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A 30 million year history of South Atlantic carbonate deposition at unprecedented detail

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Over the last 30 Myr, Earth's climate system evolved considerably. The Oligocene-early Miocene (30-17 Ma) was characterized by a unipolar Antarctic icehouse world, which virtually disappeared during the warm Miocene Climatic Optimum (MCO; 17-13.9 Ma). Following the Antarctic reglaciation ~13.9 Ma and further late Miocene-early Pliocene global cooling (7-5 Ma), a bipolar Icehouse world was established at ~2.7 Ma. The evolution of orbital-scale climate dynamics across this substantial interval remains relatively unscrutinised. High-resolution carbonate records in particular can provide insight into carbon cycle dynamics by constraining carbonate production and dissolution over time. Carbonate variability in the Equatorial Pacific Ocean has been fairly well-documented. However, relatively few Atlantic records of comparable quality exist, limiting our understanding of the palaeoceanographic evolution of this basin.

Here we present the first continuous South Atlantic carbonate record spanning the last 30 million years. We generated new high-resolution (1-2 cm) X-Ray Fluorescence (XRF) records for the 0-17 Ma interval at Walvis Ridge ODP Site 1264 (2505 m water depth), which were combined with published data (Liebrand et al., 2011 *Climate of the Past*, 2016 *EPSL*) to obtain a single continuous 30 Myr record. We revised the shipboard splice using predominantly the XRF ln(Ca/Fe) record, most notably for the late Miocene-early Pliocene interval, and generated an precession-obliquity tuning (8-0 Ma) that connects to an eccentricity tuning for the Oligo-early late Miocene interval (30-8 Ma). The ln(Ca/Fe) data was finally converted to %$CaCO_3$ and $CaCO_3$ mass accumulation rates to investigate carbonate production and dissolution in this South Atlantic since the Oligocene.

At Site 1264, $CaCO_3$% generally varied between 92-97.5%. The lowest values (92-93%) occur during the MCO, suggesting increased dissolution due to widespread global warmth. The highest values (96-97.5%) are found between 8-4 Ma, indicating high carbonate productivity during the Late Miocene Biogenic Bloom (LMBB). The timing of the LMBB at Site 1264 broadly agrees with the timing of the LMBB in the Pacific. The imprint of long-term (400 kyr) eccentricity is visible throughout. The shorter-term orbital variability of the $CaCO_3$ record is characterised by two intervals of distinctly different pacing. Prior to 8 Ma, short-term eccentricity (100 kyr) dominates the $CaCO_3$ dynamics. After 8 Ma the record displays stronger obliquity and precession-driven cyclicity. These high-resolution carbonate records will allow us to investigate how these orbital pacing regimes relate to the broader climatic trends of the last 30 Myr.