An Integrated Approach on Understanding Natural Fracture Systems in the STACK Play Using Core and Image Log Data

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ABSTRACT

Natural fracture systems can serve as conduit for, and/or compartmentalize, hydrocarbon flow in tight reservoirs. In general, the development of natural fracture systems are controlled by rock mechanical properties (associated with lithofacies), local and regional tectonic activities, and diagenetic history. An understanding of the distribution and characterization (i.e. timing, spacing, mineralization, length, etc.) of natural fractures is critical for evaluating reservoir quality and hydrocarbon productivity.

A workflow utilizing core data (fracture and lithologic facies analysis) and image logs was developed to study the impact of the natural fractures in whole core acquired as part of an integrated reservoir characterization of the Meramec for a Devon Energy operated well in North Central Oklahoma. This investigation was conducted to evaluate whether or not subsurface fracture patterns can be characterized and predicted based on the understanding of structural features and lithofacies in the reservoir.

The core captured multiple potential target intervals, which include zones within the Woodford, Osage, and Meramec Formations. Each formation exhibits variable lithofacies, but some are more conducive to fracturing than others. The higher fracture intensity zones observed in core and Image log are within the laminated radiolarian-rich chert facies, the bioturbated silica-cemented packstone to wackestone facies, the bioturbated calcareous siltstone facies and the laminated microbioclastic grainstone to packstone facies. A majority of these fractures are either terminated (strata-bound) or change characterizations at lithologic boundaries due to the differences in rock mechanical properties. In core, tensile fractures are the most abundant fracture type, and are generally healed with calcite and sometimes quartz with varying width. Some shear reactivation of pre-existing fractures may be attributed to nearby faulting.

Overall, the correlation between core and image log observed in this well gives us confidence in the fractures characterized using image logs in offset wells leading to regional fracture trends being confirmed.