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Declining sensitivity of the carbonate compensation depth to sea level during the Cenozoic

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Over the course of the Cenozoic the global carbonate compensation depth (CCD), the depth in the ocean below which carbonate deposited on the seafloor is not preserved, has shifted from a relatively shallow average position (∼3000 to 3500 m in the equatorial Pacific) in the Palaeocene to a relatively deep position (∼4600 m in the equatorial Pacific) today. Various hypotheses have been proposed to explain this shift, including increased input of terrestrial weathering products to the ocean, decreased bottom-water corrosivity due to increased ocean ventilation, and the decline of shelf carbonates leading to carbonate burial shifting to the deep ocean (known as 'shelf-basin carbonate burial fractionation'). Here we build on earlier attempts to quantify the impacts of carbonate burial fractionation on the CCD by analysing global hypsometric and carbonate burial data and determining the relationship between sea level, shelf carbonate burial extent, and the CCD. We show that if carbonate burial rates remain constant across the Cenozoic then carbonate burial fractionation can explain between 550 and 800 m of the long-term ∼1600 m CCD deepening in the equatorial Pacific, ∼430 m of which occurring across the Eocene-Oligocene Transition (EOT) ∼34 million years ago when the CCD permanently deepened by ∼500 m. This finding indicates that other processes dominated CCD change before and after the EOT and during events such as the Mid-Eocene Climatic Optimum (MECO), but a higher resolution global CCD record is required to better constrain the global magnitude of CCD change during these times. We find that the sensitivity of the CCD to sea level change was at its greatest prior to the EOT and then declined by approximately half due to the loss of extensive carbonate platforms at the end of the Eocene and the intersection of the CCD with large tracts of the abyssal plain.