

Lithofacies Analysis and Reservoir Potential of the Duperow Formation (Upper Devonian), Williston Basin, Southwestern Manitoba

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GeoConvention 2012: Vision

Introduction

The Upper Devonian Duperow Formation is a widespread carbonate-evaporite succession present in the subsurface of the Williston Basin. In southwestern Manitoba, it is 122-195 m thick and thins laterally to the east. The Duperow Formation formed in the Elk Point Basin during Frasnian time and represents the back-reef environment of a rimmed shelf in the southern part of the basin. The formation is stratigraphically equivalent to the Leduc Formation in the Alberta Basin. In Manitoba the Duperow Formation is subdivided, in stratigraphic order, into the Saskatoon, Wymark, and Seward members; additionally, the Wymark Member can be informally subdivided into lower, middle, and upper units. Relatively little recent work has been done on the Duperow Formation in Manitoba, but it is of economic interest as the formation is a proven oil producer in Saskatchewan, North Dakota, and Montana. The middle unit of the Wymark Member (herein referred to as the middle Wymark Member), which is the focus of this study, has been identified as the most prospective reservoir rock, based on good porosity and numerous oil shows in this unit.

Methodology and Results

Based on core and thin section examination, three lithofacies associations, composed of ten individual lithofacies, are recognized. The subtidal lithofacies association (LA 1) comprises: lithofacies A - nodular lime mudstone; lithofacies B - mottled lime mudstone to wackestone; lithofacies C - stromatoporoid-coral floatstone to framestone; lithofacies D - fossiliferous wackestone to packstone; and lithofacies E – peloid-intraclast grainstone. The intertidal lithofacies association (LA 2) consists of lithofacies F – massive, fine crystalline dolostone; and lithofacies G - laminated mudstone. The supratidal (sabkha) lithofacies association (LA 3) comprises: lithofacies H - intraclastic to laminated dolostone and gypsum; lithofacies I - massive gypsum; and lithofacies J - patterned dolostone. The lithofacies associations are typically stacked into meter-scale, shallowing upward, asymmetrical cycles.

Lithofacies B (mottled lime mudstone to wackestone), C (stromatoporoid-coral floatstone to framestone), D (fossiliferous wackestone to packstone), F (massive fine crystalline dolostone), and G (laminated mudstone) are pervasively dolomitized. The original fabric of these lithofacies has been variably replaced (20 to 100%) by fine to medium crystalline, idiotopic dolomite. Dolomitization significantly

increased porosity in all of these lithofacies. In particular, lithofacies F has 25-35% intercrystalline porosity. Porosity is reduced in these lithofacies due to local filling of intercrystalline porosity by fine crystalline gypsum and anhydrite cement.

The middle Wymark Member is pervasively oil-stained, but the extent of staining varies considerably between lithofacies. Live-oil staining is most prevalent in lithofacies F (massive, fine crystalline dolostone).

Conclusions

The middle Wymark Member in the Duperow Formation is a potential reservoir unit in southwestern Manitoba. In this unit, massive, fine crystalline dolostone (lithofacies F) is the most prospective reservoir rock as evidenced by the high intercrystalline porosity created by facies-controlled dolomitization and the presence of live oil. Further study of the Duperow Formation in Manitoba is required to determine whether economic reserves are present in the province.