Uncovering the potential of the Permian Basin using Advanced Applications of Borehole Images

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Nowadays we all realize that to overcome challenges in the Permian basin, we would need to enhance reservoir understanding. This can be achieved using advanced techniques not just to acquire data but also to use this data to get the answer products we need.

Borehole images have always been a key in data acquisition. Structural features including dips, faults and fractures can be clearly identified in real time while drilling using Advanced Logging-While-Drilling Imaging tools or post-drilling using Wireline Imaging tools.

In this study, we will highlight most of the advanced techniques that can provide us with unique answer products from Borehole Images with an emphasis on case studies from the Midland Basin and the Delaware Basin.

Logging-While drilling Imaging tools are used for real-time acquisition and transmission of high-resolution electrical images of the borehole, azimuthal gamma ray, and multi depth measurement of formation resistivity. Analysis of this information in real time with high data rate LWD acquisition telemetry allows proactive well-placement decision making by comparing apparent dip of the formation to the borehole trajectory. So they can help accurately geosteer the well and significantly reduce many uncertainties. In a secondary step, the analysis of the high-resolution images from the tool memory can then help identify fractures and faults and perform a structural analysis for the optimization of stage designs for hydraulic fracturing. Images of full borehole coverage enable fracture length to be accurately measured. These calibrated resistivity images can be used then directly for fracture porosity evaluation. Advanced interpretation of borehole images for multiple wells ca be then correlated in a 3D structural modeling platform.

We would also show how the integrated interpretation of borehole images and acoustics provides a comprehensive solution for determining the characteristics of a fractured environment. This solution delivers information on

discriminating open fractures from closed ones, drilling-induced fractures from natural fractures. This can be achieved today using Wireline borehole images both in Water and Oil based muds. Sonic imaging extends the range of fracture observation from near borehole to few tens of feet, greatly enhancing the understanding of production mechanisms of a fractured reservoir. This can be achieved using Wireline borehole images both in Water and Oil based muds.

Photorealistic borehole images would also enable a high resolution characterization of formation sedimentary features and fabric. This wealth of information, when combined with other data e.g. lithology interpretations and log data allows high quality interpretation of sedimentary facies. The sedimentary dips interpreted from borehole images, when corrected for structural dip, can be used to indicate depositional trends and sand body geometry. The objective of sedimentological interpretation based on borehole images and using auxiliary data is to describe the rock penetrated by a borehole in the same fashion as rock cores and to deliver sufficient data to guide the property modeling needed for static 3D reservoir modeling. In addition, Porosity analysis in Carbonates, thin bed analysis and facies identification can also be performed using borehole images for a better understanding of the reservoir.