

Diffuse Reflectance Infrared Fourier Transform Spectroscopy

Component of the LithoFlex multifactor shale-cuttings evaluation-while-drilling service

APPLICATIONS

- Mineralogical analysis for shale oil and gas characterization
- Identification of organic-rich formations (source rocks) and hydrocarbon windows

BENEFITS

- Obtains accurate, repeatable readings for greater consistency
- Improves shale lithotype identification
- Enables accurate clay typing of illite, kaolinite, smectite, and chlorite
- Provides a cost-efficient solution for logging lateral wells
- Enhances completion operations
- Measures mineralogy, total organic carbon (TOC), and kerogen maturity and density
- Estimates grain density

FEATURES

- Lateral heterogeneity mapping of TOC to optimize well placement
- Kerogen maturity (proxy of vitrinite reflectance) mapping for oil and gas window fingerprint
- Proprietary software for automatic mineralogical quantification
- Real-time data transmission for near-real-time evaluation
- Two-minute analysis time
- Proprietary sample preparation method for any type of drilling fluid (oil-, water-, or synthetic-based mud)

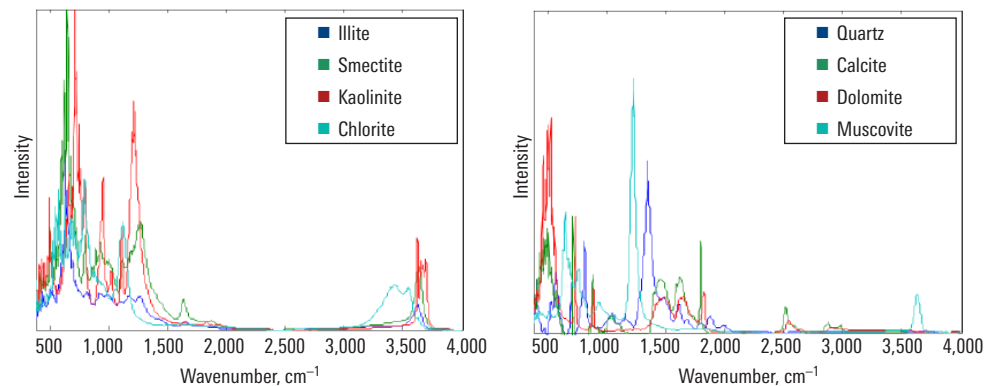
The LithoFlex* multifactor shale-cuttings evaluation-while-drilling service uses diffuse reflectance infrared Fourier transform spectroscopy (DRIFTS) technology to quantify mineralogy and organics for near-real-time evaluation at the wellsite. DRIFTS provides four main proxies from drilled rock cuttings—mineralogy, estimated TOC, kerogen maturity, and kerogen density—to characterize shale lithofacies, help identify source rock and thermal maturity, optimize well placement, and enhance completion operations. Using DRIFTS increases data consistency, reproducibility, and quality at the rig site.

Methodology

Unlike X-ray diffraction, DRIFTS measures the vibrational frequency of C-H bonds and then quantifies the minerals and organics. Measurements are performed on cuttings that have been treated through a proprietary sample preparation method to remove mud contaminants (particularly light hydrocarbon) with limited human intervention while preserving kerogen and obtain a clean and dry rock powder of roughly 3 to 4 g for analysis. This cleaning process does not involve any solvents, and up to four samples can be processed at the same time.

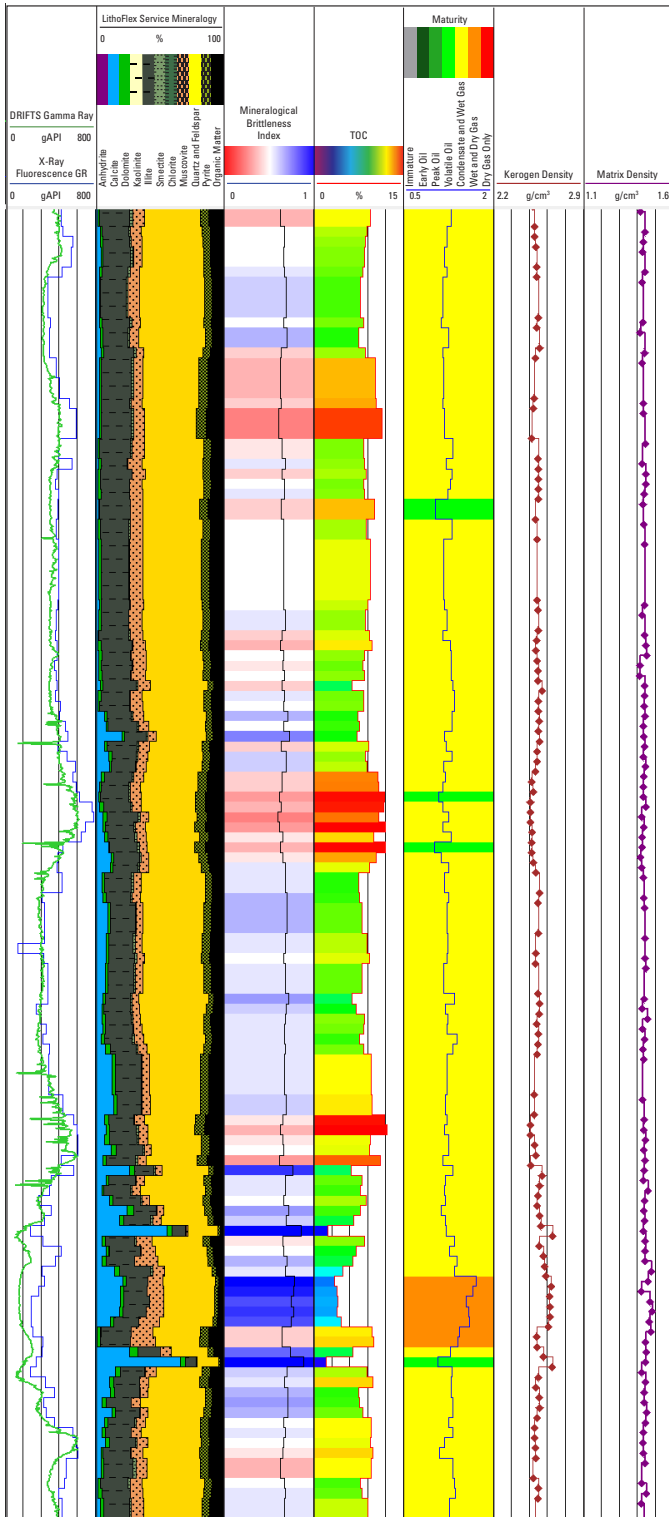
Quantification

During analysis, spectra measured reflect the quantity of absorbed light per the various minerals present in the samples. DRIFTS performs a weighted least-squares regression method using an in-house pure mineral spectrum database. In one click, the software refines raw spectra and identifies and quantifies all minerals and kerogen content present in rock samples. DRIFTS can also quantify the abundance of aliphatic CH_2 , CH_3 , and aromatics groups to determine the equivalent vitrinite reflectance.



DRIFTS spectrum examples for different minerals.

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Composite log with DRIFTS.

Mineralogical and Organic Phases	Average Absolute Deviation, %	Limit of Quantification, %
Quartz-feldspars	5	2
Calcite	5	2
Dolomite	5	2
Kaolinite	5	2
Smectite	5	2
Chlorite	5	2
Muscovite	5	2
Estimated TOC (type I and II)	1	0.2
Kerogen maturity (type II), equivalent vitrinite reflectance	0.1	0.5 to 2

DRIFTS Specifications	
Spectral range	375 to 7,500 cm^{-1}
Spectral resolution	4 cm^{-1}
Detector type	Deuterated, L-alanine-doped triglycine sulfate (DLaTGS)
Dimensions	13 × 10 × 13 in [33 × 26 × 33 cm]
Weight	15.4 lbm [7 kg]
Measurement software	OPUS®

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