Redox variation and nutrient controls on organic carbon deposition of the Miocene Monterey Formation

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The Miocene was a time of dramatic climate transitions that led to and coincided with major ocean circulation changes, intensification of upwelling regimes, and enhanced nutrient availability, all within a backdrop of increasing tectonic restriction of ocean gateways. These characteristics make the Miocene an ideal time for exploring the dynamics of nutrient delivery to surface waters and its effects on primary productivity, basin redox, and organic carbon deposition and burial. The Miocene Monterey Formation of California represents a significant locus of carbon burial deposited under an oxygen-minimum zone (OMZ) in a number of sediment-starved basins with varying sedimentological histories. This highly siliceous and organic-rich deposit spans the transition from greenhouse to icehouse conditions in the Miocene. The samples in this study were collected from cores taken in the Santa Maria Basin, interpreted to have been on the outer shelf connected with the open ocean, and the San Joaquin Basin, a more landward, restricted basin with higher terrigenous input. Thus far, bottomwater redox conditions in these basins have been poorly constrained, and this study presents the first high-resolution, multi-basin redox data, including iron speciation and trace metal concentrations. Preliminary molybdenum concentrations suggest periods of euxinia, though iron signatures diagnostic of euxinia are not always achieved. These relationships play out differently in these basins with different iron budgets. Nitrogen isotopes suggest extreme denitrification ($\delta^{15}N$ range: +2 to +20‰) and potentially, at times, nitrogen limitation. This relationship is likely related to the high availibility of phosphorus in an intense upwelling regime, combined with the decreased oxygen solubility in a warmer ocean. Collectively, these data speak to primary local and regional controls on carbon cycling during one of the major climatic adjustments of the Cenozoic.