

Hydrocarbon Play Ranking and Production Trends in Saskatchewan

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Abstract

Hydrocarbon production from plays within Ordovician to Cretaceous strata in Saskatchewan has been statistically assessed to evaluate average per-well production, cumulative production and overall production trends.

The average per-well production is a parameter that reflects reservoir quality and actual drainage area of the reservoir and is a good measure of success. On the basis of average per-well production ranking, the Jurassic Roseray and Upper Shaunavon plays rank the topmost, followed by, respectively, the Mississippian Midale and Devonian Winnipegosis plays. The Mississippian Ratcliffe, Frobisher-Alida, Alida-Tilston and Alida rank fifth, sixth, seventh and eighth, and Cretaceous Dina and Basal Mannville ninth and tenth, respectively.

Introduction

This study is a geological approach to the historical oil and gas production data to rank the major plays in southern Saskatchewan. It compiles and evaluates all cumulative hydrocarbon production data (to December 2011) from a database managed by Petroleum Statistic Branch of Saskatchewan Energy and Resources. The number of wells producing from a given play in December each year is used for the well count for that year. The number of wells that has produced oil or gas from a given play from initial production to December 2011 is used for the total production-well count. The total production-well count is a measure of industry drilling activity, but not a good measure for success. In this study, the average per-well production value is used as a measurement of success because it reflects reservoir quality and actual drainage area of the reservoir, and, therefore, points out the most prolific plays.

Most of the major hydrocarbon pools in southern Saskatchewan were discovered as a result of intensive exploration efforts in mid-1950s and early 1960s. Waterflood recovery was applied in many pools shortly after discovery since the first waterflood project in 1956 in the Upper Shaunavon in the Dollard Pool in southwestern Saskatchewan (Saskatchewan Industry and Resources, 2003). An *in situ* combustion project was implemented in the Roseray reservoir at Battrum in 1965 and was commercially operated until 2001 (Saskatchewan Industry and Resources, 2003). With development of advanced technology, horizontal well drilling has been used since 1987 and has increased oil production significantly from the mid-1990s in southern Saskatchewan (Saskatchewan Ministry of Energy and Resources, 2011). The first commercial CO₂ miscible flood project commenced operation in the Weyburn Midale Pool in 2000 and is expected to produce at least 20.8 x million m³ of incremental oil (Saskatchewan Industry and Resources, 2003). In this study, the impact on the oil-production trends of application of the above-mentioned recovery methods is assessed using historical production data.

The objectives of this study are to i) monitor hydrocarbon production trends for the major plays using historical production data, ii) indicate the relationship between production and well count through the production history and pool development, iii) investigate the impact of water flooding, infill-drilling, horizontal well drilling and enhanced oil recovery methods on the production trends, and iv) identify highly prolific plays in southern Saskatchewan. The results of this study will aid in the development of future petroleum exploration strategies in Saskatchewan.

Oil Production

Most oil production in Saskatchewan has been from Madison Group (Mississippian) carbonates in southeastern Saskatchewan, cumulatively amounting to 364 million m³ of medium and light oil or about 43% of oil production in the province. The Midale play alone has yielded about 190 million m³, about 23% of the total oil production from a total of 6,946 production wells (Figure 1).

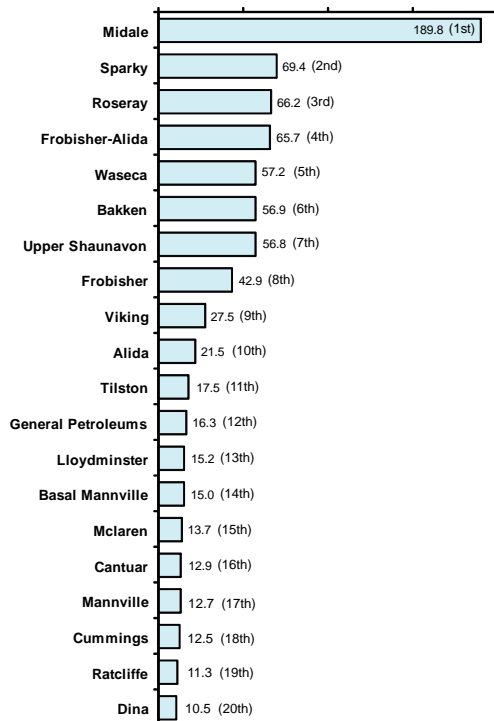


Figure 1 – Top 20 plays by oil production (in million m³) to the end of December 2011 in Saskatchewan.

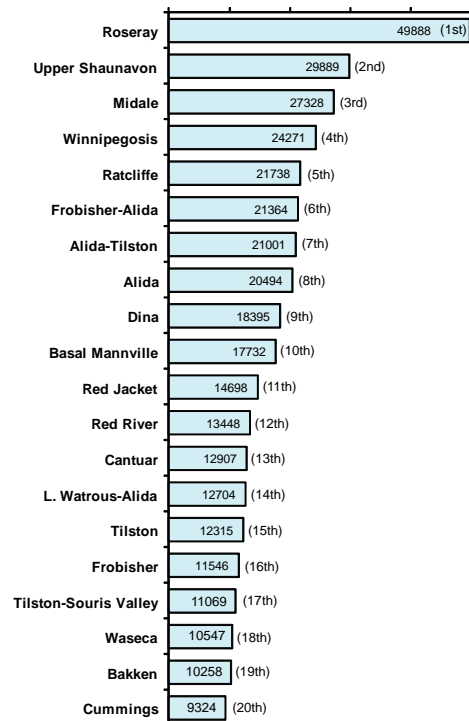


Figure 2 – Top 20 plays by average per-well oil production (in m³) to the end of December 2011 in Saskatchewan.

Followed the Madison Group is the Cretaceous sandstone reservoirs that rank the second with a total oil production of 280 million m³ or 33% of oil production in the province from 39436 production wells. The major oil producer from Cretaceous reservoirs is the Mannville play in central west Saskatchewan, amounting to 246 million m³ of heavy oil from 29022 production wells. The Sparky, Waseca and Viking plays are highest producers with oil production of 69, 57 and 33 million m³ accounting for 8, 7 and 4%, respectively.

Led by the Roseray and Upper Shaunavon plays, the total Jurassic crude oil production in southwestern Saskatchewan has amounted to 130 million m³, about 16% of the overall production from

Saskatchewan. It is interesting to note that Roseray and Upper Shaunavon production is from a total of only 3,229 producing wells, yielding the highest per-well average of 50 and 30 x 10³ m³ respectively.

Recent intensive drilling activity in southeastern Saskatchewan has resulted in light oil production booming from the Bakken (and Torquay) play which yield a total production of 58 million m³ or 7% of total oil production.

Although a total of only 4 million m³ of oil has been produced from the Devonian Winnipegosis, Birdbear and Duperow plays, the total well count of 306 in the Devonian plays is substantially lower than the other major plays. The comparable per-well average production between the Devonian and Mississippian plays highlights the hydrocarbon potential of Devonian reservoirs in Saskatchewan.

The Red River play is the major Ordovician oil producer, having a total production of 4 x million m³ of oil and a per-well average of 13.5 x 10³ m³.

On the basis of average per-well oil production ranking, the Jurassic Roseray and Upper Shaunavon plays in southwest Saskatchewan rank the topmost, followed by the Mississippian Midale in southeast of the province (Figure 2). The Devonian Winnipegosis play ranks fourth. The Mississippian Ratcliffe, Frobisher-Alida, Alida-Tilston and Alida rank from fifth to eighth. The Cretaceous Dina and Basal Mannville plays in the west central area rank ninth and tenth, respectively.

Gas Production

The Upper Cretaceous Belle Fourche (Second White Specks), Medicine Hat and Milk River formations are the major shallow-gas producers in Saskatchewan with a total production of 111 billion m³ or 43% of total gas production in the province. There are approximately 13,000 wells producing from the Milk River, 5700 from commingled Milk River and Medicine Hat, 2100 from the Second White Specks, 1400 from the Medicine Hat, 760 from commingled Milk River, Medicine Hat and Second White Specks, and 560 from commingled Milk River and Second White Specks. The per-well average is about 4.7 x million m³.

The major oil plays in Saskatchewan have produced large amount of associated gas during oil production, accounting for 57% of the total gas production in the province. The Mannville, Madison, Viking, Bakken, Roseray, and Shaunavon plays are the top associated gas producers in Saskatchewan, produced 61, 36, 27, 10, 9, and 2 billion m³ of gas respectively. The top six plays have produced a total of 145 billion m³ of associated gas in Saskatchewan.

Conclusions

Mississippian Madison Group carbonates, and sandstones of Cretaceous Mannville and Viking, the Jurassic Roseray and Upper Shaunavon plays, and Mississippian-Devonian Bakken in Saskatchewan have produced the largest volumes of oil to December 2011. The Upper Cretaceous Milk River, Medicine Hat and Second White Specks plays are the major unconventional shallow-gas producers in southwestern Saskatchewan. The major oil producers are also the major associated-gas producers in Saskatchewan.

For most of the mature plays, hydrocarbon production and well count generally correlate well during the earlier stage of the production. Water flooding, infill-drilling, horizontal well drilling and CO₂ miscible flood technology have had significant impacts on the production trends of mature plays, such as Midale. Appropriate application of these recovery technologies will optimize recovery and prolong the life of hydrocarbon pools.

This statistical study cannot predict future drilling and production, but it does point out the production trends, effective recovery methods and the most prolific plays in Saskatchewan, which help highlight hotspots for future exploration.

Acknowledgments

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Reference

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