Oil in Manitoba: Exploration, production, reserves and revenues

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Outline

- Geology and exploration
  - Manitoba’s oil facts.
  - Geological setting and stratigraphy
  - Oil fields and their producing formations
  - Helping exploration: MGS Projects

- Oil Economy: production, reserves and revenues
  - Provincial oil economy
  - Drilling activity
  - Production & reserves
  - Hydraulic fracturing basics

Questions
Did you know that...

- Discovery well: 1951 in the Daly Field;
  - First productive oil well in the Williston Basin!

- 13 designated oil fields and ~200 oil pools in SW Manitoba.

- Hydrocarbon-bearing formations in SW Manitoba occur at depths up to 2300 m.

- Drilling and Production:
  - Current production depths is between ~500-1200 m;
  - ~ 9100 wells licensed (~6450 wells producing);
  - 49.5 million m$^3$ (311.3 million bbls) oil produced to date;
  - First hydraulic fracture was conducted in the 1950's;
  - First horizontal well was drilled in 1991.

- Oil and Gas Mineral Rights:
  - 80% privately owned;
  - 20% Crown owned.
Manitoba’s Geological Position

Geological Map of Canada (Wheeler et al., 1996)

Current oil producing area

Hudson Bay Basin

Williston Basin
Western Canada Sedimentary Basin / Williston Basin

- Cretaceous- to Cambrian-aged rocks
- ~2300 m deep in Manitoba
- Manitoba represents the northeastern flank of the basin
- Focus of oil and gas exploration in Manitoba
- SW dipping
SW Manitoba cross section

Cenozoic
present to 65 million years ago

Mesozoic
65-250 million years ago

Paleozoic
300-550 million years ago

West

A

50 million year unconformity

~70 million year unconformity

A'

East

500 Metres

100 Kilometres
Hydrocarbon Horizons

- biogenic shale gas horizons
- oil and solution gas horizons
The Oil Patch

- Daly Sinclair Field
- Tilston Field
- Waskada Field
- Lulu Lake Field
- Virden Field
- Whitewater Field
- Pierson Field
- Kirkella Field
- Souris Hartney Field
- Regent Field
- Mountainside Field
- Birdtail Field
- Manson Field

2012 oil field map
Oil Production by Formation

- Mississippian
- Lower Amaranth
- Bakken-Three Forks

Year

Oil ($10^3$ m$^3$)

Future Prospects

- Continued exploration and development in known oil fields.
- Expand hydrocarbon producing and exploration area.
- Hudson Bay frontier area.
- Still many prospects in the shallow & deep horizons.
Helping exploration: MGS Petroleum Projects

- Shallow Unconventional Shale Gas Project
- Bakken-Torquay Project
- GEM Hudson Bay and Foxe Basins Project
Cretaceous Gas Shows
1906-1933:

- Natural gas used for domestic lighting and cooking purposes at several sites in SW Manitoba.
- Historical documents indicate up to 12 gas wells drilled in SW Manitoba between 1906 and 1933.
  - At least two wells remain capped.
Drilled in 1907
Well TVD: 396 m
Gas Depth: 183 m

Notre Dame de Lourdes, MB
Drilled in c. 1930
221 kPa initial pressure

Drilled in 1933
Manitou, MB
276 kPa initial pressures
Modern Exploration: 2003-2006

2003 to 2006: Waskada Field area, north of Pierson Field, and the Manitou area

- 3 wells cased for production in the Favel Formation in the Waskada Field; now abandoned.
- 2 wells north of Pierson Field: cored, cased, stimulated.
- 1 well in Manitou area: cased, formation tested.
Project goals:

- To verify if the Cretaceous sequences of SW Manitoba have the right **geological conditions** for economic shale gas accumulations.

- Identify the best target formations.

- Determine type of gas (biogenic or thermogenic).

- Create sequence stratigraphic framework:
  - exploration model.
Sampling 2008-2012

- Outcrop mapping
- Shale sampling
- Soil sampling
- Water well sampling
- Gas well sampling
Shale Gas Target Details

- West (T1 R29W1):
  - 620 m thick
  - 100 m TVD to 720 m TVD
  - Pierre Shale (Odanah Mb) to Ashville Fm.

- East (T2 R9W1):
  - 220 m thick
  - 100 m TVD to 310 m TVD
  - Pierre Shale (Odanah Mb) to Ashville Fm.

Yellow highlight indicates units with documented gas shows.

- Stratigraphic details:
  - East (T2 R9W1):
    - 220 m thick
    - 100 m TVD to 310 m TVD
    - Pierre Shale (Odanah Mb) to Ashville Fm.

  - Fingerprint of rocks are similar to other shale gas basins (e.g. Michigan Basin – Antrium Shale).

  - Play type: unconventional biogenic shallow gas.

  - Potential shale gas area: 50,000 km².
Helping exploration: MGS Petroleum Projects

- Shallow Unconventional Shale Gas Project
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Isopach map of the Three Forks Fm
1986: First Bakken production.
2003: First Torquay production.
Two new oil fields.
Represents ~50% of Manitoba’s oil production.
Exploration and development is ongoing.
Williston Basin Bakken-Torquay Play: How does it compare?

**Manitoba:**
- Immature
- Shallow
- Thin

Depth to Torquay:
300 – 2400 m

Avg. Torquay: ~87 m
Avg. M.Bakken: ~46 m

**Saskatchewan:**
- Mature
- Shallow to deep
- Thick

Depth to Torquay:
700 – 3900 m

Avg. Torquay: ~90 m
Avg. M.Bakken: ~46 m

**North Dakota:**
- Mature
- Deep
- Thick

Depth to Torquay:
360 – 1290 m

Max. Torquay thickness: 45 m (65 m in anomalous area)

Avg. Torquay: ~87 m
Avg. M.Bakken: ~46 m

Depth to Torquay:
300 – 2400 m

Avg. Torquay: ~87 m
Avg. M.Bakken: ~46 m
Helping exploration: MGS Petroleum Projects

- Shallow Unconventional Shale Gas Project
- Bakken-Torquay Project
- GEM Hudson Bay and Foxe Basins Project
Devonian, Silurian and Ordovician aged strata.

Some Cretaceous rocks.

~ 2500 m deep in the center.

Exploration has been limited and sporadic:
- 1966 to 1970
- 1981 to 1985

New modern data = renewed interest by industry.
Hudson Platform Cross-Section

Manitoba

Central Uplift

(Zhang, 2007)
Hudson Bay Basin

Nunavut
Québec
Manitoba
Ontario
Churchill
Hudson Bay

Hudson Bay Basin
Hudson Bay Lowland
West East

Whitebear Creek

Kaskattama No.1

Comeault No.1

200 km

NE Manitoba cross section
GEM Energy - Hudson Bay and Foxe Basins Project

- Frontier basin.
- No current oil or gas production.
- GEM - new research & discoveries:
  - Evidence of active hydrocarbon system:
    - Mature oil shale (source)
    - Bituminous residue (migration)
    - Oil staining (migration)
  - Hydrothermal dolomite (HTD) confirmed in core. (reservoir)
  - Extensive reef occurrences. (reservoir)
  - Conditions for traps and seals present.
Manitoba’s Oil Economy: production, reserves and revenues

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Manitoba’s Oil Economy

- In 2011, Manitoba’s...
  - oil production was 2.39 million m$^3$ (15 million barrels), up 27% from 2010;
  - total value of oil production was $1.4 billion, up 56% from 2010;
  - Oil industry expenditures - $1.23 billion
  - Provincial petroleum revenue - $42.4 million (includes Crown royalties, production taxes, Crown oil and gas rights leasing and fees);
In 2011, Manitoba’s…

- Oil royalties paid to private (freehold) mineral owners - $218 million;
- Payments made to landowners for surface rights - $34 million;
- Property taxes paid to rural municipalities - $11 million
- Oil industry provides over 4000 direct & indirect jobs.
Manitoba Drilling Activity

Wells drilled

Year

Average Oil Price ($/bbl)

(To November 26, 2012)
Horizontal Well Construction

Source: Trican

Horizontal Section Length 600 – 1400 m
Five Well Drilling Pad (Waskada)
Horizontal Well Survey Plan

- Abandoned Vertical wells
- Surface location
- Horizontal section
- Target entry point

HORIZONTAL DRILL PATH DETAIL

SCALE 1:5000

METRES
Eight Well Drilling Pad
Based on wells drilled to November 29, 2012
Breaking records

- 672 wells licensed in 2011
- 2.38 million m³ oil in 2011 (15 million barrels)
- 985,987 m³ oil in 1969 (6.2 million barrels)

Time (years)
Cumulative Oil Production by Formation (2012)

- **Bakken-Three Forks**: 13%
- **Melita**: 0%
- **Lower Amaranth**: 15%
- **Mission Canyon**: 5%
- **Lodgepole**: 67%

Cumulative Oil Production - 311 million barrels
Waskada 11-30-1-25 Oil Battery (2005)
Waskada 11-30-1-25 Oil Battery (2012)
Waskada 15-21-1-25 Oil Battery
Crude Oil Markets

- Manitoba has no oil refineries
- All Manitoba crude oil production is exported to refineries in the U.S. and Canada
- The majority of Manitoba crude oil is shipped to market via the Enbridge Interprovincial Pipeline System
- Enbridge has a large storage oil terminal at Cromer
- In 2011, the first crude oil rail loading facility was built in Manitoba
- CN and Tundra Energy Marketing have announced plans to build a 2nd rail loading terminal near Cromer

Source: Enbridge
Enbridge Cromer Terminal

Tundra Cromer Truck Terminal

Source: Tundra Energy Marketing
Hydraulic fracturing (also called “fracing”) is the process of pumping a fluid down an oil and gas well to fracture (crack) the rock formation to increase the production of oil or gas from the well.

The frac fluid (usually fresh water with some additives) holds a proppant (usually sand) that flows into the cracks.

This layer of sand props open the cracks and allows oil and gas to flow at higher rates into the well.
Is there Fracing in Manitoba

- Fracing in Manitoba is regulated under *The Oil & Gas Act*.

- Fracing has been used to increase oil production from Manitoba wells for over 60 years.

- There is currently no shale gas development in Manitoba (shale gas is natural gas).

- Manitoba has shale gas potential.

- Natural gas prices and other economic factors make near-term shale gas development in Manitoba unlikely.
Common Public Concerns about Fracing

- Fracing can contaminate groundwater.
- Fracing uses a lot of water.
- Frac fluids are not properly managed.
- Frac fluid additives are toxic.
- Fracing causes earthquakes.
There has never been a known case where fracing has resulted in groundwater contamination in Manitoba.

In Manitoba, oil reservoirs are located 400 – 1000 metres below groundwater aquifers.

This separation distance coupled with the regulatory requirements for the drilling, construction and operation of oil wells minimizes the risk of groundwater contamination from fracing.
Aquifers

Oil
Gas
Salt
Water

Source: Trican
Manitoba aquifer separation distance
400 – 1000 m

Fractures contained within oil and gas zone
Fracing - Water Use

- Oil industry water use in Manitoba is regulated.
- Fracing operations in Manitoba use significantly less water than shale gas fracing in other jurisdictions.
- Average frac job in Manitoba uses 400 - 700 cubic metres of water.
- The average family of 4 uses 500 cubic metres of water a year.
- Oil industry is reducing the use of fresh water by re-using/recycling frac fluid and using salt water instead of fresh water.
Fracing at Difference Scales

Large frac job (B.C.)
(unconventional; shale gas)

Small frac job (Manitoba)
(conventional; oil)

Source: Trican
Frac Fluid Management

- Frac fluids in Manitoba are managed from cradle to grave.
- Frac fluids are stored in tankage before being injected into a well.
- Frac fluids produced back from a well are disposed of into an approved underground disposal zone using a disposal well permitted for that purpose.
- Closed loop approach minimizes potential adverse environment impacts associated with fracturing.
Frac Fluid Additives

- There is a concern about the toxicity of frac fluid additives.
- The industry has agreed to voluntarily disclose frac fluid additives.
- The industry is also continually moving to greener frac fluid additives.
- Many frac fluid additives are used to treat water or in food processing and others are found in household products such as cosmetics, pharmaceuticals, toothpaste and detergents.
Fracing - Earthquakes

- Seismic activity potentially resulting from fracturing measures less than 3.5 on the Richter scale.

**Richter Scale (worldwide):**

- 2 or less  8,000 / day  Not felt
- 2 – 2.9  1,000 / day  Not felt, recorded
- 3 – 3.9  49,000 / year  Often felt, rarely causes damage

(Note: Each level on scale is 10 x stronger than the previous level)

- Damaging earthquakes reported in the news have 10,000 times more energy than earthquakes linked to fracing.
Fracing – What’s Next

- Oil industry has been proactive in adopting new policies and procedures for fracing to address public concerns.

- Petroleum Branch is reviewing adoption of new guidelines and regulations in Manitoba to ensure that fracing remains safe and public concerns are addressed.

- Initiatives under review:
  - Enhanced submissions requirements;
  - Disclosure of frac fluid contents;
  - Baseline water well testing;
  - Collection of water source and usage data.
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Questions?