

sCore Lithofacies Classification Reveals Barnett Shale Reservoir Quality

Litho Scanner service’s wellsite mineralogy and TOC outputs drive identification of optimal completion intervals

CHALLENGE

Reliably identify intervals with superior reservoir and completion quality in the Barnett Shale.

SOLUTION

Input accurate, quantified mineralogy from Litho Scanner* high-definition spectroscopy service to the automated sCore* lithofacies classification scheme to generate a log display of the classification and quality-indicator overlays on a ternary diagram.

RESULTS

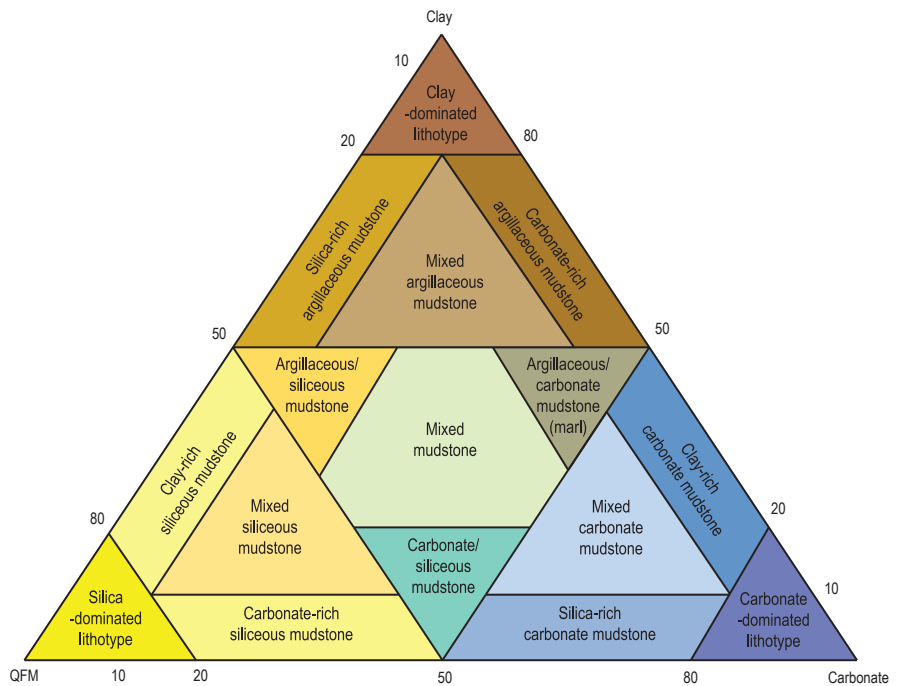
Identified the optimal intervals for completion from the sCore scheme’s reservoir and completion quality overlays.



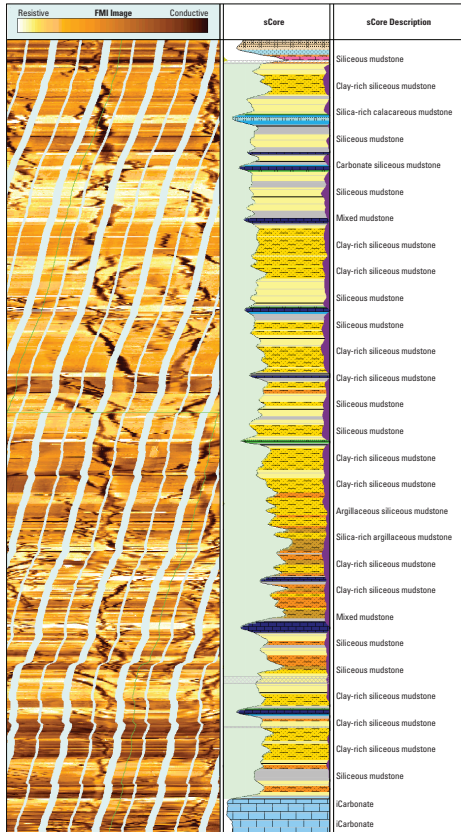
Shale classification challenges

Key to successfully completing Barnett Shale reservoirs is targeting intervals with superior reservoir and completion quality. However, these so-called shales are more than just fine-grained sedimentary rocks with a high content of organic matter. Rather, these organic mudstones are typically a complex mineralogic

assemblage that is heterogeneous at fine vertical scales. In addition to identifying optimal intervals in terms of reservoir and completion quality, operators need a mineralogy-based classification to better understand depositional conditions and correlate reservoirs across different fields and basins.



The sCore lithofacies classification scheme for organic mudstones is defined by a ternary diagram, with the three apexes representing the dry-weight components clay, carbonate, and quartz, feldspar, and mica (QFM). The term “dominated” is used for a mudstone containing more than 80% of a particular component. When the primary component is 50% to 80% of the composition, the mudstone is described as siliceous (50% < dry-weight QFM < 80%), argillaceous (50% < dry-weight clay < 80%), or carbonate (50% < dry-weight carbonate < 80%). The term “rich” indicates a secondary component representing 20% to 50% of the total composition.



The sCore scheme’s log display for a 200-ft section of a vertical Barnett Shale well is paired with an FMI* fullbore formation microimage log in Track 1 that reveals numerous drilling-induced features. The green area in Track 2 represents the organic mudstone interval to which the sCore classification was applied. The lithofacies display in Track 2 was created with inputs from Litho Scanner high-definition spectroscopy service. The TOC flag, shown in purple along the right boundary of Track 2, represents TOC > 2%. The gray crosshatching pattern indicates zones affected by borehole rugosity. The left boundary of the lithofacies display represents the mineral-based brittleness index (MBI). Track 3 lists the sCore lithofacies in text format.

Optimal reservoir identification

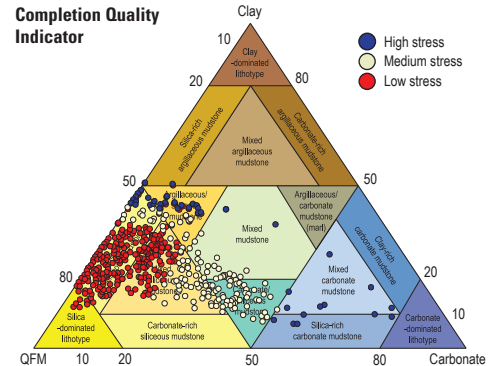
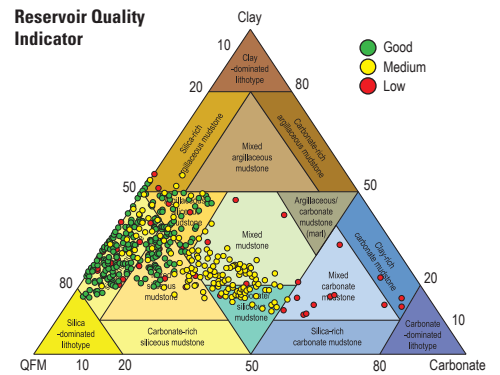
Shale facies are readily and automatically identified using the sCore lithofacies classification scheme. The sCore classification is based on mineralogical relationships within a ternary diagram customized for organic mudstone lithologies to determine both lithofacies and reservoir and completion quality indicators.

The sCore scheme’s log display is generated with minimal processing and no interpretation input required. Descriptive parameters such as organic carbon, pyrite, and the presence of expandable clays are flagged. The log provides a consistent description of the organic mudstone section and the inputs necessary for effective decision making when selecting a landing points for well placement, tailoring completion designs, and planning a drilling development project. Quality indicator parameters such as porosity, total organic carbon (TOC), fracture density, and stress are also overlaid on a ternary diagram to relate the parameter quality to the sCore classification’s lithofacies types.

Accurate mineralogy input for the sCore classification comes from Litho Scanner high-definition spectroscopy service logs for carbonate, clay, QFM, and TOC in combination with additional inputs from basic triple-combo logs for porosity and resistivity. Mineralogy is provided by Litho Scanner service at nearly immediate turnaround, instead of having to wait for laboratory X-ray diffraction (XRD) analysis of core samples.

Lithofacies quality indicators

From the sCore classification log for the Barnett Shale well, reservoir quality and completion quality indicator overlays on the ternary diagram were generated. The color-coded points represent the different log depths for the indicator parameters that correlate with reservoir quality (top diagram) and completion quality (bottom diagram).



Gas-filled porosity (top) and in situ stress (bottom) measurements plotted on the sCore classification’s ternary diagram provide better understanding of reservoir quality and completion quality distribution within the Barnett Shale.