Sedimentology and Biostratigraphy of Bart Reef: A New Mud-Mound Discovered in the Northern Sverdrup Basin, West-Central Ellesmere Island

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Summary

Lower Permian (Sakmarian-Kungurian) carbonate rocks of the Sverdrup Basin, Canadian Arctic Archipelago, record the initiation of a dramatic cooling of ocean temperature and regional climate.1 Asselian-Sakmarian tropical-like climate cooled episodically to subtropical, temperate and finally polar-like conditions by the Kungurian.2 Cooling is recognized by monitoring changes in fossils, lithology and sedimentary textures within Permian shallow marine strata. While initial cooling during the Sakmarian from tropical to subtropical conditions is undoubtably geologically rapid, the rate of change is currently unknown. Measurement of this rate is currently being investigated by monitoring habitation depth of temperature sensitive tropical fossils on the Asselian-Sakmarian carbonate shelf, while timing is determined using the conodont biostratigraphic zonation developed for the Sverdrup Basin in conjunction with absolute dates on the International Time Scale.3

Fieldwork carried out in Summer 2007 included the first description of a new tract of Asselian mud mounds on the northern margin of the Sverdrup Basin. Contained within the Nansen Formation, this tract has been informally named the Simpson reef tract. This study documents the sedimentology and conodont biostratigraphy of Bart reef; a member of this tract. Spectacular outcrop exposure of reef and off-reef strata has enabled a truely thorough characterization including the correlation of reef and off-reef facies.

Conodont biostratigraphic dating of correlative off-reef facies indicate a middle to late Asselian age for Bart reef. Basal reef lithology is a bryozoan wackestone-packstone, with abundant void filling calcite spar. Connected outcrop exposures indicate as much as 50 metres of relief from reef to off-reef strata. Growth of Bart reef and off-reef strata is characterized by stacked, cyclic shelf packages, with reef and off-reef cycles directly correlatable in outcrop. Reef to off-reef relief is reduced with each subsequent cycle, with resistant reef facies laterally expanding. Younger off-reef cycles, interpreted as a result of progressive shallowing, exhibit bedded microbial laminites, bioclastic grainstones and large scour surfaces. A large cobble sized, calcite cemented intraformational breccia caps the uppermost and thickest bedded microbial laminite.

Development of the Simpson reef tract on the location of the previously proposed Elmerson High4 requires a revision of the Early Permian paleogeography of the northern Sverdrup Basin. Outcrops measured northwest of Bart Reef suggest that a paleo-high was located further north, with the shelf extending continuously from Bart reef to the Tolkien reef tract.

Discovery of the Simpson reef tract indicates that other Permo-Carboniferous reefs may yet be discovered in outcrop or in the subsurface of the Sverdrup Basin. Considering that similarly aged reefs are prolific oil reservoirs in the Timan-Pechora region of Russia, and many counterparts in the Sverdrup Basin (eg.Tolkien reefs) exhibit hydrocarbon reservoir quality lithofacies, Late Carboniferous to Early Permian reefs of the Sverdrup Basin constitute an atttractive play for future hydrocarbon exploration.

Figure 1: Bart Reef, a middle to late Asselian mud mound, northern Sverdrup Basin, Ellesmere Island. Glacial scour coupled with retreat has provided exceptional outcrops for correlation of reef and off-reef strata.

Acknowledgements

The corresponding author would like to thank B. Beauchamp and C.M. Henderson for the opportunity to travel and study in the Canadian Arctic. Funding for fieldwork was provided by a Canadian Polar Continental Shelf Grant to B.Beachamp, an NSERC Discovery Grant to C.M. Henderson and a Department of Indian and Northern Affairs Northern Scientific Training Program (NSTP) Grant to M.L. Wamsteeker.

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