REDOX VARIATION AND NUTRIENT CONTROLS ON MONTEREY FORMATION DEPOSITION: A CASE STUDY OF CLIMATE CONTROLS ON BASIN UPWELLING AND PRIMARY PRODUCTIVITY

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Abstract

The Miocene was marked by a transition from early-middle Miocene warming of the Climate Optimum (ca. 22-16 Ma) to the "icehouse world" of 15-10 Ma, which led to ice sheet growth on Antarctica and Greenland. These events coincided with dramatic changes in ocean circulation, initiation of upwelling regimes, and nutrient delivery to surface waters, resulting in intense organic deposition. This study focuses on the Monterey Formation, which today is of great economic interest for its shale-oil reserves. The driving questions of this investigation are the following. (1) How did basin circulation and nutrient delivery change throughout the climatic events in the Miocene and what are the subsequent effects on primary production and basin redox? (2) What are the limits on upwelling for sustaining deposition of high amounts of organic matter, and what were the negative feedbacks that "turned off" this deposition? These questions will be addressed by systematic sampling a number of basins in which deposition was controlled by degree of upwelling, terrigenous input, and restriction from the open ocean. To answer the first question, we will use well-established redox proxies including iron speciation, degree of pyritization, and molybdenum concentrations and isotopes to determine redox fluctuations during deposition and organic matter controls by primary production. The second question will be addressed through use of biomarkers and nitrogen isotopes, which are useful for unraveling microbial ecology and nutrient limitation. This study has implications for understanding source rock formation as well as unraveling climate controls on ocean circulation and primary production.

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