

Lithofacies, Depositional Environments and Petroleum Reservoir Characteristics of the Ordovician Red River Formation, Williston Basin, Southeastern Saskatchewan

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Abstract

The carbonate reservoirs of the Ordovician Red River Formation in the Williston Basin of southeastern Saskatchewan first produced oil in 1958, with the height of exploration and development spanning from the mid-1990s to 2000. Oil has been produced almost exclusively from structural traps (Potter and St. Onge, 1991; Kreis and Kent, 2000; Pu and Qing, 2003; Potter, 2006), and, since the early 2000s, the petroleum targets have been primarily shallower (e.g., Mississippian Frobisher Beds). The theoretical oil generated from Red River source rocks is calculated at $95.4 \times 10^6 \text{ m}^3$ (600×10^6 barrels (bbls); Winnipeg Formation – since disproved; Dow, 1974) or $31.8 \times 10^6 \text{ m}^3$ (200×10^5 bbls; Red River Formation kukersites; Osadetz and Haidl, 1989; Osadetz *et al.*, 1989); the amount of oil produced from the Red River in Saskatchewan's subsurface has been calculated at $4.87 \times 10^6 \text{ m}^3$ (30.6×10^6 bbls; IRIS). These data suggest that there are significant volumes of oil remaining in the subsurface. That, coupled with the hiatus of Red River exploration and Saskatchewan's goal of increasing oil production to 600 000 bbls per day by 2030, has warranted a re-investigation into the Red River Formation. The study area just southeast of Regina extends from Township 8, Range 5 west of the Second Meridian (Tp. 8, Rge. 5W2M) to Tp. 16, Rge. 15W2M, covering approximately 99 townships and 9229 km². Analysis of wireline logs, core descriptions, petrographic evaluation and mapping facilitated the identification of nine lithofacies and four facies associations. Collectively, these facies are interpreted to have been deposited as part of a low-energy muddy tidal flat system. Evaluation of reservoir characteristics (e.g., porosity, permeability, oil saturations) suggests that dolomitized intertidal lithofacies (Lf3, Lf4, Lf8 and Lf9) have the greatest potential as oil reservoirs.

Bio



Ashlee Thomas is a Research Geologist with the Saskatchewan Geological Survey (SGS), part of the Ministry and Energy Resources of the Government of Saskatchewan. She graduated from the University of Regina in 2013 with a B.Sc. (Hons.) in Geology then worked various petroleum exploration projects with CNOOC International (formerly Nexen) out of Calgary, Alberta until 2020. Following a pair of maternity leaves, Ashlee has been back in Saskatchewan with the SGS full-time since 2023 where she has been evaluating the carbonate-evaporite succession of the Ordovician Red River Formation in southeast Saskatchewan and completing a detailed reservoir characterization assessment on the once prolific oil producing zone for renewed prospectivity. Ashlee is currently pursuing a M.Sc. in Geology from the University of Regina and is a registered professional geologist (P.Geo.) with APEGA.