Geochemical, Radiolarian Faunal, and Color Variations of the Lamar Limestone in the Delaware Basin: Implications for Paleoclimatological Change and Cyclostratigraphy

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Geochemical proxies integrated with radiolarian data from the Lamar Limestone provide insights into climatical controls on radiolarian distribution in the northern part of the Delaware Basin during late Guadalupian. Major radiolarian variations between sphaerellarian-dominated and *Follicucullus*-dominated faunas appear to be controlled by fluctuations in nutrient supply and salinity. Geochemical parameters of bulk carbonate carbon and oxygen isotopes ($\delta^{18}O_{carb}$), organic carbon isotope, and total organic carbon (TOC) show apparent variations on two scales. On decimeter scales, sphaerellarian-dominated beds are associated with a relatively siltier lithology, higher radiolarian richness, and higher TOC, and are interpreted as the result of a rise in productivity stimulated from increased terrestrial input. On meter scales, $\delta^{18}O_{carb}$ data co-vary with available Mg/Ca ratio data in limestone samples and are interpreted as a proxy for paleosalinity in response to changes in basin circulation. Our data suggest intermittent restriction in the Delaware Basin, prior to change to a dominantly evaporative regime in the late Permian, and on a finer scale, show dramatic and frequent ecological fluctuations that appear to be driven by fluxes in terrestrial input and, to some extent, paleoproductivity.

Spectral and wavelet analyses on color, radiolarian relative abundance, and geochemical data reveal significant cycles with periods of ~1.2 m, ~0.28 m, 0.16 m, and ~0.08 m. Average spectral misfit calculation applied on the color data implies that average post-compaction rock accumulation rates of ~1.5 cm/kyr provide the best fit of the data to orbital frequencies. This accumulation rate is corroborated by statistical tests and estimations of accumulation from stratigraphic thickness of the Capitanian strata in the Delaware Basin. The upper Lamar Limestone appears to record the eccentricity (~100 kyr), precession (16-21 kyr), and possibly sub-precession cycles (5-11 kyr), with apparently depressed obliquity influences. Given the paleogeographic and paleoclimatic conditions over the western equatorial Pangea during Permian, the precession-related monsoonal circulation could have transferred the orbital signals into these rhythmites through changes in precipitation and run-off, which ultimately affected the radiolarian fluctuations.