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Reconstructing the production and fate of pelagic carbonate in the Cenozoic Atlantic Ocean

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To maintain mass balance, riverine delivery of alkalinity into the oceans must equal marine carbonate burial fluxes at any instant of geological time. However, while 33.9 Tmol alkalinity is delivered annually to the global ocean via rivers [1], 50-133 Tmol $CaCO_3$ is precipitated by calcifying plankton [2]. This overproduction of biogenic carbonate requires the deep ocean to be undersaturated in CO_3^{2-} to dissolve the excess and re-equilibrate. The complex interplay between atmospheric pCO_2, alkalinity inputs via weathering, biogenic carbonate production, and the dissolution regime that drives this balance remains largely unconstrained in geological time. The mass accumulation rates of $CaCO_3$ (MAR_c) combine surface productivity, export efficiency, undersaturation and respiration dissolution, and the rates of burial above a fluctuating CCD. Differentiating these components is likely to reveal the causes of decoupling between the various reservoirs of the pelagic carbon cycle. Here, we used a supra-lysoclinal composite sediment record from the equatorial Atlantic to isolate an index of shallow dissolution and quantify the relative contributions of nannofossils and foraminifera to total carbonate burial. We then integrated our profiles over a basin-wide compilation of MAR_c and evolving sea-surface area to reconstruct a Cenozoic history of pelagic $CaCO_3$ production for the Atlantic Ocean. Our results demonstrate how variations in plankton community structure and growth rates modulated Atlantic $CaCO_3$ production, how the expression of the lysocline and the CCD evolved across the Cenozoic, and how these changes regulated the strength of the geological carbon sink.

[1] A comparative overview of weathering intensity and HCO_3 flux in the world's major rivers with emphasis on the Changjiang, Huanghe, Zhujiang (Pearl) and Mississippi Rivers, Cai et al. (2008), *Continental Shelf Research* 28, 1538-1549.

[2] Prediction of pelagic calcification rates using satellite measurements, Balch et al. (2007), *Deep Sea Research Part II: Topical Studies in Oceanography* 54, 478-496.