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September 21-23
2020
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Evidence for Strike Slip Faulting from 3D Seismic and HZ strip logs and its impact on Hydrocarbon distribution at the Worsley Charlie Lake LL Pool

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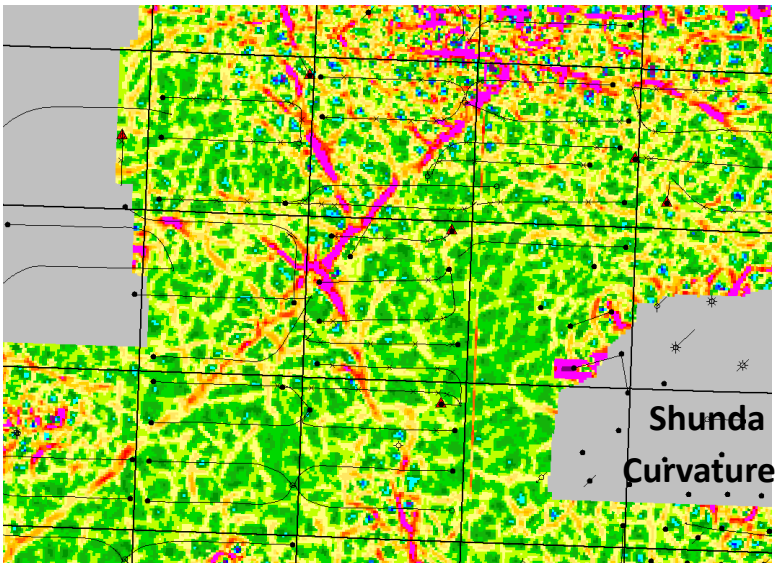
Summary (Heading in Arial 12pt bold)

The Worsley Charlie Lake LL pool is of Triassic age and is situated in NW Alberta about 180 km north of Grand Prairie. Production comes from three layers in the Charlie Lake known as CLLK A, CLLK B and CLLK C. In the mid 2000's the pool was extended into T88 R10W6 using Multi-Stage Frac Horizontal wells targeting the CLLK A unit. The initial direction of the horizontal legs was east west and that convention was continued with all the subsequent drilling. In 2010 and 2015 two 3D seismic surveys were acquired to aid in the guiding of the HZ well trajectories and possibly gain insight into what controlled the limits of the pool. The 3D seismic revealed a conjugate pair of strike slip faults. The NE-SW trending fault had virtually no vertical throw and was identified as a fault by curvature, amplitude, and coherence attributes both at the Charlie Lake level and deeper in the section at the Mississippian level. Wells that were drilled east or south of this strike slip fault produced the typical light oil with API's in the high 30's. However wells drilled west or north of this fault produced a medium grade oil with API's in the mid 20's. Fingerprint typing of the two oils confirmed that the lighter oil (south of the fault) was of a Doig Phosphate source while the medium grade oil (north of the fault) was of a Nordegg source. A number of horizontal wells actually crossed the strike slip fault with no apparent ill effects other than the produced oil was a mixture of light and medium grade. The cuttings, gamma ray log and gas detector from the strip logs for these horizontal wells show evidence of the strike slip fault precisely where the 3D seismic would predict the fault. The HZ strip log evidence is limited to a zone of 3-8 metres which we interpret as representing the fault gouge.



Observations

The observations include 3D seismic attributes suggesting a stike slip fault of Triassic age, unusual HZ strip log behavior of the horizontal laterals where they intersect the fault, different oil types on either side of the fault and regional dip at time of oil migration of N-S rather than the current NE-SW.

Conclusions

The conclusion that we have arrived at is that the strike slip fault is a permeability barrier to hydrocarbon migration. The initial phase of Doig Phosphate oil migration moved from the south to the north and was trapped by the fault gouge resulting in the lighter oils being trapped on the south side of the fault. Subsequent Nordegg oils were released and are only found on the north side of the fault.

Novel/Additive Information

Well bore breakout analysis on a vertical pilot hole showed the direction of current maximum HZ stress is N30 degrees east. Interpreting the azimuth of the strike slip faults suggests a direction of maximum horizontal stress at Triassic time (time of the faulting) of 16 degrees east of north. This difference between current stress and paleo stress can be explained by the rotation of the North American continent following the breakup of Pangea.

Acknowledgements

This work was done while employed at Birchcliff Energy and I would like to thank Birchcliff Energy for allowing me to present this paper and to show interpretations of their proprietary 3D seismic data.

References

Reference Style (use Arial 9pt normal)