geoconvention Virtual Event September 21-23 2020
CSPG · CSEG · CWLS · GAC · MAC · IAH

# The Geometry of Hydrocarbon Fields in Fold and Thrust Belts, with Analogues from the Western Canadian Cordillera

*Andrew C Newson B.Sc. P.Geol.*

*Moose Oils 2014 Ltd*

## Summary

Understanding the geometry of a structure in any fold and thrust belt is the key to exploration success. The relative position of the rocks does control the four key elements required to make a prospect: source, seal, reservoir and timing. Earth scientists working on these geometrically complex structures develop their knowledge by mapping the surface geology, interpreting the borehole logs and mapping the seismic reflectors.

## Workflow

This knowledge can be enhanced by using suitable analogues, such as those found in the Western Canadian Cordillera. Here the surface geology is easily accessible and exhibits a wide variety of geometry. There is a large publicly available well database and there exists a history of close collaboration among the geological, geophysical and petrophysical communities. One part of this fold and thrust belt that has many good analogues is an area 60 km southwest of Calgary, that broadly encompasses the Moose, Quirk Creek, Highwood and Turner Valley structures. (Figure1)

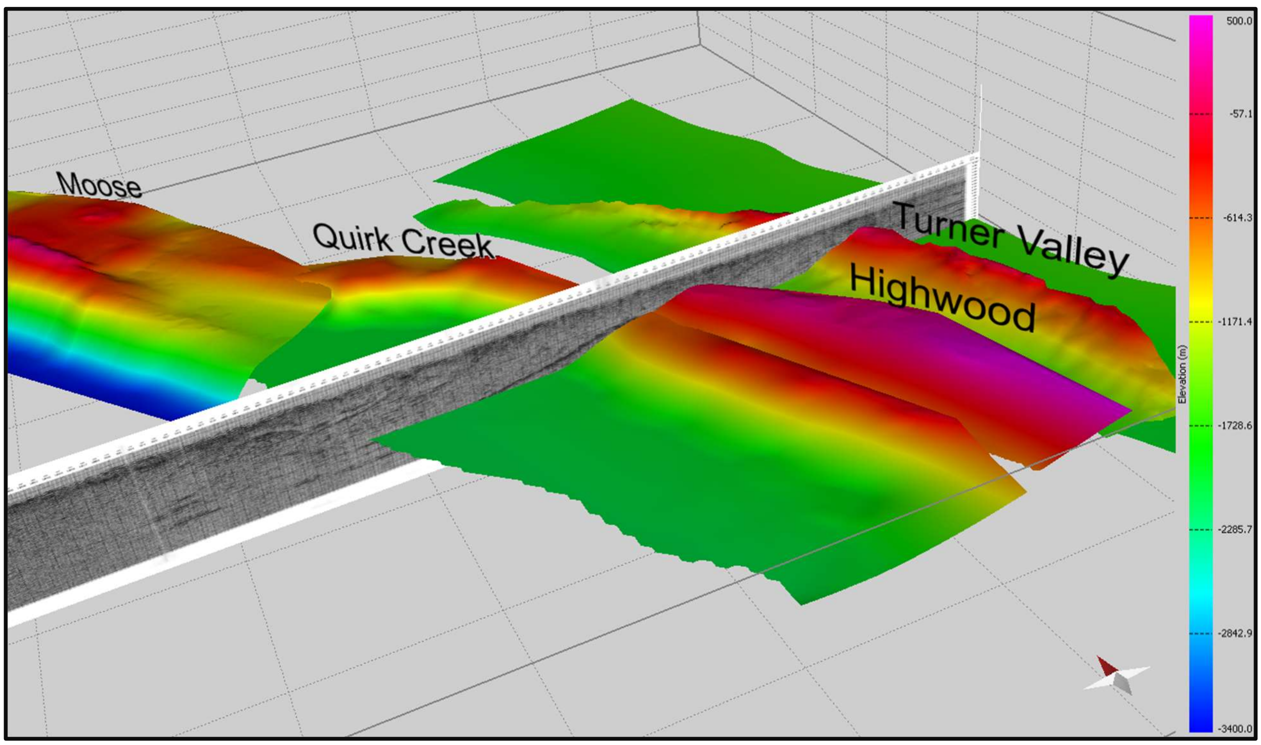


Figure 1: Looking northeast over a 3D Model of the Moose, Quirk Creek, Highwood and Turner Valley structures in the Western Canadian fold and thrust belt. Elevation ranges from +500 to -3000m. Modelled in Move.

## Additive Information

This presentation will focus, to start with, on the Moose structure. This oil and gas field was initially drilled in the 1920's and 30's looking for shallow oil production on a well-defined surface anticline with surface gas seeps. It was not until 1959 that an improvement in the understanding of the structural geometry of the anticline led to the drilling of the gas condensate discovery well 16-6-23-6W5m. In this well, the productive Mississippian, Turner Valley formation was intersected after having drilled through the Cambrian, Cathedral formation in the hanging wall of the Moose Mountain low angle thrust fault.

After an additional four development wells had been drilled, the field was tied into a pipeline in 1986. During the next 10 years an improved interpretation of the geometry of Moose was developed. This was due to a variety of factors. At one level the adoption of new geophysical acquisition and process techniques increased the ability to image the reservoir geometry more exactly. In addition, improved software was available to analyse the petrophysical logs with more accuracy to determine the geometry and quality of the reservoir. Lastly, the understanding of this complex structure had progressed due to the close integration between industry, academia and the national and provincial geological surveys. This work resulted in the drilling of 16 more wells on the Moose structure between 1998 and 2008, which tripled the gas condensate production from the Moose field.

Because of the recent development drilling, a large amount of modern digital well data was made available, which included all the image and dip logs acquired by the present and past operators. This data was then used in a series of twelve detailed dip sections, drawn every 2,000m along the strike of the Moose field. In addition, the twelve sections were linked together by two sub parallel strike sections along the crest of the structure. These fourteen sections have provided a greater understanding of the geometry of the reservoir formation and how it varied in the dip and strike direction. We can clearly see how a change in the interpretation of the distribution of the folds and faults on this structure contributed to the subsequent hydrocarbon discoveries in the Moose structure.

## Conclusion

Because of the detailed work on this structure, we can use the Moose structure as an analogue to frame our review of the other structures in the area, including the productive Quirk Creek and Turner Valley structures and the non-productive Highwood structure. Furthermore, these structures individually or linked together could provide suitable analogues for exploration and development opportunities in fold and thrust belts around the world.

## Acknowledgments

MOVE by Petroleum Experts