated logs further enhance understanding of reservoir characteristics and potential productivity, which, in turn, reduces the risks inherent to key decision-making processes.

Evaluate your reservoir at surface while drilling

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1 in 10 Number of unconventional wells in the United States that are logged

Approximate number of subeconomic unconventional wells in the United States

40%
Siliciclastic reservoirs: **Complement mineralogy with geochemical fingerprinting**

The GeoFlex service conducts geochemical fingerprinting, one of the most advanced formation evaluation techniques available for a sediment. By identifying feldspars, clays, and carbonates as well as the distinction between cement and matrix, geochemical fingerprinting helps predict producibility in siliciclastic and all other reservoirs.

This enhanced formation evaluation method improves wellsite lithology identification and easily pinpoints intrafield formation tops. Mineral recognition can be done in semiautomatic or automatic mode to simplify this task for field personnel. The limit of detection for each mineral is established in relation to the matrix and is programmed into software used at the wellsite that is proprietary to Schlumberger.

Further, geochemical fingerprinting from the GeoFlex service enables you to update petrophysical models and optimize logging and coring operations.

*HRDM from the GeoFlex service magnifies cuttings by up to 200 times for improved characterization.*
### Interpreted Lithology

<table>
<thead>
<tr>
<th>Anhydrite</th>
<th>Calcite</th>
<th>Dolomite</th>
<th>Quartz</th>
<th>Siderite</th>
<th>Total clays</th>
<th>Total feldspars</th>
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### XRD Mineralogy

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<th>Component</th>
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</tr>
<tr>
<td>TiO₂</td>
<td>5%</td>
</tr>
<tr>
<td>P₂O₅</td>
<td>5%</td>
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<tr>
<td>Na₂O</td>
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### Image Descriptions

- **Anhydrite**: A mineral that appears as white, crystalline, and typically forms in evaporative environments.
- **Calcite**: A common mineral, found in white, transparent, or colorless crystals.
- **Dolomite**: A carbonate mineral, typically white or gray in color.
- **Quartz**: Found in various colors and forms, often transparent and hard.
- **Siderite**: A mineral that is often metallic or bright red, containing iron carbonate.

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The image shows a detailed analysis of lithological compositions, with specific mineral percentages indicated.
Carbonate reservoirs: **Unlock potential productivity**

In carbonate reservoirs, production potential is highly influenced by the mineral composition of the matrix. By clearly identifying and quantifying calcite, dolomite, and siderite—the main carbonate minerals—the GeoFlex service provides information critical to assessing porosity and permeability and, thus, production potential.

Identification and quantification of clays and anhydrite, for example, provide significant insight into the porosity and permeability of carbonate reservoirs. Accurate quantification of pyrite can notably improve any subsequent petrophysical log interpretation.

High-resolution digital pictures from the GeoFlex service also aid in the recognition of microfossils and the subsequent characterization of biomarkers, resulting in a more comprehensive stratigraphy and dating of the reservoir.

*Using HRDM and XRD, the GeoFlex service provides objective and precise evaluation of mineral composition.*
Presalt reservoirs: **Reveal complex formations**

Presalt formations are among the most difficult environments to drill and evaluate. The presence of carbonate lithology with complex mineralogy—pyrite, k-feldspars, plagioclase, calcite, dolomite, clays—and the frequency of encountering altered volcanic rocks and hydrothermal depositions create challenges for rock and reservoir classification.

The cuttings-based GeoFlex service helps to solve this challenge by clearly flagging biogenic silica and accurately identifying and quantifying volcanic, carbonate, and hydrothermal minerals.

Using high-resolution digital microscopy, X-ray diffraction, and X-ray fluorescence, the GeoFlex service provides direct and comprehensive measurements of lithology, mineralogy, and elemental composition. Near-real-time data from this service is combined with other available data sources to create a comprehensive log that enables advanced modeling, including basin reconstruction and dynamic simulation.
The identification and characterization of igneous rock has become increasingly important to hydrocarbon exploration and production. While drilling, reaching the basement rock often means that the bottom of a potentially hydrocarbon-producing interval has been reached.

Additionally, the production of hydrocarbon resources trapped in igneous fractured formations has made significant progress in the past few years. In both cases, identifying the presence of igneous, volcanic and volcanoclastic rocks is of paramount importance.

The GeoFlex service optimizes geostopping by accurately detecting basement rock. The service uses high-resolution digital microscopy to identify the texture of igneous rock and to characterize flow structure and crystal sizes. Magnification of up to 200 times enables the mud logger to easily recognize altered and reworked volcanic rocks.

The GeoFlex service identifies all rock types, making basement rock easy to detect.
With the GeoFlex service, obtaining reservoir and completion quality data is possible in each and every well regardless of budget constraints, ROP objectives, and well profile type.

This cost-effective, at-surface evaluation method provides direct detection and quantification of organic and inorganic matter in near-real time. The presence of trace elements provides fundamental information about the depositional environment of the drilled formation and the likelihood it contains preserved organic matter.

Shale lithofacies characterization data from the GeoFlex service is available at the wellsite and remotely for analysis by multidisciplinary teams. As a result, you can land and steer with precision as well as optimize the number and location of fracturing stages.

By precisely measuring TOC, the GeoFlex service makes it possible to determine when the well is being drilled out of zone.
This ternary diagram from the GeoFlex service identifies cuttings samples by rock type (location on diagram) and brittleness (color of plot point). When combined with TOC measurements, this data represents a key parameter for planning the number and location of fracturing stages.
GeoFlex

Bringing lab-quality cuttings characterization and formation evaluation to the rig site