

Sedimentology and Reservoir Potential of the Upper Devonian Duperow Formation, Southwestern Manitoba

Kerry B. Bates*, University of Manitoba, Dept. of Geological Sciences, Winnipeg, Manitoba

batesk@cc.umanitoba.ca

and

Nancy Chow, University of Manitoba, Dept. of Geological Sciences, Winnipeg, Manitoba

Introduction

The Upper Devonian (Frasnian) Duperow Formation in the subsurface of the Williston Basin is part of the discontinuity-bounded Saskatchewan-Beaverhill sequence. The formation, which consists of cyclical successions of limestones, dolostones and evaporites, was deposited in the intracratonic Elk Point Basin in a restricted platform interior or lagoonal setting. The Duperow Formation in Manitoba reaches a thickness of 122 to 195 m and thins laterally to the east. The formation is stratigraphically correlative with the economically important Leduc Formation in the Alberta Basin. In Manitoba the Duperow Formation is divided into three members based on laterally continuous marker beds: Saskatoon Member (7-14 m thick), Wymark Member (80-108 m thick; subdivided into lower, middle and upper units) and Seward Member (49-58 m thick).

The Duperow Formation is a proven hydrocarbon producer in Saskatchewan, Montana and North Dakota. Limited geological knowledge of the formation has resulted in low exploration activity and no commercial production within Manitoba. This study focuses on the stratigraphy, sedimentology and reservoir potential of the Duperow Formation in Manitoba with the understanding that the middle Wymark Member is the main reservoir unit, but also recognizing the reservoir potential of the remaining members.

Methodology and Results

Cored intervals of the Duperow Formation from 28 wells in southwestern Manitoba were examined and sampled at the Midland Core Storage Facility in Winnipeg. Core logging included detailed documentation of lithologies, sedimentary textures and structures, fossil identification and diagenetic features, and was accompanied by analysis and correlation of well log data. Thin-section petrography of representative samples was done to characterize allochems, matrix, cement, dolomite and porosity.

On the basis of core and thin section examination, three lithofacies associations composed of twelve individual lithofacies are recognized. The subtidal lithofacies association (LA 1) consists of six lithofacies: (A) skeletal wackestone-packstone; (B) skeletal framestone-rudstone; (C) intraclast wackestone-packstone; (D) mottled to nodular lime mudstone; (E) stromatoporoid-coral floatstone; and (F) stromatoporoid framestone. The intertidal lithofacies association (LA 2) consists of 2 lithofacies: (G) massive dolomudstone; and (H) laminated lime mudstone. The supratidal lithofacies association (LA 3) consists of 4 lithofacies: (I) intraclast rudstone; (J) interlaminated dolostone and anhydrite; (K) massive anhydrite; and (L) patterned dolostone. Cyclicity of the Duperow Formation is on the scale of several meters and displays shoaling-upward trends.

Lithofacies G (massive dolostone) in the middle Wymark Member has the highest porosity (15-20%). Secondary porosity in the form of microvuggy and intercrystalline porosity is locally occluded by anhydrite cement. Lithofacies H (laminated lime mudstone) is also recognized as a potential reservoir

lithology; partial dolomitization has resulted in dolomite-rich laminae with good intercrystalline porosity (15%). Live-oil staining was observed in all three members of the Duperow Formation but appears to be most pervasive in the middle and upper Wymark Members.

Conclusions

Duperow Formation in southwestern Manitoba consists of subtidal, intertidal and supratidal lithofacies associations which are stacked into meter-scale, shoaling-upward cycles. The formation contains highly prospective reservoir units as evidenced by the good microvuggy and intercrystalline porosity produced by facies-controlled dolomitization and by the presence of live-oil staining. Additional study of the Duperow Formation in Manitoba is needed to determine the potential for economic reserves.

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