The Influence of Sea Level and Sediment Gravity Flows on the Sedimentation and Geochemistry of the Wolfcamp Formation B3 and B2 Intervals, Midland Basin, Texas

Cecilia Lopez-Gamundi[1], R Philp[2], Roger Slatt[3]
[1]University of Miami; [2]na; [3]University of Oklahoma

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Abstract

The Permian-aged (~268 Mya), hydrocarbon-rich, mixed carbonate-siliciclastic mudrocks of the Wolfcamp B3 and B2 Intervals are highly heterogeneous, hampering paleoenvironmental reconstruction. However, a localized application of a regionally accepted 2nd order sequence-stratigraphic framework was established through conventional sedimentological techniques such as core description, petrography, and ichnology. The sedimentological and geochemical effects of this 2nd order sea level fall and rise are often occluded by nested higher order cycles and episodic event deposits. These higher frequency variations often fall below a 2-inch (~ 5 cm) vertical resolution, warranting both the discretization of the core into nine distinct sedimentary facies and a novel inorganic geochemical interval-averaging methodology for more accurate paleoenvironmental interpretations. Furthermore, the segregation of trace metal data by sequence stratigraphic interval lead to enhanced trace metal-TOC covariation, from which critical preservation and productivity information can be gleaned. The influence of 2nd order eustatic sea-level fluctuations and oxygenating sediment gravity flows on paleoredox conditions was confirmed. Combined geochemical and ichnological evidence suggest that the Wolfcamp B3 and B2 mudrocks were deposited under suboxic conditions, with relatively more anoxic conditions during lowstand and progressively more oxic conditions during transgression and highstand, respectively. Petrographic and biomarker evidence also suggest frequent Tasmanites algal blooms

occurred during the latter part of the highstand. This enhanced paleoproductivity lent itself to cyclic episodes of relative anoxia due to the subsequent algal bloom die offs. These unique mixed carbonate-siliciclastic mudrocks deposited under suboxic conditions not only shed light on the role of preservation and productivity on organic matter but aid in discerning the influence of lithology and redox on classic biomarker ratios typically associated with carbonate and reduction or siliciclastic and oxidation.