

# The End Ordovician Icehouse and the First Mass Extinction of the Phanerozoic: Its History Recorded in Multiple Archives

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During the latest Ordovician (Hirnantian, ~443–442 Ma) an apparently double-pulsed Mass Extinction event wiped out an estimated 60% – 85% of marine organisms at the generic level (Alroy et al., 2008; Fan et al., 2022). Although, the cause of the extinction is highly debated, new data suggest that sudden, abrupt, intense, and multiple glaciations are to blame for the first mass extinction of the Phanerozoic.

A combination of archives (brachiopods, halite, and dolomite) from four localities (Anticosti Island, Hudson Bay Basin - Canada, South China, and Canning Basin, Australia) form the foundation for a robust trend in seawater-Sr during the Hirnantian. Strontium isotope analyses of carbonates and halite within the same stratigraphic intervals of the Red Head Rapids yielded results agreeing with those of brachiopods (Fig 1, seawater-Sr curve; Veizer et al., 1999). Plotted data on the strontium seawater curve fall within the ±0.6 ‰ natural variation of <sup>87</sup>Sr/<sup>86</sup>Sr in modern marine environments, providing rigorous age assignments and confirmation of their preservation and reliability of the Hirnantian trend.

Furthermore, halite from the Red Head Rapids Formation, an evaporite-dominated succession, of the Hudson Bay Basin and from the Mallowa Salt Formation of the Canning Basin, occupy positions about the tropical Late Ordovician-Earliest Silurian (Lavoie et al., 2013, Haines, 2009). They suggest that severe temperature fluctuations emulate the transition from a pre-event hothouse into an icehouse. Microthermometry analysis of primary halite fluid inclusions illustrate paleotemperatures with bimodal trends, indicative of seasonal/daily variations (Fig 1, glaciation). The temperature oscillations are typical of inter- and/or glacial times, representing about three-four pulses. Thus, the end Ordovician Mass Extinction was not only a short and intense event, but one characterized by multiple (up to four and possibly more) pulses successively detrimental to the global marine fauna.

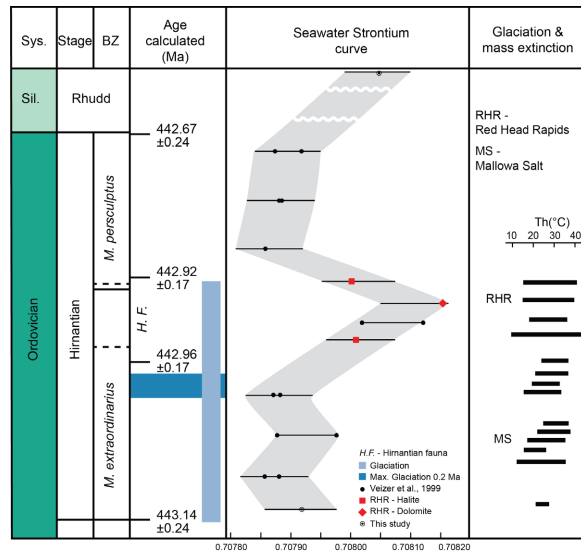
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 Fig. 1