Sedimentological Analysis and Reservoir Potential of the Lower Silurian Attawapiskat Formation, Hudson Bay Basin, Northeastern Manitoba

Akhil Ramdoyal*, University of Manitoba, Dept. of Geological Sciences, Winnipeg, Manitoba R3T 2N2
aramdoa@gmail.com
and
Nancy Chow, University of Manitoba, Dept. of Geological Sciences, Winnipeg, Manitoba R3T 2N2
n_chow@umanitoba.ca

Introduction

The Lower Silurian Attawapiskat Formation occurs in the Hudson Bay and Moose River basins, which are part of the Hudson Platform. The formation is a reefal succession comprising largely stromatoporoid- and coral-rich limestones and, to a lesser extent, dolomitic limestones and dolostones. These strata represent the last open-marine excursion onto the Hudson Platform during the Silurian, with the reefs encircling the Hudson Bay Basin entirely, forming bank and barrier-reef deposits. Recent studies have outlined similarities between the Hudson Bay Basin and the Michigan and Williston basins, which are major oil-producing basins. The underexplored Hudson Platform is considered a frontier prospect, with the Attawapiskat Formation being the main potential reservoir rock.

Method and Results

This study of the Attawapiskat Formation examined cores from three petroleum wells drilled in the Hudson Bay Lowland in northeastern Manitoba: Merland *et al.* Whitebear Creek STH #1, Sogepet Aquit Kaskattama Province No.1, and Houston *et al.* Comeault STH # 1. Petrography of representative thin sections was done to identify allochems, matrix, cement, dolomite and porosity. Stable carbon and oxygen isotope analysis was completed to evaluate the influence of rock-water interactions and biological processes.

Eleven lithofacies were recognized based on core examination and petrography. These lithofacies are grouped into three lithofacies associations as part of a shallow rimmed-shelf succession. The subtidal association (LA 1) consists of nine lithofacies: (A) skeletal wackestones with thinly bedded intraclastic packstones; (B) coral-stromatoporoid framestones; (C) skeletal rudstones; (D) thinly interbedded intraclastic wackestones and grainstones; (E) skeletal mudstones to wackestones; (F) oncoidal bindstones; (G) mottled-nodular crinoidal-intraclastic grainstones and rudstones; (H) mottled-nodular skeletal wackestones and intraclastic rudstones; and (I) graded oolitic grainstones. Lithofacies B, up to 5 m thick, represents patch reefs; and lithofacies C, up to 11 m thick, represent reef flank beds. The intertidal association (LA 2) comprises lithofacies J - laminated skeletal mudstones to wackestones; and the supratidal association (LA3) comprises lithofacies K – laminated dolostones. Cyclicity in the Attawapiskat succession is of the order of several metres to tens of metres thick and shows shallowing-upwards trends.

Lithofacies C (reef-flank skeletal rudstones) has the highest primary porosity (20-40%; interparticle) in the Attawapiskat cores examined for this study. Porosity is locally occluded by early marine cements of radial-fibrous and radiaxial-fibrous calcites, and by burial cements of coarse crystalline, equant calcite cement. Lithofacies K (supratidal laminated dolostones) is composed of 0.016-0.06mm, crystalline, idiotopic dolomite which has intercrystalline and vuggy porosity of 35-45%. Dead-oil staining was observed locally in lithofacies A, B, C, E, H, J, K.

Conclusions

The Attawapiskat Formation in the Hudson Bay Basin in northeastern Manitoba is divided into subtidal, intertidal and supratidal lithofacies associations which are stacked into metre-scale shallowing-upward cycles. The formation is recognized as a highly prospective reservoir unit on the basis of the good porosity recognized in almost all lithofacies but particularly the primary interparticle porosity in the reef flank lithofacies and the intercrystalline and vuggy porosity associated with dolomite in the supratidal lithofacies.