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Shallow Unconventional Cretaceous Shale Gas in Southwestern Manitoba

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Summary

The Shallow Unconventional Shale Gas Project is in its first year of a multi-year investigation of the unconventional shale gas potential in Manitoba's Mesozoic shale sequences, particularly the Ashville, Favel, Carlile and Pierre formations. Historical and new gas shows have been mapped, and historical and new geochemistry has been compiled, including Rock-Eval® 6, total organic carbon (TOC); and major and trace elements, and mineralogical analysis will be conducted on samples from these horizons.

Field investigations identified a thick siltstone unit with overlying and underlying black organic shale in the Boyne Member of the Carlile Formation that can potentially serve as a gas reservoir in the subsurface. Dissolved gas analysis of groundwater and free gas samples collected report up to 89% methane.

Introduction

High crude oil and natural gas prices, and the constant threat of declining world petroleum reserves, have industry looking for new, less traditional petroleum resources. In Manitoba, the two areas that are the least tested are the deep Devonian to Cambrian and the shallow Mesozoic formations. Shallow shale gas occurrences have been recorded in Manitoba for decades (Manitoba Industry, Economic Development and Mines, 2005), but understanding of and geoscientific data on this potential economic resource are limited. The goal of the Shallow Unconventional Shale Gas Project is to help address some of these issues, by providing potential investors with the basic information needed to undertake exploration in the new and risky unconventional shallow shale gas plays. The current project is targeting mostly the Mesozoic formations, including the Ashville, Favel, Carlile and Pierre formations (Figure 1).

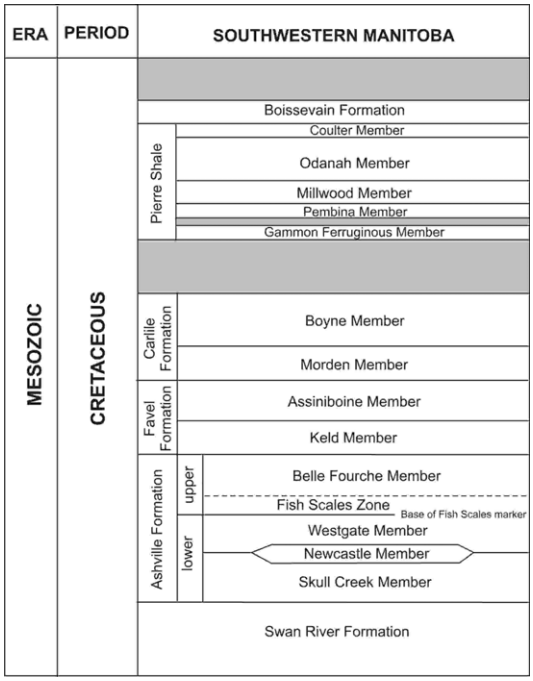

Figure 1: Cretaceous stratigraphy of southwestern Manitoba.

Method

The project has been divided into two phases. Phase 1 is aimed at testing the overall project objectives in a geographic subarea, where outcrop sampling is limited to the Pembina Hills region of southwestern Manitoba (subsurface data are limited to wells south of Twp. 13), was started in the summer of 2008. Phase 2 of the project, which will begin in the summer of 2009, will be based on the results from Phase 1, broadening the project area to include outcrop data from the Riding Mountain, Duck Mountain and Porcupine Hills regions and subsurface data up to Twp. 44.

Phase 1 included visiting field sites and sampling shales from various Late Cretaceous formations, particularly the Favel, Carlile and Pierre formations, along the Manitoba Escarpment, as well as logging of Cretaceous subsurface core and a few drill cuttings south of Twp. 13. Samples of the shale were sent for a combination of analyses, including Rock-Eval® 6 and TOC geochemistry, X-ray diffraction, and whole rock geochemistry. Groundwater samples have been collected and sent for dissolved gas, dissolved solids, alkalinity and stable isotope analysis to determine the composition of the gas and whether it is biogenic or thermogenic, and chemistry of the groundwater. Free gas samples from old non-active gas wells and water wells were collected and sent for compositional and isotopic analysis.

Further study will include detailed log analysis on wells to obtain sand-silt-shale ratios, and water resistivities and formation temperatures where possible. Payson gas readings will be compiled to give a qualitative assessment of the gas content in each formation.

Phase 1 – Early Results

Field work in the Pembina Hills region provided some early insight into the good potential for shale gas. Field investigations showed that lithological variations were notable within some of the formations, particularly the Boyne Member of the Carlile Formation and the Odanah Member of the Pierre Shale. In

contrast, the Morden Member of the Carlile Formation and the Pembina and Millwood members of the Pierre Shale showed very slight lithological variations in their sections, except for numerous bentonite seams within the Pembina Member.

Most outcrops sampled are uniform fissile shale. One roadside outcrop in the Boyne Member, however, contains a 2 m thick, shaly siltstone bed underlain by a dark black shale and topped by a medium brown shale. The shaly siltstone, being more resistant to weathering than the overlying and underlying shale beds, stands out prominently in the roadcut. This resistant unit can be subdivided into two beds: a lower shaly siltstone and an upper shaly siltstone to sandstone. Possibly due to its resistant character, this unit is characterized by abundant centimetre-scale, horizontal and vertical fracturing, as well as decimetre- to metre-scale jointing. The lower shaly siltstone is calcareous, and displays internal bedding, crossbeds, thin laminae, and lenses of siltstone to fine sandstone. The upper shaly siltstone to sandstone is similar to the lower unit, but contains thin beds and lenses of fine sandstone throughout. The outcrop, located in the Snow Valley along Roseisle Creek southwest of Roseisle, Manitoba, is the only location visited that displayed this particular siltstone bed; all other Boyne outcrops were stratigraphically higher. One quarry outcrop northeast of Notre Dame de Lourdes along the Manitoba Escarpment edge, contains a thin siltstone bed in the upper Boyne Member, but its exact stratigraphic position relative to the Roseisle Creek outcrop is uncertain.

The discovery of siltstone beds within the Boyne Member is significant because it indicates that porous gas-bearing siltstone beds, similar to those that host Saskatchewan's gas fields, are present in Manitoba. The extension of the siltstone beds into the subsurface, where they can serve as a gas reservoir, has yet to be investigated in full, but preliminary log analysis indicates that they extend westward to the Saskatchewan border. Multiple thin siltstone beds were identified in core to the west, in Twp. 4, Rge. 29W1, where shale gas production was attempted.

Dissolved gas in groundwater and free gas compositions show high methane concentrations throughout the Pembina Hills region. Gas analyses reported up to 89% methane in the free gas samples, and up to 84% methane in groundwater samples.

Conclusions

Manitoba is often not thought of when considering unconventional gas exploration due to misperceptions that the Cretaceous shales in the far eastern extent of the Western Canada Sedimentary Basin are too tight and lack permeable siltstone or sandstone layers. Early results from this project prove that siltstone and sandstone beds do occur within the organic shale sequences in Manitoba, in beds as thick as two metres, and gas reports indicate gas generation has already occurred, and the organic content of the shale is sufficient to generate large quantities of natural gas. While no commercial production of shale gas is yet reported in Manitoba, the right geological conditions occur for this unconventional play to be further explored.

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