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Shelf invading low oxygen waters control Cenozoic organic carbon burial rates

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The thermostatic mechanisms of Earth's persistent habitability remain unresolved. High resolution Cenozoic organic and inorganic C isotope records, P accumulation and coarse fraction I/Ca, allow the recalculation and assessment of controls on the global proportion of total carbon buried as organic carbon (f_{org}), a regulator of atmospheric CO_2 and O_2. f_{org} was suppressed during the Eocene hothouse, coincident with an oxygenated water column and low water column phosphate. With decreased sea-level, the area for efficient organic carbon and phosphate sedimentary burial diminished, leading increasingly to greater water column phosphate, higher primary productivity and emergent water column de-oxygenation. At the highest sea-levels of the Cenozoic, the sea-level influence on areal extent of high sedimentation in shelf regions acts as a control on phosphate availability for new production, respiratory demand and ocean oxygenation, as proposed by Bjerrum et al., 2006 (1).

At intermediate sea-levels of the Neogene, the emergence of oxygen minimum zones with $O_2 < 80$ µmol/kg lead to pulses of enhanced organic carbon burial which prevailed for multi-million years, in response to the redox recycling of phosphate. We propose the existence of a self-limiting intermediate sea-level sweet spot at which peak proportional C_{org} burial occurs due to redox recycling of phosphate, whereby OMZ waters with $O_2 <$ 80 µmol/kg impinge on the most C_{org} rich continental shelf sediments. Such a sweet spot has narrowed over Earth history due to deepening OMZs, stabilising both atmospheric O_2 and CO_2. Continental marine inundation controls on phosphate availability, and the sedimentary carbon flux, provide an inevitable positive feed-back on the waxing and waning of icesheets.

1. C. J. Bjerrum, J. Bendtsen, J., J. J. F. Legarth, Modelling organic carbon burial during sea-level rises with application to the Cretaceous. *Geochem, Geophys, Geosys.* **7**, Q05008, 1-24 (2006).