Integrated Geologic Interpretation in the Deep-Water Gulf of Mexico using Borehole Spectroscopy Logs, Microresistivity Images, Log-Derived High-Resolution Mineral-Based Lithofacies, and Regional Seismic Data

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ABSTRACT

Mineralogical inputs are often overlooked when performing subsurface geological and reservoir interpretation. Categorizing log data into vertical units representative of lithofacies aids the geologist in various ways; however, manually doing this is time consuming and may be biased depending on the interpreter. Some lithofacies recognition software may be available but is either too simplistic or too cumbersome so that it is inconsistent or results are not repeatable. Borehole spectroscopy data in conjunction with high-resolution micro-resistivity images can be used to generate mineral-based high-resolution lithofacies identification using a log-based classification scheme. This scheme classifies the dry weight mineralogical output from borehole spectroscopy data based on an exclusively designed ternary-diagram classification system, and identifies dry-weight mineralogy-based lithofacies. Calibrated high-resolution micro-resistivity image data is integrated with the generated dry-weight mineralogy-based lithofacies to identify a final mineral-based high-resolution set of lithofacies. This entire process can be accomplished on a workstation within a very short time.

Geological and reservoir interpretation of a deep-water northern Gulf of Mexico well has been conducted using this innovative method of lithofacies classification and identification. The example used for this study incorporates all of the finite elements of the borehole and incorporates regional geologic interpretation from the deepwater Gulf of Mexico. This correlation includes integrated elements of regional deposition and how that is manifested in the borehole image and how it is compared to the core data analysis. Borehole images with associated dips have also been used in the interpretation. Sand units have been identified as sheet sands and amalgamated sheet sands. Interbedded sand/shale sequences have also been interpreted based on these lithofacies. Further, seismic comparison is made to integrate the log interpretation into a more regional framework. Future applications in the field include detailed well-to-well correlation, planning, execution, and evaluation of borehole pressure and fluid sampling programs, and, potentially, reservoir modeling.