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Depositional history of a Late Ordovician-Early Silurian distally-steepened carbonate ramp, Mackenzie Mountains, NWT, Canada

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Summary

The Misty Creek Embayment (MCE), a deep-water intrashelf rift basin, represents the northwestern edge of Laurentia's tectonically complex passive margin in the Early Paleozoic. The passive margin developed along western Laurentia following Precambrian rifting, forming a distally-steepened ramp during the Late Ordovician-Early Silurian. Recent mapping and stratigraphic studies indicate the Late Ordovician-Early Silurian sequence of the platformal Mount Kindle and Whittaker formations, and the coeval, basinal Cloudy Formation were deposited on this distally-steepened ramp (Figure 1A). Within the MCE, another sequence is evident as the Early-Middle(?) Silurian portion of the Mount Kindle Formation overlies the Cloudy formation in several measured sections (Figure 1B), suggesting a shallowing event and subsequent sea level fall. Siluro-Devonian tidal flat facies of the Tsetso Formation unconformably overlie the Early-Middle(?) Mount Kindle Formation, indicating the MCE was filled by the Early-Middle(?) Silurian.

A full section measured through the Cloudy Formation (~720 meters thick) is anomalously thick (>300 m) relative to other measured sections of the Cloudy Formation, located in the MCE. The unusual thickness variation may indicate syndeposition of the Cloudy Formation related to local episodes of extensional faulting within the MCE. Measured sections and thin-section petrography helped determine depositional environments and understand the diagenetic history of the ramp. Stable isotope (C, O) chemostratigraphy of the Cloudy Formation will help determine the relative timing and duration of deposition. Conodont samples will constrain regional correlations of the platformal Mount Kindle Formation and basinal Cloudy Formation. New conodont data confirm the Early Silurian age of the upper part of the Cloudy Formation.

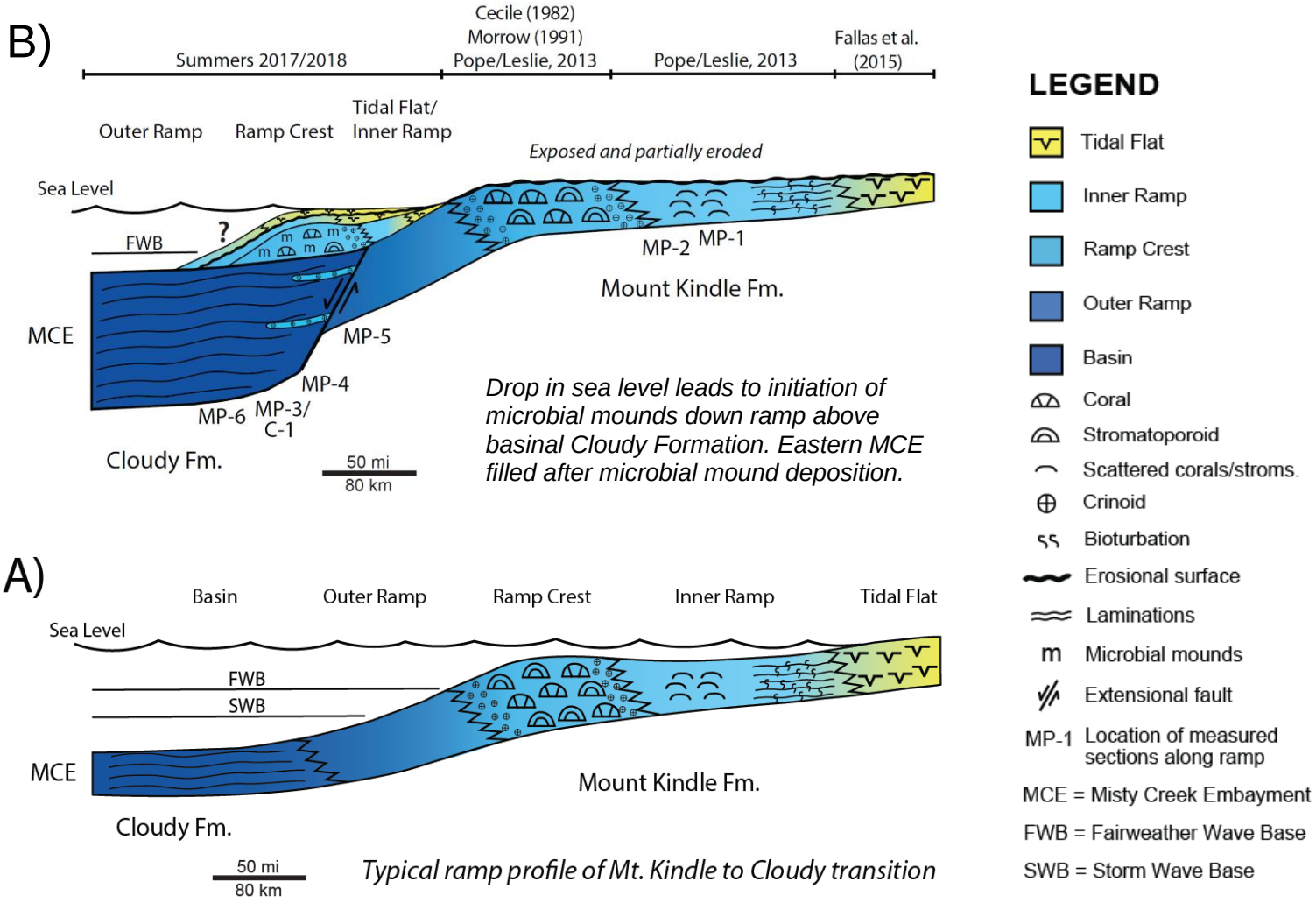
Methods

This study includes seven measured stratigraphic sections (each 20 to 570 meters thick), noting sedimentological structures, facies changes, bedding geometries, and faunal content to determine the evolution of this carbonate ramp. These high-resolution (cm-scale) stratigraphic sections were measured bed-by-bed. Samples from a well-exposed section of the Cloudy Formation were collected every 1.5 meters for stable isotope (C, O) chemostratigraphy, in hopes of capturing the large $\delta^{13}C$ excursion of +4 to +7 $^{0}/_{00}$ that occurred during the Late Ordovician-Early Silurian glaciation. Seven conodont samples were collected and processed for biostratigraphic age control from the Cloudy Formation.

Results, Observations, Conclusions

A typical ramp profile transitioning from the platform into the MCE includes an inner ramp of lagoonal and tidal flat facies within the Mount Kindle Formation. The ramp crest is composed of coral-stromatoporoid-sponge biostromes that pass basinward into outer ramp facies of interbedded dolosiltstone and dolomudstone (Figure 1A). Distal steepening of the ramp is indicated by interbedded lime mudstone, and carbonate-clast conglomerates recording turbidity flows and debris flows in the basinal Cloudy Formation (Figure 1B).

Multiple sections record the Mount Kindle Formation overlying the Cloudy Formation within the MCE, suggesting a shallowing event along the ramp related to a subsequent relative sea level fall (Figure 1B). Within these sections, the Mount Kindle Formation preserves microbial mounds up to 300 m thick. An unconformity lies between the Early-Middle(?) Silurian Mount Kindle Formation and Late Silurian-Devonian tidal flat facies overlying the Mount Kindle. This unconformity, plus conodont data, suggests the MCE was filled by the Early-Middle(?) Silurian.



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