

High-resolution Cyclostratigraphy of a Late Devonian reef-to-basin Margin: Insights from equivalent outcrops to the Duvernay Formation in Alberta-Canada

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Summary

Sedimentological and geochemical proxies have allowed us to quantify the pacing and relative magnitude at which relative sea level evolved during the Late Devonian; particularly we present observations from outcrop strata equivalent to the Duvernay Formation. The stratigraphic setting showcases a seismic-scale reef-to-basin system with interfingering relationships between in-situ reef carbonates and organic-rich mudstones. Facies stacking patterns combined with Fischer accommodation plots illustrate three m-scale cycles, each comprising upward enrichments in carbonate content accompanied by upward decreasing organic carbon contents. These cycles are interpreted to record a lower transgressive phase followed upwards by a highstand phase. During transgression, the aggrading reefs keep-up growing with rising sea level and create bathymetric barriers that restrict water circulation patterns in basinal areas; as a result, bottom-water stagnation and fluctuating low-oxygen conditions allowed the accumulation of organic-rich fine-grained strata interbedded with bioturbated deposits. During highstand, first, the improved water circulation patterns allow the import of terrigenous material and oxygen to the basin; then, widespread early marine cementation progressively exceeds the rate of accommodation space, thus making the margins susceptible to gravitational collapse; this is represented by the calcite-cemented diagenetic intervals overlain by coarse-grained gravity-driven deposits, including debris flows and turbidites. At a higher order of eustasy, the three m-scale cycles seem superimposed onto a larger cycle covering the entire thickness of the studied succession; this larger cycle records the early stages of platform drowning at the base of the Perdrix/Duvernay Fms. up to the complete drowning of the adjacent carbonate factory at the top of the Perdrix/Duvernay Fms. Observations from this study can be utilized as diagnostic criteria to improve our ability to predict facies distribution in complex stratigraphic settings, such as across basinal-to-reef deposits that might hold economic importance.

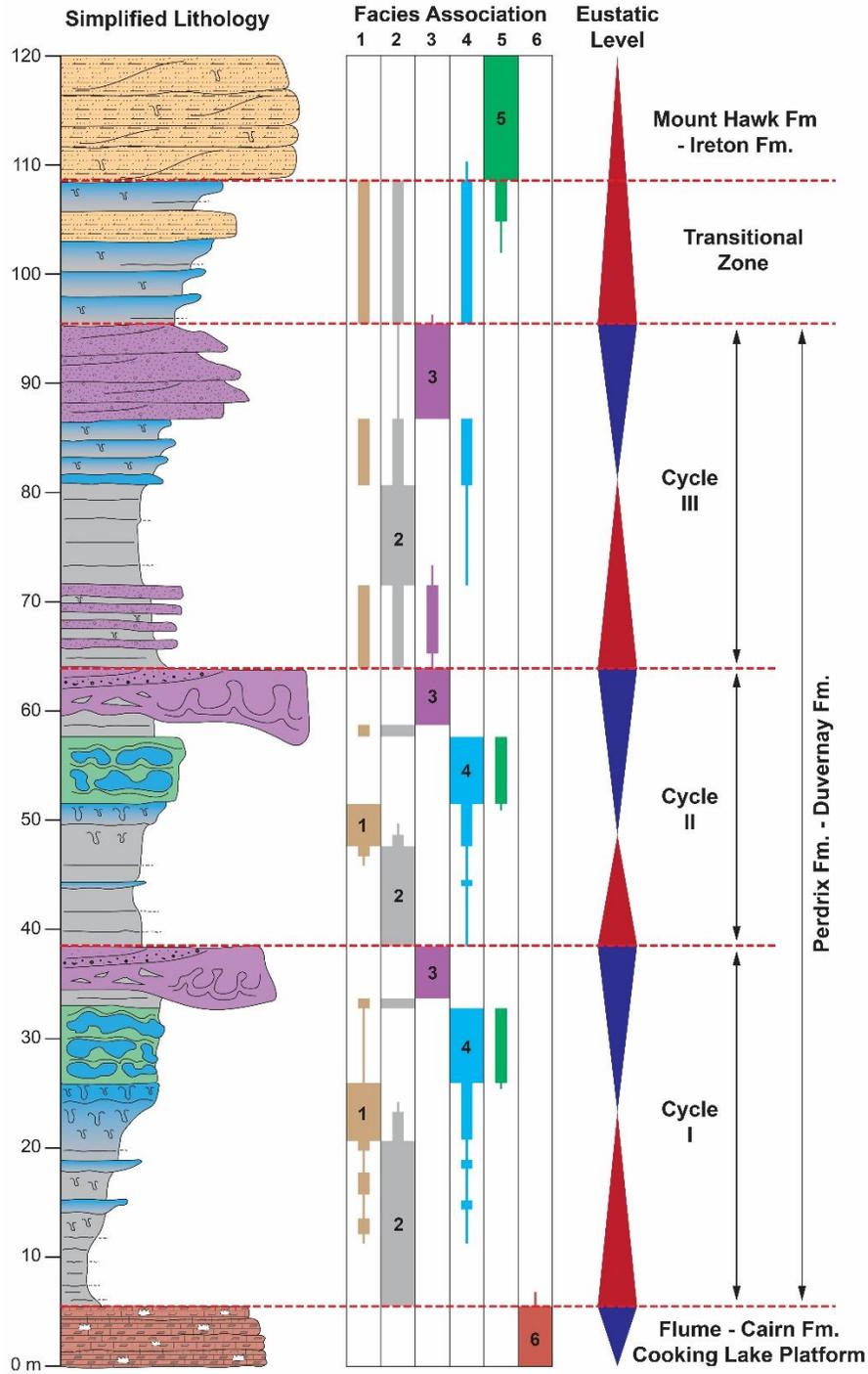


Figure 1. Facies stacking patterns and stratigraphic interpretation of the Perdrix Fm. (Duvernay's equivalent) adjacent to carbonate reef buildups. Rocky Mountains Area, Alberta.