HIERARCHY OF CARBON CYCLE MODULATION IN CYCLICAL LATE TRIASSIC-EARLY JURASSIC AGE LACUSTRINE STRATA, NEWARK SUPERGROUP, USA

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Latest Triassic and Early Jurassic cyclical lacustrine strata in eastern North American rift basins record at least three levels of bulk organic $\delta^{13}C$ fluctuations, indicative of three largely independent levels of ecosystem-to-biosphere behavior. At the millennial scale, deepwater lacustrine strata record changes in water column stratification. When lake levels were deepest, meromixis was most stable and the biological pump most efficient, leading to trends towards heavy carbon isotope compositions (typically -27) within an overall relatively light isotopic milieu (typically –29), both of which reflect the predominance of organic matter derived from cyanobacteria. In slightly shallower water, meromixis often broke down, leading to a less efficient biological pump, and a tendency towards mixing of the water column and consequently more negative δ^{13}Corg values.

At the ~20ky precession cycle level, during times of high eccentricity, the large-scale changes in lake depth produced gross changes in ecosystem efficiency that resulted in preferential preservation of different sources of organic matter. During high lake levels, meromixis and oligomixis led to poor ecosystem efficiency and preservation of relatively labile cyanobacteria- and alga-derived organic matter with values of ~ -29. When the lake was shallow, regardless of its productivity level, the oxygenated bottom waters encouraged high ecosystem efficiency, and the consequent respiration of the organic matter derived from phytoplankton left a residuum of isotopically heavy vascular plant matter with values of ~ -24. The Milankovitch hierarchy of cycles reflects this ecosystem change of state in a hierarchy of δ^{13}Corg cycles.

Overprinting both of these relatively local ecosystem controls of δ^{13}Corg, the global $\delta^{13}C$ changes reflect changes in the structure of the oceanic and continental carbon reservoirs communicated via the atmosphere. Recorded largely in vascular plant matter from these strata, the initial short-term negative excursion at the Triassic-Jurassic palynological turnover event precedes a much longer-term negative main excursion (in Hesselbo's phrase) that endures through most of the Hettangian. The origin of the excursions involves perhaps methane release or a reorganization of the structure of the marine ecosystems due to biodiversity collapse.

Identification of the δ^{13}Corg events associated with mass extinctions allows global correlation for the Early Mesozoic. A global cyclical δ^{13}Corg signal of Milankovitch origin allows even finer levels of correlation. But to unambiguously see this level of variability in the global signal it is necessary to use molecular level $\delta^{13}C$ methods, rather than bulk organic methods, because these former integrate local and global sources of variation.