



Cardium Formation Paleo-Depositional Facies Analyses Using Stochastic Inversion and Seismic Stratigraphy

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Summary

The study represents new methods of seismic reservoir characterization added to the geological and geophysical work carried out earlier in the area to evaluate the full potential of Late Cretaceous Smoky Group that includes Cardium Formation. This study re-defines the importance of seismic in the areas with the use of high frequency restoration and new inversion processes.

Introduction

Cardium Formation is one of the most prolific light oil and gas producer in Alberta for last 70 years. After the introduction of extensive horizontal drilling and new fracking techniques in last decade the recoverable reserves from the Cardium Formation have nearly doubled. Although estimates of reserves are difficult due to the involvement of hundreds of small operators in the area, this formation continues to evolve through better understanding of various members within the stratigraphic interval.

Previous work presented by the authors showed that the shoreface trends and thickness changes in the Cardium Formation can be detected from seismic and could be helpful for better hydrocarbon recovery and finding new shoreface trends. This study further enhances the investigations through the use of new horizontal well data, seismic rate of deposition analysis and stochastic inversion methods.

Methodology

Main method is the integration of quantitative and qualitative seismic methods with inferences from present day shoreface geological models. Stochastic and neural network inversions are added to achieve high resolution sequence stratigraphy derived from the seismic.

Seismic Inversion process is inherently uncertain due to band limited nature of seismic data. Stochastic inversion methods partly solve the problem through generation of uncertainty of a solution through the constrains derived from extensive well data. In the stochastic inversion technique, thousands of pseudo-wells, 1D geologic models without spatial information are generated in a simulator that combines geologic reasoning with Monte Carlo statistics.

A much refined stratal model is achieved through the use of local variation in stratigraphic dips of the high resolution seismic.

Cardium Formation of Deep Basin

Wapiti, Kakwa and Bilbo field areas constitute the most northern fringe of the hydrocarbon bearing Cardium shoreface as it extends further north into wet trend.

In last few years many wells are drilled through Cardium Formation for deeper targets thus making the well database even richer than it was few years ago. In addition to these wells (vertical penetrations through Cardium) there are numerous horizontal wells drilled in Kakwa member of the Cardium

Formation. Previously derived models were based on the vertical wells and seismic facies analysis as presented by Baranova et. al., 2011. The new well information shows better understanding of stacking pattern of prograding shoreface sequence and basinward decrease of porosity for each shoreface.

Stochastic inversion is applied to a small interval covering the stratigraphic section of Smoky group. The inversion results depict the lithologic facies variation as we progress from mainland towards lagoon, beach and tidal deposits.

Conclusions

A better integrated model is achieved that allows differentiation of hidden prolific zones within the Smoky Group. Development of the vast deposits within the Cardium Formation needs more horizontal wells, controlled well orientation and reduced fracking to allow better exploitation.

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References

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