

Using a drill cuttings-based approach to predict reservoir performance for improved well optimization: a case study from the Harkey Mills Sand and 2nd Bone Spring Sand, Bone Spring Formation, Lea County, New Mexico, USA

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Abstract

Understanding the spatial reservoir parameters of unconventional plays can be challenging but is necessary in order to execute successful field development plans and well stimulations leading to better producing wells.

This study focuses on multiple lateral wells targeting two separate benches, the Harkey Mills and Bone Spring sands, from the Bone Spring Formation and commenced with a data driven campaign to better understand key reservoir drivers. Valuable surface logging data, e.g. drill-cuttings and continuous quantitative mud gas data were collected at the wellsite, analyzed and interpreted in order to build data-rich models to assist in a greater understanding of the reservoir quality and well performance.

More than 1,200 drill-cuttings samples were prepared, rapidly analyzed and interpreted for color extraction and particle size and shape, using various image analysis algorithms, and elemental and mineralogical data using bench-top XRF and XRD. Each sample was then depth-matched to MWD Gamma Ray using a dynamic depth shifting workflow. This entire analytical process together with hydrocarbon fluids composition collected from the mud-gas stream, enabled the construction of a robust lithofacies scheme and inferred facies architecture model applicable to these benches within this Play. Each sample was systematically classified in terms of the lithofacies scheme, thus providing a per lateral well interpretation. Five lithofacies are defined using distinct markers (e.g. elemental & mineralogical data, color, brightness and texture) with each lithofacies having an inferred

geometry. The highest quality reservoir rock relate to strongly confined, probable stacked deep-water channel sands, while the lowest quality reservoir rock relate to distal pelagic plain and/or unconfined overbank sheet sands. In the study area laterals, the percentage of highest quality reservoir rock ranges from 8% to 80% and is dependent on factors such as well placement, landing zone and lateral reservoir heterogeneity. Early production trends from both benches indicate that those laterals with a higher percentage of higher quality reservoir rock are outperforming those wells with a lower quality reservoir.

Utilizing a drill cuttings-based approach to better understand Unconventional Plays, normally requires a substantial initial investment and long analyses times. However, the workflow presented here offers increased efficiencies by providing a cost-effective and rapid method to collect, analyze, define and predict key reservoir drivers. The ability to identify a specific lithofacies and reservoir architecture change from fresh and legacy drill cuttings samples will allow operators to better predict the spatial reservoir architecture of the Play as well as providing a better understanding of near well-bore behavior. This approach offers another tool to confidently make design changes in order to further optimize the production performance of the field, and individual well performance.