A new framework for reinterpreting the Late Ordovician mass extinction on Anticosti Island (Québec, Canada): Sequence stratigraphic correlation within the eastern Ellis Bay Formation

Joshua B. Zimmt*[1], Steven M. Holland[2], Seth Finnegan[1], David S. Jones[3], and André Desrochers[4]

[1]University of California [USA] – United States
[2]University of Georgia [USA] – United States
[3]Amherst College [USA] – United States
[4]University of Ottawa [Canada] – Canada

Abstract

Anticosti Island (Québec, Canada) exposes a well-preserved and fossiliferous Ordovician–Silurian boundary succession that is one of the best-studied records of climatic, environmental, and biological events associated with the Late Ordovician mass extinction. Recent biostratigraphic, chemostratigraphic, and radiometric age studies have demonstrated that both the Ellis Bay Formation (*sensu* Copper et al., 2013) and lowermost part of the overlying Becscie Formation record the terminal Ordovician Hirnantian Stage, during which major climatic and oceanographic events are thought to have caused the Late Ordovician mass extinction. The stratigraphic succession on Anticosti Island thus contains one of the thickest, most fossiliferous records of the Late Ordovician mass extinction, making it critical to our understanding of the extinction event.

However, despite more than a century of work on the island, a comprehensive stratigraphic correlation framework for the Ellis Bay Formation remains elusive. Rapid lateral facies variability within the Ellis Bay Formation, particularly in the eastern half of the island, has hindered the establishment of a sequence stratigraphic correlation framework for the formation. Previous work has highlighted that a well-resolved sequence stratigraphic framework is necessary for differentiating stratigraphically-generated clusters of last occurrences from pulses of extinction to determine the underlying pattern and drivers of an extinction event (*e.g.*, Zimmt et al., 2021). The absence of a correlation framework for the Ellis Bay Formation therefore is a major impediment to understanding the expression of the Late Ordovician mass extinction on Anticosti Island.

Here, we combine sedimentological, stratigraphic, and chemostratigraphic data from seven continuous exposures of the eastern Ellis Bay Formation into a robust sequence stratigraphic framework, identifying six sequences in the eastern Ellis Bay Formation that are bounded by subaerial unconformities and maximum regressive surfaces. In contrast to previous studies, we find evidence that subaerial unconformities can be traced laterally across the entirety of the eastern Ellis Bay Formation. Subaerial unconformities are marked by a combination of microkarst, quartz pebble lags, negative carbon isotope excursions, and incised valleys.

*Speaker

While often subtle, these indicators of subaerial weathering and erosion suggest that the Ellis Bay Formation records large, successive fluctuations in relative sea level that likely played a critical role in the presence and absence of species in the fossil record. Furthermore, the cryptic expression of unconformities in the Ellis Bay Formation suggests that other Hirnantian sections may record similarly subtle evidence of subaerial weathering and erosion throughout the Hirnantian Stage, with important implications for understanding the sequence of climatic, environmental, and biological events during the Late Ordovician mass extinction.

Keywords: Sequence stratigraphy, Ordovician, Mass extinction, Anticosti