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# CHARACTERIZATION OF THE LOWER CHARLIE LAKE, A NATURALLY FRACTURED, TIGHT-OIL RESERVOIR, ALBERTA, CANADA

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## Summary

The Middle/Lower Charlie Lake has recently become the target of significant tight oil Horizontal Multi-Stage Fractured well exploration and development. Pickett plots provide a method to calculate cementation exponent 'm' indicating a dual porosity system made up of both fractures and matrix. Computed tomography (CT) and thin section images are used to identify, classify and describe natural fractures along with degree of mineralization. Fracture porosity is estimated using both electrical properties data and Pickett plots.

## Theory / Method / Workflow

The Lower Charlie Lake formations (Carnian) in the Peace River Arch area constitutes an emerging Triassic-aged, naturally-fractured resource play within the Western Canada Sedimentary Basin. Porosity in the Middle and Lower Charlie Lake ranges from 0 to over 20 per cent. The best porosities and permeabilities are associated with micritic dolomites deposited in evaporitic environments.

Detailed sedimentological description provides a facies framework and, coupled with thin sections XRD, MICP and routine core analysis measurements, provides further understanding of the facies and their relationships to reservoir quality at both the macro and micro-scales. The Middle Charlie Lake reservoir is dominated by dolomite deposition in the form of cements and as primary framework grains. Significant anhydrite cementation is also present, complicating the development detailed petrophysical models.

Pickett plot in Figure 1 provides a method to illustrate the regional similarities of the Middle Charlie Lake over 10's to 100's of kilometers. Comparison of measured versus calculated cementation exponent 'm' from Pickett plots (Figure 1) indicates potential for a dual porosity system within the Lower Charlie Lake made up of both fractures and matrix.

According to core descriptions, thin sections and CT scanning data, the Lower Charlie Lake has relatively high occurrence and densities of vertical micro-fracturing. Fracture porosities and corresponding partitioning coefficients can be calculated using methods proposed by Serra 1989 and Auguilera 2003.

Pervasive microfractures likely affect the geomechanical behavior of these rocks during multi-stage fracture stimulation operations due to fracture dilation and reactivation along existing planes of weakness further enhancing production performance.

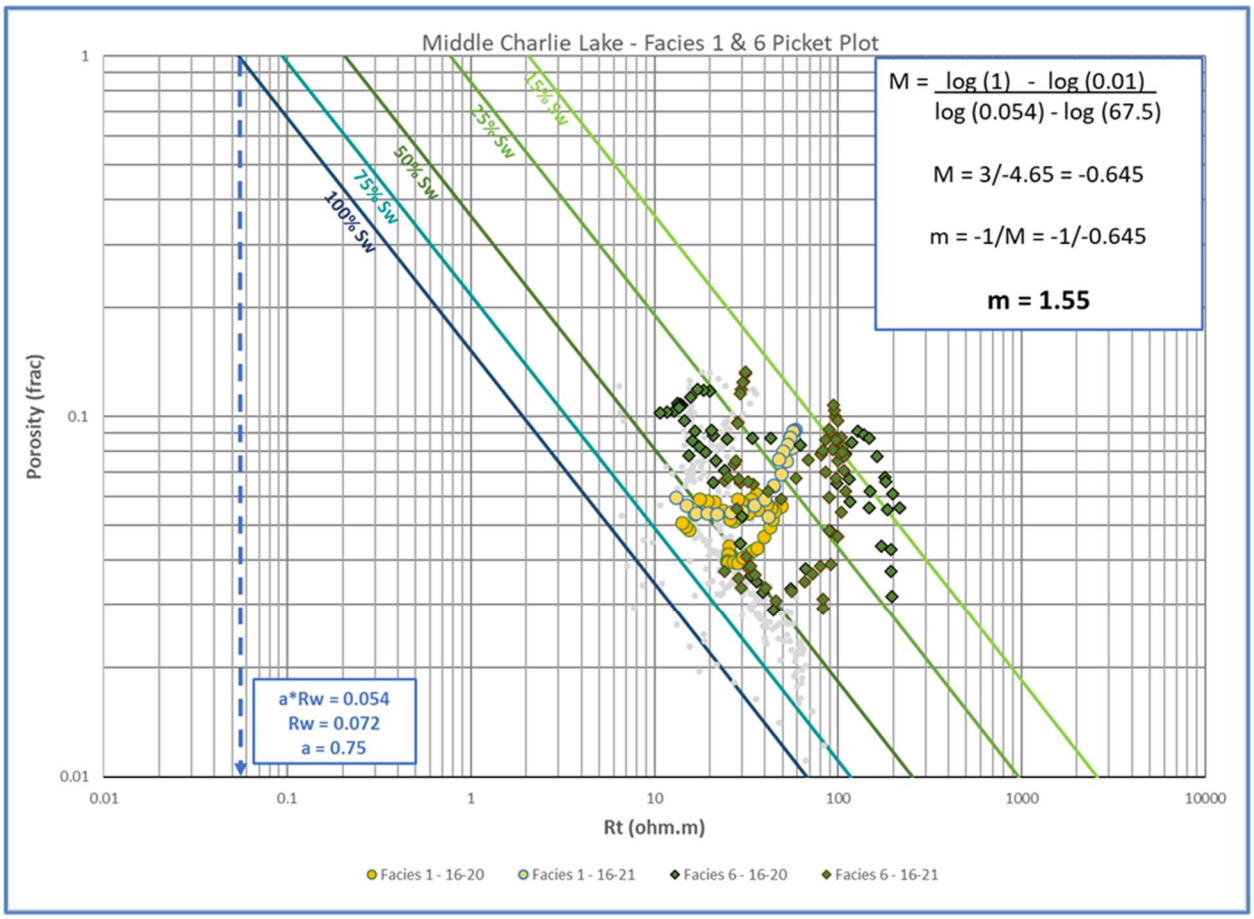



Figure 1 – Middle Charlie Lake Pickett Plot with Facies 1 & 6 data from 16-20 & 16-21-078-08W6 wells

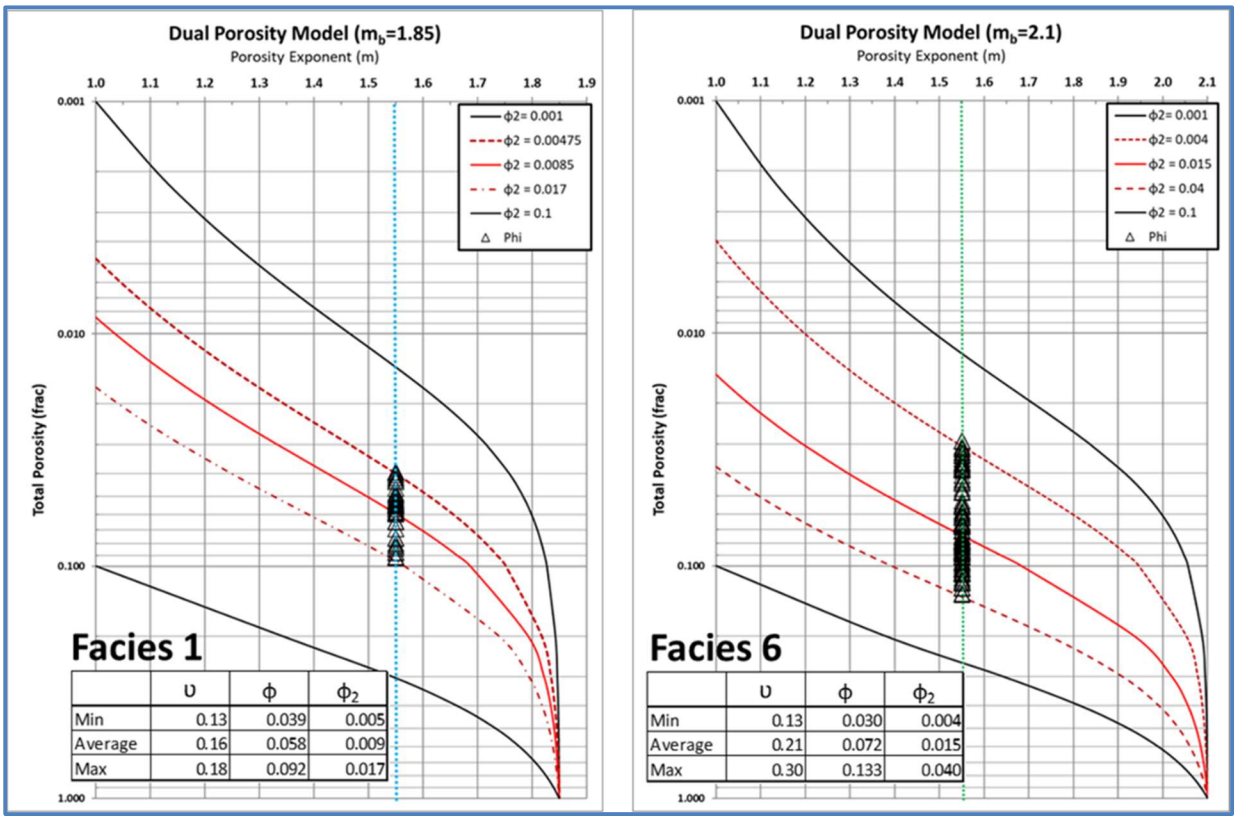
## Results, Observations, Conclusions

This reservoir exhibits many of the characteristics of a regionally continuous oil accumulation contained within a large, regional, unconformity-bounded, stratigraphic trap. With over 130 wells currently on production in this reservoir, detailed characterization of this Middle/Lower Charlie Lake is important to fully understand the potential of this large regional tight-oil resource.

Calculations of the cementation exponent 'm' in Figure 2, indicate a dual porosity system made up of fractures and matrix, which are confirmed by observations of fractures in core, CT scans and thin sections. Fractures are classified as diagenetic/contractional due to the random fracture orientations and the lack of continuity through the cores. Observed fractures are generally occluded by secondary mineralization in the form of anhydrite, dolomite or authigenic quartz cements.

Mapping of interpreted petrophysical log as well as basic geological data provides detailed estimation of the extent and volume of the Middle Charlie Lake reservoir. OOIP in the Middle Charlie Lake ranges from 4 to over 10 million barrels per section (256 ha). With an aerial extent of over 400 square miles, the hydrocarbon potential in the Middle Charlie Lake is significant.

Ongoing well results confirm that the Middle Charlie Lake is an emerging light oil play in the Peace River Arch area of northwestern Alberta.




| Facies 1 | υ | ϕ | $\phi_2$ |
|---|---|---|---|
| Min | 0.13 | 0.039 | 0.005 |
| Average | 0.16 | 0.058 | 0.009 |
| Max | 0.18 | 0.092 | 0.017 |

| Facies 6 | υ | ϕ | $\phi_2$ |
|---|---|---|---|
| Min | 0.13 | 0.030 | 0.004 |
| Average | 0.21 | 0.072 | 0.015 |
| Max | 0.30 | 0.133 | 0.040 |

Figure 2 – Middle Charlie Lake dual porosity model for Facies 1 & 6 with data from 16-20 & 16-21-078-08W6 wells

## Acknowledgements

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