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Modeling ocean biogeochemistry in the Cretaceous: what triggered ocean anoxia?

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Accumulating evidence from sediment core records and model studies of global biogeochemical cycling suggest that changes in the marine phosphorus (P) and nitrogen (N) cycles may have been of specific importance for the initiation of oceanic anoxia in the Cretaceous. For example, a moderate increase in nutrient delivery to an ocean with a sluggish circulation can result in a cascade effect causing complete oxygen depletion in the deep sea. The source of the nutrients that possibly acted as the trigger for anoxia remains unclear. Proposed mechanisms include increased riverine nutrient delivery and changes in upwelling regimes. The relative roles of N and P availability in controlling primary productivity are also not fully understood. Here, we expand an existing model of the coupled cycles of P, carbon (C) and oxygen in the ocean with the marine N cycle. With the updated version of the model, we assess the role of changes in ocean redox conditions for N-removal and we test the hypothesis that enhanced availability of P can fuel N2-fixation, increase organic C burial and trigger oceanic anoxia.