

Tectonically Influenced Platform Development in the Middle Devonian Winnipegosis Formation, Southwestern Manitoba

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Summary

Devonian carbonate strata in the subsurface of Manitoba have been under-studied in comparison to stratigraphically equivalent units in Saskatchewan, Alberta, and North Dakota, and consequently their full economic potential is poorly known. This study focuses on integrating the sedimentology and organic petrology of the Middle Devonian Winnipegosis Formation and associated Elm Point and Ratner formations in southwestern Manitoba in order to better understand the depositional origin and petroleum potential of these successions.

Based on detailed core examination, five lithofacies associations have been recognized in the Winnipegosis, Elm Point, and Ratner formations in the study area. The ramp association comprises the Lower Winnipegosis Member and Elm Point Formation and includes deposits of inner to mid-ramp settings as well as off-shore tidal flat islands. The platform interior association and platform slope association comprise the Upper Winnipegosis Member and include deposits of open to slightly restricted lagoonal settings and lower to upper slope settings respectively. The isolated reef association occurs in the Upper Winnipegosis Member and includes proto-reef, lagoonal, fore-reef, reef crest and reef flat deposits. The basinal salina association comprises the Ratner Formation.

Following deposition of the carbonate ramp, basin differentiation occurred and a rimmed platform and isolated reefs in the basinal area grew in response to rising relative sea-level. Within the study area, the western platform margin is approximately coincident with the Birdtail-Waskada Axis, which is a north-south trend manifested as structural and isopach anomalies in Phanerozoic strata that overlie the Precambrian Superior Boundary Zone. The northern platform margin is approximately coincident with the east-west trending boundary between the Precambrian Uchi and English River domains. These relationships raise the issue of tectonically influenced basin differentiation and platform development. It is postulated that platform deposition within the study area occurred on a basement block and was uplifted sufficiently to sustain the carbonate factory during transgression. Areas to the north and west of these boundaries essentially became part of a starved basin where normal carbonate sedimentation ceased except at locations where isolated reefs initiated.

Organic-rich facies in the study area did not thermally mature to the extent of their deep-basin counterparts in Saskatchewan and Alberta. This has enabled detailed maceral examination, providing insight into the origin of sedimentary organic matter and petroleum genesis in the Elm Point, Winnipegosis, and Ratner formations. Bituminous laminites in the study area were deposited primarily as a result of elevated phytoplankton productivity. These deposits are best developed in stratigraphic intervals associated with changes in depositional regime including the transition from ramp-to-platform/basin and from an open to restricted basin at the end of Winnipegosis time.