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Which Parameters Control Production from Tight Reservoirs?
Formation Quality vs. Completion Severity

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Summary

The industry is facing significant challenges due to the recent downturn in oil prices, particularly for the development of tight reservoirs. It is more critical than ever to 1) identify the sweet spots with less uncertainty and 2) optimize the completion-design parameters. The overall objective of this study is to quantify and compare the effects of reservoir quality and completion severity on well productivity.

We developed a supervised fuzzy clustering (SFC) algorithm to rank reservoir quality and completion severity, and analyze their relative impacts on wells' productivity. We collected reservoir properties and completion-design parameters of 1,784 horizontal oil and gas wells completed in the Western Canadian Sedimentary Basin. Then, we used SFC to classify 1) reservoir quality represented by porosity, hydrocarbon saturation, net pay thickness and initial reservoir pressure; and 2) completion-design severity represented by proppant concentration, number of stages and injected water per stage. Finally, we investigated the relative impacts of reservoir quality and completion severity on wells' productivity in terms of first year cumulative barrel of oil equivalent (BOE) as the productivity indicator.

The results show that almost half of the studied wells are completed in poor to average (low-quality) parts of the reservoirs, and the other half is completed in average to good (high-quality) parts of the reservoirs. In low-quality reservoirs, the effects of completion-design on wells' productivity is less pronounced, but the productivity follows reservoir quality. However, in high-quality reservoirs, the role completion-design becomes significant, and the productivity can be deterred due to inefficient completion-design.
The results suggest that in low-quality reservoirs, the productivity can be maximized with less sever completion-design, while in high-quality reservoir, a more severe completion significantly enhances the productivity.

This study introduces new insights on how the effect of completion-design on well productivity varies depending on the reservoir quality. Outcomes of this study can assist oil and gas operators to efficiently optimize completion-design as a function of reservoir quality to maximize the economic return. Unlike pure statistical classification techniques, adding supervision to SCE algorithm allows integration of physical understanding and observations with statistical techniques to guide/supervise the data-driven analysis.