An Integrated Approach to Developing the Cardium in West Pembina

D. Robert Pinckston, Vermilion Energy, 3500, 520-3rd Ave SW, Calgary
rpinckston@vermilionenergy.com

In this talk I will outline how Vermilion has tackled the development of its Cardium assets in the West Pembina area. The Cardium has been a focus for the company since drilling our first horizontal well in early 2010 and continues to be a cornerstone for the Canadian operations.

Geology and Geophysics

In 2010 we consolidated our land base in West Pembina and began a systematic evaluation of the area starting with a geological model supported by geophysical and petrophysical parameters wherever possible. The Cardium in this area was mapped as individual sand wedges deposited in a wave dominated deltaic system prograding in a NE direction. Seven regressive parasequences have been mapped out in addition to a transgressive shaly conglomerate capping the entire package. The sands vary in reservoir quality from moderately high perms (5-10mD) and porosities (15%) to tight, quartz cemented sands to the SW with permeabilities less than 0.1mD. The bioturbated silty sandstones commonly producing from the east side of the Pembina field do exist in West Pembina but because of the greater depth do not produce in this area and were considered to be non-reservoir. A static model was created in 2011 to help improve production and reservoir predictability. We have since modified it with horizontal data in order to fine tune the depositional architecture and now use the model additionally for wellbore placement.

Seismic has been of limited use as the sand are too thin to resolve, however, we have been using time structure mapping to help with well placement. Primarily, this is to image thrusts that exist in the underlying SWS which will affect the structure of the Cardium. Microseismic has been used to corroborate stress regimes in the area and to monitor how fracturing of the rocks occurs during completions.

Drilling and Completions

Vermilion has been diligent about driving down costs to the point where we are now among the industry leaders in this play. Through the use of drilling pads and optimal fracing techniques we have systematically lowered our costs over a 3 year period. We have multi-well pads built to minimize down time during breakup to the point where we can drill with as little as 6 weeks of downtime. Numerous types of fracing programs have been employed but we have found and stuck with a specific cost effective method. Because we have fraced over 100 gross operated wells to date, we have been using the ISIP values in our fracturing data to determine areas of low stress. This allows us to evaluate potentially underperforming areas and to monitor future frac jobs including refrac candidates. Well

lengths have evolved from one mile to one and a half miles and we are now considering drilling two mile horizontal wells in areas where the rock is tighter.

Production and Development

Wells now have almost three years of production history and as such we have created numerous type curves based on a database of almost 200 gross operated and non-operated producing wells. The development of the Cardium has evolved from a simple three part qualitative system to a method of five categories based effectively on phi-h variations. Our first focus will be to drill category 4 or best reservoir areas then move to category 3 and finally down to category 2 or least economic but still NPV positive areas. Vermilion now has a waterflood pilot project which will be closely monitored for performance to see if widespread waterflooding will increase our recovery factors. In August 2011 we commenced start-up of a 15,000 bopd oil battery in Cyn-Pemb. The facility has been sized to accommodate all our production plus third party volumes.

Acknowledgements

I would like to thank Vermilion Energy for allowing me to present these data and to the Cardium development team in particular for their support.