Schlumberger

MP2 Mechanical Properties Profile Service

Facies modeling based on geomechanical properties

APPLICATIONS

- Quantitative assessment of rock heterogeneity and fracture density
- Rapid identification of regions of weakness in hard and soft rock
- Sand strength analysis in completion design, for example, selective perforating, sand management, and placement
- Significant improvement of the predictive capacity and reliability of rock mechanical models for wellbore stability and sanding potential
- Aid to comprehensive understanding of variance in rock strength for hydraulic stimulation design
- Adequate sampling of all facies by enabling picking locations for sidewall core plugs to ensure adequate sampling of all facies

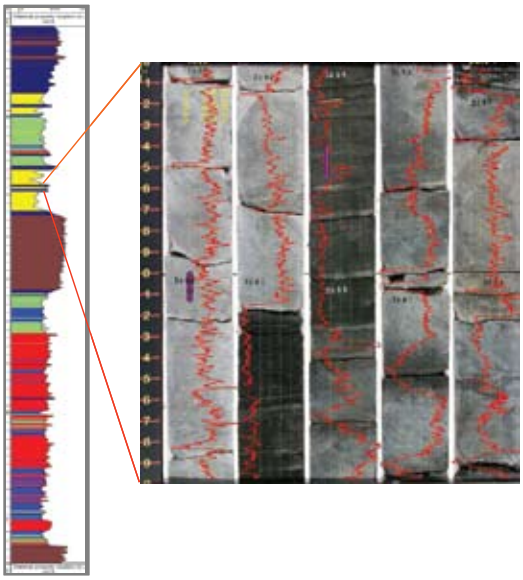
MODELING

The MP2* mechanical properties profile service integrates the continuous unconfined compressive strength (UCS) measurement from the Profiler* scratch test system with petrologic and geologic core descriptions, and with cluster analysis of log measurements, for complete characterization of material properties at wellbore-scale. The MP2 service provides a facies-type analysis based on integrating log and mechanical properties measurements—up to several hundred per inch of core. It allows you to integrate this analysis with your other log data to determine the best approach for completing the well for maximum productivity. Whether you use the actual measurements for sanding analysis to determine the need for sand control or optimal screen placement, or in hard rock for identifying the limits of rock strength heterogeneity across the treatment zone (to ensure a complete zone treatment), the MP2 service will help increase each well's productivity and effective recovery.

CONTINUOUS STRENGTH MEASUREMENTS

The Schlumberger Profiler core scratch test system is patented technology for continuous measurements of rock UCS by cutting (scratching) the rock surface. These measurements include evaluating the normal and tangential forces required to create continuous cohesional (i.e., shear) failure along the rock surface under conditions of a constant depth of cut and constant cut velocity. From these measurements, the energy required per unit of volume of rock cut (specific energy) is determined. For Coulomb rocks, the specific energy for cohesional failure and the unconfined rock strength are directly related, and thus the latter can be calculated along the core length. Data gained from scratching significantly improves the evaluation of rock heterogeneity and thus the construction of mechanical models for wellbore stability applications.

The system provides core-scale continuous measurements of rock strength, allows quantitative assessment of rock heterogeneity and fracture density, and offers rapid identification of regions of weakness. The MP2 service integrates these continuous strength measurements with petrologic and geologic attributes for improved evaluation of rock texture, composition, and litho-type variation. It allows defining scaling relationships of mechanical properties, from plug size to core size to well size. The service integrates these attributes with dominant rock units along the length of the core and the wellbore, as identified via cluster analysis of logs.



Vertical heterogeneity at log-scale. Similar cluster colors represent units with similar material properties. The profile overlaying the cluster colors is the measured continuous core strength, but displayed at lower (log-scale) resolution. The insert shows an example of a core section where the transition between carbonate units and an argillaceous mudstone unit is apparent.

The continuous strength data is taken digitally and is depth-corrected to conventional log data. This data provides an easy high-resolution integration with cluster analysis and other petrophysical log data, such as density, compressional, and shear information from sonic and even image logs. This process allows the geology, petrophysics, and geomechanics teams to honor all their data on a consistent scale.

MP2 Mechanical Properties Profile Service

FEATURES

- Continuous, high-resolution UCS measurement over the entire cored interval, creating a continuous log
- Integration of direct core measurement with log measurements
- Convenient geomechanics-based facies analysis
- Fast, efficient process that delivers data in a matter of days
- Cluster tagging analysis that is designed to be extended to offset wells
- Geomechanical evaluations of in-situ stress and wellbore stability

ADVANTAGES

- Improved reservoir understanding
- More accurate prediction of rock properties
- Full-picture interpretation that allows integration with other facies-based interpretations
- Fast data delivery to allow changes in the current well
- Dataset that allows interpretation of the reservoir in addition to the wellbore
- Improved drilling performance with better understanding of wellbore stability

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CLUSTER ANALYSIS

Cluster analysis evaluates the variability of all log measurements as a function of depth, creates a pattern of these combined responses, and uses pattern recognition technology to identify the occurrence of identical data patterns along the length of the interval of interest. Results from the analysis are presented as a color-coded display, plotted as a function of depth, and define all existing fundamental, nonredundant clusters with distinct material properties along the region of interest.

Evaluation of log data using cluster analysis provides a mathematically precise, objective, and robust methodology for defining rock units (clusters) with distinct material properties. The analysis is a mathematically based methodology that can be used on wildcat exploratory wells, where no previous definitions of the various rock types (e.g., reservoir and seal sections) exist. In these cases, the analysis provides differentiation between the various reservoir and seal units without explicitly differentiating producing and nonproducing intervals. The principal advantage of cluster analysis in these circumstances is accurate identification of the extent of a region to be cored.

Cluster analysis shows heterogeneity at log-scale and discriminates zones of consistent mechanical behavior within heterogeneous media. Results from this analysis are used for selecting core samples (or rotary sidewall plug locations), giving you the most efficient sampling plan for heterogeneous formations, and—after laboratory testing—allowing you to identify the units with best reservoir quality and the units with best fracture containment potential.

UNCORED WELLS

Cluster tagging allows the comparison of log responses in a well (e.g., a noncored well) with log responses and associated reservoir properties in a reference well (e.g., a cored and adequately characterized well via laboratory testing or scratching, if available). Cluster tagging uses cluster definitions from the reference well to assign clusters to comparison well logs. It also produces an error curve that evaluates the degree of compliance between the two wells. Good compliance indicates a strong correlation between the two wells and associated clusters and a strong similarity in material properties. Poor compliance between some sections or the entire section between the two wells indicates the presence of new (nonrepresented) facies. Cluster tagging between wells and the analysis of the compliance help monitor changes in thickness and location of previously defined cluster units between wells. They also help identify new facies requiring coring and laboratory characterization.

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