SFB 754 | Ocean Deoxygenation: Drivers and Consequences · Past · Present · Future ·

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Spread of ocean anoxia and sluggish overturning circulation in a warmer-than-today world: Does the geological record support this scenario?

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During the past 125 million years, the Earth experienced a series of major global warming episodes, including the Early Aptian Selli-Event (OAE1a) the Cenomanian-Turonian Boundary Event (OAE2), the Paleocene-Eocene Thermal Maximum and the Miocene Climate Optimum (MCO). All these episodes were associated with fundamental disturbances of the global carbon cycle, expressed as prominent excursions in marine and terrestrial carbon isotope records. Characteristic features are (1) an initial negative carbon isotope excursion, which last several 100 000 years and is related to the injection of d13C depleted carbon into the atmospheric and marine reservoirs followed by a massive and relatively rapid increase in d13C to a plateau, that can last as long as 3.2 million years during the middle Miocene Monterey Event (~16.7 to ~13.5 Ma). The positive excursions and ensuing plateaus suggest large-scale burial of d13C depleted organic carbon associated with the development of widespread anoxia in the Cretaceous Ocean.
We present high resolution carbon and oxygen isotope records across the Cretaceous OAE1a, and OAE2 which show that the positive excursions and plateau phases of the d13C records are punctuated by transient cooling events. These cooling events were paced by changes in orbital eccentricity and obliquity of the Earth's axis and were associated with re-oxygenation events of the ocean floor during Cretaceous OAEs. Processes that controlled this unexpected dynamic behavior of climate and ocean oxygenation following important episodes of greenhouse gas release into the atmosphere include increased drawdown of atmospheric CO2 by enhanced carbon sequestration through feedback loops in marine nutrient cycles and a more vigorous than expected thermohaline circulation in a warmer ocean.

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