Optimizing lateral placement and production while minimizing completion costs in the STACK

Shale plays are an extremely difficult arena in which to explore. Lack of heterogeneity is not the only problem. Numerous hydrocarbon sources and multiple stacked zones that vary considerably across the play result in mixed drilling success in the Oklahoma STACK (the **S**ooner **T**rend (oilfield) **A**nadarko (basin), found primarily in the **C**anadian and **K**ingfisher counties).

Conventional logging technologies provide important information while drilling to infer the presence or absence of hydrocarbons. However, these logging technologies do not measure hydrocarbons directly, but rather measure hydrocarbon proxies and infer hydrocarbon presence and phase based on the aforementioned data. These technologies, while sophisticated, can lack specificity and sensitivity when trying to accurately identify hydrocarbon source, hydrocarbon families, hydrocarbon mixing, or compartmentalization.

Downhole Geochemical Logging (DGL) provides an ultra-sensitive assessment of the hydrocarbons in a well by analyzing cutting samples to directly characterize the composition of hydrocarbons vertically and laterally through prospective sections. This methodology has the unique ability to look at a broad compound range from C_2 to C_{20}, which is significantly more expansive than the limited traditional ranges of C_1-C_5 from mud logs or C_1-C_9 from laboratory analyses. The result is a detailed granular hydrocarbon characterization in stratigraphic intervals that is a thousand times more sensitive than other methods. This sensitivity and extended carbon range not only allow extensive characterization of reservoir and pore space hydrocarbon fluids, but also for the identification of possible seals.

The purpose of the project, given this was a relatively frontier acreage with little well control, was to not only provide granular hydrocarbon characterization and compartmentalization information in the various vertical stratigraphic intervals in multiple wells, but also compare those formation hydrocarbons laterally across the field. In particular there was interest in the number of unique hydrocarbon fingerprints or hydrocarbon families as well as hydrocarbon mixing, both vertically and laterally across the field.

The primary formations of interest were the Chester, the Upper Meramec, the Lower Meramec, the Osage, and Woodford formations. Of particular interest was understanding possible compartmentalization within the Meramec formation.

It was also known that the DGL technology could determine a water saturation (Sw) proxy by ratioing specific C_6 and C_7 aromatic and n-alkane compounds. Thus, there was particular interest in evaluating water saturation vertically in the various formations from well to well.

In conclusion the data helped to:

- Clearly distinguish between multiple gas, condensate, and oil signatures vertically and laterally in the field,
- Infer separate hydrocarbon sources,
- Identify by-passed pay,
- Increase production by focusing completion placement in hydrocarbon rich and porosity rich zones,
- Infer mixing vertically in wells and laterally across the field,
- Identify zones with high water saturation which would increase production costs,
- Compare water saturation levels laterally across the field.