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Variable Production in the Montney and the Potential for Improved Liquid Recovery: Insights from Produced and in situ Hydrocarbon Fluids

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Summary

Hydraulically fractured Montney horizontal wells often display drastically different production declines and liquid recoveries at the field or even at the pad scale. Such variations are attributed to differences in reservoir properties, reservoir pressures & temperatures, in situ fluid PVT properties, well placements and stimulations, and operations. But the quantitative impacts of these factors are poorly understood, severely impeding our ability to predict and optimize liquid recoveries. We attempt to quantify the relative effects of these factors on production and liquid recoveries using systematic compositional reservoir simulations incorporating a range of geological and engineering parameters representative of the Montney. Based on the production data and fluid properties of over 1000 Montney wells, the effects of the phase behaviors and saturation pressures of in situ fluids on well performance and liquid recoveries are highlighted.

Method

Field production data of liquid-rich Montney wells and associated fluid compositional data are analyzed, and compositions of in situ hydrocarbon fluids are assessed. Then compositional reservoir simulation models with representative Montney properties and operations are constructed based on basin-wide mapping and analyses of reservoir pressure and temperature, historical production, fluid properties and GORs. Multilayer reservoir models are constructed based on the petrophysical properties of type wells. Representative saturated and undersaturated condensates are characterized with EOS-based PVT models fine-tuned with laboratory PVT tests. Effects of well completion and stimulation are investigated considering well and fracture spacing, flowing bottom hole pressures and surface separator conditions. The modeled production decline curves and compositions of produced fluids are analyzed to highlight the effects of individual factors and applied to analyze the variable performance of Montney wells in gas condensate windows.

Results & Conclusions

The analyses of production data and compositions of produced fluids reveal that significant fraction of liquids are left in the reservoir and not recovered. Results from systematic reservoir simulations highlight the controls of geological and engineering parameters on the production characteristics of the Montney. Combined with field data, our study clearly suggests that engineering parameters, such as well completion, stimulation and operations, impose significant influences on well performance and liquid recovery, which can be optimized when local geological and reservoir properties and PVT phase behavior of in situ fluids are considered. The results also suggest the potential for improved liquid recoveries from current Montney wells.

The systematic approach with integrated analyses of production data and fluid compositions, comprehensive compositional reservoir simulations, regional mapping and analyses of pressures, temperatures, and field data provides a framework to understand influences of various parameters on hydrocarbon recoveries of Montney wells. The results of our study significantly advance our understanding of the underlying causes of underperforming Montney wells and provide guidance to optimize hydrocarbon recoveries in the liquid-rich Montney and other unconventional plays.