ShaleEval℠ Service
A Dedicated Team of Experts and Unique Capabilities Help Optimize the Shale Production Process from the Lab through Well Production

Halliburton ShaleEval℠ shale formation evaluation service through the Duncan Technology Center (DTC) is designed to help operators, geologists, and engineers answer key questions at critical junctures during the life of the shale asset.

The ShaleEval Service Team
The heart of ShaleEval service is a team of experts applying proven analytical and interpretive skills to provide better understanding of the shale reservoir. No other service company can match the years of combined experience of the team members.

The ShaleEval service team’s direct link to Halliburton’s technical experts in the various shale production areas around the world enables close collaboration with Operators. Working together to rigorously implement the ShaleEval service process is helping make shale reservoirs more productive.

The ShaleEval Service Process
The evaluation process is divided into four stages: 1) formation screening process, 2) fluids screening process, 3) fracture treatment screening process and 4) fracture evaluation and candidate selection process which includes Halliburton’s ultra-low-permeability testing apparatus. ShaleEval service capabilities enable Halliburton to offer a complete, optimized analysis of a shale reservoir all the way through post-treatment.

ShaleEval Service Stage 1 - Formation Screening Process
At this early stage in the life of a potential well two basic questions must be answered: “Is it a petroleum reservoir”? and if so, “Is it producible”? The formation screening process is designed to answer those questions.

A geochemical analysis will be conducted as part of the formation screening process. Using core samples, total organic carbon (TOC), kerogen typing and thermal maturity are measured and reported to evaluate the formation in terms of potential to generate hydrocarbons and produce petroleum, and hydrocarbon type.

The wide variety of shale lithologies makes it clear why a thorough evaluation is critical to help determine viability and producibility of shale reservoirs.

The formation screening process also includes a mineralogical analysis which utilizes x-ray diffraction (XRD) and glycolation testing. This analysis is used to profile the mineralogical traits and propensity for clay swelling of the core samples.

This process answers the two questions of viability and producibility and supplies the operator with the information needed to make good decisions about field development plans.

ShaleEval Service Stage 2 - Fluid Screening Process
Assuming the reservoir is producible, the next question is addressed: “Is this particular formation sensitive to fresh water or acid or both”? The second phase of Halliburton’s ShaleEval service is the fluid screening process. This process is used to evaluate the compatibility of core samples with a variety of base fluids. Acid solubility and capillary suction testing are performed to understand swelling tendency and reactivity when samples are exposed to chosen base fluids.
ShaleEval Service Stage 3 - Fracture Treatment Screening Process

Once a base treatment fluid is identified from the fluid screening process, the next question is, "Which frac treatment will help maximize production of the shale asset"? The fracture treatment screening process helps the engineer design specific fluids and additives that reduce formation damage as much as possible. At this stage, rock mechanical properties can be measured, the information correlated back to acoustic logs and then input into a fracture design simulator. The fracture treatment screening process is meant to help reduce risk for the operator.

The fracture treatment screening process will provide insight into the shale’s ductility or brittleness by determining Young’s Modulus, Poisson’s Ratio, and the Brinell hardness of the core(s) provided.

Scanning electron microscopy (SEM) is conducted to learn about lithology and potential reaction to the treatment fluid.

**Ultra-Low-Permeability Testing Apparatus (ULPTA)**

This process also incorporates Halliburton’s exclusive ULPTA. Tests conducted using the ULPTA will define the impact to regained permeability beyond the fracture face once the formation is exposed to the fluid system. This special flow device is a key indicator of well productivity once fracture stimulation has occurred. It enables core testing on intact cores (nano to micro darcy permeability). This represents a significant improvement over current industry practice of grinding samples to powder prior to testing.

Scanning electron microscopy (SEM) micrograph shows etching of a shale sample after exposure to a reactive fluid. The rough surface is the result of etching, indicating that reactive fluids can be useful in shale stimulation.
Halliburton's ultra-low-permeability testing apparatus (ULPTA) is a significant advancement in understanding shale reservoirs. The device is used to measure steady-state permeability of shale core down to the nano-darcy range. This device is particularly useful in evaluating fluid effects on shale in the form of retained or regained permeability. It is also useful for determining intrinsic permeability and permeability heterogeneity of shale core. The plot is the regained permeability (in percent) in a core as a function of potassium chloride (KCl) in a brine solution.

Brinell hardness number (BHN) measurements are relative and lithology dependent; a comparison is shown derived from Halliburton's Duncan Technology Rock Mechanics database. Tests can be conducted before and after fluid contact to help select optimal fluids for maximum hydraulic fracture conductivity retention.
ShaleEval Service Stage 4 - Fracture Evaluation and Candidate Selection Process

Now that ShaleEval service has been used to determine producibility, evaluate sensitivity to base fluids and define the treatment fluid to help maximize production, the final questions to answer are “How effective was the treatment”? and “Can refrac candidates be identified”?

A diagnostic fracture injection test can qualitatively indicate the presence of a pre-existing fracture (SPE96785). Type curve analysis using variable-storage constant-rate drawdown is used to estimate the producing fracture half length and transmissibility. This analysis can be very valuable in determining the outcome of a fracture treatment and in choosing candidates for future treatments. This process, in collaboration with Halliburton’s ShaleLog SM and Sigma SM services, can be utilized to optimize treatments and evaluate existing wells for refrac consideration.

For more information about how Halliburton’s ShaleEval SM service can help you maximize the profitability of your shale assets, contact your local Halliburton representative or email stimulation@halliburton.com.