Analysis of Sediment/Geochemical Accumulation Rates and Molluscan Evolutionary Rates during the Cenomanian−Turonian Biotic Crisis, Western Interior Seaway

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With ammonite/inoceramid species loss of up to 85% in the Western Interior basin, the Cenomanian−Turonian boundary event represents a significant biotic crisis. Hypotheses proposed for the driving mechanism of species turnover include mainly changes in benthic and water column oxygen levels associated with Oceanic Anoxic Event II, and changes in substrate consistency associated with limestone−marlstone alternation. Although the critical agent of biotic deterioration under oxygen deficient conditions is likely to be elevated pore water and bottom water sulfide concentrations, evidence for extensive and prolonged euxinia during OAE II in the Western Interior is lacking. In this study the main hypotheses for biotic turnover are reviewed in light of new sediment and geochemical accumulation rates, as well as recalculated evolutionary rates across the stage boundary. These new rates are based on a high resolution time scale developed through cyclostratigraphic analysis of the Cenomanian−Turonian Bridge Creek Limestone Member.

Evolutive harmonic analysis of an optical densitometry record from the central basin #1 Portland core (Colorado) permits detailed reconstruction of changes in sedimentation rate, including the quantification of hiatuses, thus allowing construction of an unbiased time−scale. The new high−resolution time scale facilitates an independent quantitative assessment of the rates of accumulation of environmentally sensitive geochemical proxies, and calculation of rates of evolutionary change (FA/kyr, LA/kyr) in the C−T boundary interval. We employ the new proxy flux data, and published paleobiologic, stratigraphic, and sedimentologic data, to assess secular paleoenvironmental change in the Western Interior sea (e.g., redox state of sediments/water column, productivity of pelagic autotrophs, changes in terrigenous silicilastic flux). Based on this, a series of major modal switches in sedimentation are identified. These modal switches may represent fundamental changes in the ocean−climate−sediment transport system, and include: (1) a shift from clay−dominated black shale (Hartland Shale Member) with evidence of sulfidic pore/bottom waters to carbonate dominated limestone−marlstone (lower Bridge Creek Limestone) lacking such evidence, (2) a shift to increased organic carbon/carbonate flux in the later portion of OAE II (lower Bridge Creek Limestone) that lacks evidence of extensive pore/bottom water sulfide, and (3) a shift to highest organic matter accumulation following OAE II (upper Bridge Creek Limestone) that shows evidence of sulfidic pore/bottom waters. Interestingly, the highest rates of extinction do not correspond to intervals with the greatest indication of sulfidic conditions. Further comparisons of paleoenvironmental data with molluscan evolutionary rate allow evaluation of alternate biotic controls, such as substrate consistency, turbidity, and nature/frequency of environmental disturbance.