Predicting Channel Sand Wells in the Anadarko Basin with a 90% Accuracy

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ABSTRACT

Ultrasensitive hydrocarbon mapping can be used in conjunction with seismic programs to dramatically de-risk exploration and reduce costs while improving production. This is particularly true in channel sand fields where seismic resolution may not be sufficient to map sinuous sand beds. Additionally, ultrasensitive hydrocarbon mapping can identify phase for the charged sands which cannot be elucidated by seismic data. The surface surveys took place in southwestern Custer County and southeastern Roger Mills County of western Oklahoma, along the axis of the Anadarko Basin. The purpose of the survey was to map over pressured gas condensate from the Pennsylvanian Red Fork channel sands at a depth of ~14,000'. One of the difficulties of the project was that the Anadarko Basin includes numerous charged horizons throughout the Paleozoic section. Consequently, passive sorbers were placed at the surface around strong producing wells and around dry wells to provide end member hydrocarbon signatures of interest. Additional samples were placed in grid patterns across five townships covering 120 mi2. The end member signatures were used to generate a probability contour map to identify the location of the winding channel sands. The contour map was then used, in conjunction with seismic data, to identify high prospectivity drilling locations.

Thirty post-survey wells were drilled based on the ultrasensitive geochemical results.

- 22 wells were drilled on positive geochemical anomalies for Red Fork gas condensate, with 21 commercial discoveries and 1 dry well (i.e. 95% accuracy),
- 8 wells were drilled on negative anomalies (no hydrocarbons), with 5 P&A'd and three gas discoveries (one failed to pay completion cost)

The ultrasensitive hydrocarbon mapping correctly predicted 27 of 30 wells (i.e. 90% accuracy) drilled post-survey.

The ultrasensitive probability factors were also plotted verses porosity* net pay (phi-h). The plot shows a strong correlation (i.e. r2 = 0.87) between effective reservoir porosity (y wells
and sub-economic wells with a probability factor ranging from ~50% - 60% while wells with the highest phi-h exhibited the highest probability factor (i.e. 80% - 90%). Thus, the graph demonstrates the ability of the ultrasensitive geochemical data to identify and map areas of higher porosity and net pay thickness (i.e. Sweet Spots).

There was also a strong correlation with the survey probability factors and production. Field production increased proportionally with surface survey probability values. The graph also identify a potential completion problem. A well reporting only 300 MCFPD had an elevated probability factor (i.e.~73%) and an elevated phi-h, suggesting possible additional behind-pipe pay.

Summary:

- With multiple hydrocarbon signatures the ultrasensitive geochemical data was still able to distinguish Red Fork gas condensate charge from other petroleum systems in the area (e.g. Granite Wash, Cleveland sands),

• The survey was able to map Sweet Spots (i.e. areas of higher production) with better hydrocarbon richness, porosity, and net-pay over 5 townships.
• The field production history and post-survey wells validated the survey results,
• The survey identified depletion affects,
• The survey optimized production in areas where seismic resolution was insufficient to do so.