Lithic Mannville: Significant New Oil Opportunities*

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Abstract

The informal stratigraphic names “Lithic Mannville” and “Lithic Glauconitic” are becoming more common in Industry Press Releases, yet what do they mean? The “Lithic Mannville” and “Lithic Glauconitic” in the WCSB are significant plays with large upside potential. Glauconitic and Post Glauconitic Upper Mannville Group lithic channels have been successfully developed for gas production over many years with fracture stimulated vertical wells yet, remain relatively underexploited for oil especially when comparing them to the Cardium and Viking. Evidence shows that these plays should experience significant oil and gas production growth in the immediate future. Even in today's challenging price environment, these lithic channels often demonstrate favorable economics. The Upper Mannville Group consists of channels and “regional sandstones”. Extensive channel systems exist in both the Glauconitic Formation as well as in the Post Glauconitic Upper Mannville Group. Fluvial channel sandstones in the Glauconitic quartzose to Glauconitic and Post Glauconitic Lithic time period records a progressive provenance change manifested by a decrease in mineralogical maturity. Compositional changes coupled with burial diagenesis result in notably reduced reservoir quality in lithic sandstones. Traditionally the conventional higher quality Glauconitic Formation quartzose channels have been the favored oil exploration and development target, while the more extensive lower permeability Glauconitic and Post Glauconitic lithic channels remain largely underevaluated and undeveloped. With the advent of multistage fracture stimulated horizontal wells, the lower quality lithic sandstones have recently been targeted as a new oil resource. Oil-In-Place for the lithic channels can range from 12-20 million barrels of oil per section per channel. Therefore, in many areas, lithic channel stacking can dramatically increase potential oil reserves. Understanding the paleogeography, stratigraphy, provenance, lithostratigraphy, petrology, diagenesis and petrophysics is key to unlocking this play. These factors result in lithic sandstones having distinct but recognizable rock properties that require different exploration and exploitation strategies. Three case histories will illustrate how previous lithic sandstone bypassed pay was recognized and subsequently developed for oil production. A seismic example will additionally illustrate the integration of geology and geophysics.

References Cited

Canadian Discovery Digest Spark, March 4 2015, Into the Void: the Glauconitic and Basal Quartz, Entice, AB.

Encana Oil and Gas, Internal Studies.


PanCanadian Petroleum Ltd., Internal studies.

PrairieSky Royalty Ltd., Internal studies.


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The informal stratigraphic names “Lithic Mannville” and “Lithic Glauconitic” are becoming more common in Industry Press Releases, yet what do they mean?

The “Lithic Mannville” and “Lithic Glauconitic” in the WCSB have been successfully developed for gas production over many years with fracture stimulated vertical wells yet, remain relatively underexploited for oil especially when comparing them to the Cardium and Viking. Evidence shows that these plays should experience significant oil and gas production growth in the immediate future. Even in today’s challenging price environment, these lithic channels often demonstrate favorable economics.

The Upper Mannville Group consists of channels and “regional sandstones”. Extensive channel systems exist in both the Glauconitic Formation as well as in the Post Glauconitic Upper Mannville Group. Fluvial channel sandstones in the Glauconitic formation record a progressive provenance change manifested by a decrease in mineralogical maturity. Compositional changes coupled with burial diagenesis result in reduced reservoir quality in lithic sandstones.

Traditionally the conventional higher quality Glauconitic Formation quartzose channels have been the favored exploration and development target, while the lower quality lithic sandstones were largely under evaluated and undrilled. With the advent of multi-stage fracture stimulated horizontal wells, the lower quality lithic sandstones have recently been targeted as a new oil resource. Oil-in-Place for the lithic channels can range from 12-20 million barrels of oil per section per channel. Therefore, in many areas, lithic channel stacking can dramatically increase potential oil reserves.

Understanding the paleogeography, stratigraphy, provenance, lithology, diagenesis and petrophysics is the key to unlocking the play. These factors result in lithic sandstones having distinct but recognizable rock properties that require different exploration and exploitation strategies. Three case histories will illustrate how previous lithic sandstone bypassed pay was recognized and subsequently developed for oil production. Seismic examples will additionally illustrate the integration of geology and geophysics.

**Lithic Mannville Oil Opportunities-Introduction**

- Play is low permeability conventional to unconsolidated Glauconitic and post Glauconitic lithic channel and regional sequence.
- Significant plays with large upside potential.
- Extensive undrilled fairways exist.
- High bypassed pay play with very good data; well control, core, DST.
- Lower quality lithic sandstones often overlooked.
- Progressive provenance change as represented by a decrease in mineralogical maturity.
- Compositional changes coupled with burial diagenesis result in reduced reservoir quality.
- Traditionally, the conventional higher quality Glauconitic Formation quartzose channels have been the favored oil exploration and development target, while the lower quality Lithic channels remain largely under evaluated and undrilled.

**Previous Regional Studies**

Len Stevens PSK Internal

Potocki and Huchon, 1992, AAPG Memoir 55

Fairway: 340 miles long X 108 miles wide, 36720 sq. mi., Alberta, Canada

*Modified from M. D. Shevin, 2011 CSGP Abstract Mannville Paleotopography and Depositional Trends in the Glauconitic Formation, Southern and Central Alberta*
The Mannville Group-Progressive Understanding
Excerpts

The Mannville Group, Central Alberta, Gordon D. Williams, University of Alberta, 1960

Sandstones of the Lower Mannville Group are quartz-rich lithic sandstones or quartz sandstones. Sandstones of the Upper Mannville Group range from lithic sandstone at the base through rock fragment sandstone to arkose at the top. Feldspar content increases upward in section to a maximum of about 50 per cent of the framework.

Channel Trends in the Glauconitic Member, Southern Alberta, CSPG Bulletin, Michael D. Sherwin, Sept. 1996, Glauconitic channel sandstones are highly quartzose and form excellent reservoirs.

Lithic channel sandstones, in contrast, form poor reservoirs.

The Mannville Group, Progressive Understanding
Excerpts

Three Major Sandstone Lithofacies in the Mannville

Quartz rich at base, followed by Lithic, Volcano Feldspathic

Mannville-Three Major Sandstone Lithofacies

Quartz rich at base, followed by Lithic, Volcano Feldspathic

Three Major Sandstone Lithofacies in the Mannville

Mannville-Three Major Sandstone Lithofacies

Quartz rich at base, followed by Lithic, Volcano Feldspathic

Mannville-Paleogeography

Mannville Paleogeography

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Mannville Paleogeography

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Mannville Paleogeography

Mannville Paleogeography

Deciphering Lithostratigraphy

00/06-11-25-22 W4M Lithic Channel Core Thin Sections

13% porosity and 3 md k
Len Stevens-PSK internal

Gluconitic Lithofacies Relationships

Controls on Sandstone Composition
Early Glauconitic Time

Controls on Sandstone Composition
Mid Glauconitic Time

Controls on Sandstone Composition
Late Glauconitic Time

Gluconitic Lithofacies Relationships

Gluconitic Quartzose vs Lithic Channels

Deciphering Lithostratigraphy
00/06-11-25-22 W4M Lithic Channel Core Thin Sections

13% porosity and 3 md k
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Lithic Mannville: Significant New Oil Opportunities, Part 4/4, Case Studies, Conclusions, AAPG ACE June 2016

PrairieSky Royalty Ltd. Lithic Mannville OIL Prospect Areas

Prospect Presentations available upon request

PrairieSky Royalty Ltd. Current Fee Land in Lithic Mannville OIL Fairway

Acknowledgements

To PrairieSky Royalty Ltd. and Encana for their permission and support to prepare and present this study.

To the many hundreds of excellent Industry Geoscientists and Engineers that have added tremendous value and insight into the Lithic Mannville.

The Lithic Mannville’s time is now!

References

Canadian Discovery Digest Spark, March 4 2015, Into the Void: the Glauconitic and Basal Quartz, Entice, ... Southern Alberta, Canada, The American Association of Petroleum Geologists Bulletin, V. 76, No. 6, p. 904-926

PrairieSky Royalty Ltd. website

www.prairiesky.com

Seismic Data can be viewed in the PrairieSky Royalty Ltd. 3D Seismic in Lithic Mannville OIL Fairway, 2D seismic not shown

PSK 3D Seismic

12000 sq. km

2D Seismic

44000 km

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PrairieSky Royalty Ltd. Snapshot

3

(> 12000 sections)

www.prairiesky.com

French, J. L., 1989, Infill Drilling and Improved Recovery in the Mannville Group of Alberta: AAPG Memoir 55, 150-250 Mstb/well (assuming 5% RF)

Primary EUR’s

290 125 (300) >100 0.7 37

Mature Pools

74

New Pools

8

250 74 (300)

200 57 (250)

200 57 (250)

200 57 (250)

200 57 (250)

200 57 (250)

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