Geophysical Research Abstracts
Vol. 14, EGU2012-10794, 2012
EGU General Assembly 2012

A high-resolution benthic stable-isotope record for the South Atlantic: implications for orbital scale changes in Late Paleocene–Early Eocene climate and circulation

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The Paleogene was climatically dynamic, with both sustained and transient episodes of elevated global temperatures, and pCO_2 levels, as well as periodic carbon-cycle perturbations of varying magnitude, and so provides a natural laboratory for investigating the links between climate and the carbon-cycle under a range of greenhouse conditions. Although the Paleogene "hyperthermals" such as the PETM and ETM-2 have been studied in great detail, the background low-amplitude cycles seen in carbon and oxygen isotope records throughout the Paleocene–Eocene have hitherto received less attention. Here we present a continuous, >6 myr long high-resolution (∼2–3 kyr), orbitally-tuned, benthic foraminiferal stable-isotope record spanning the late Paleocene and early Eocene interval (∼54–61 Ma) of Site 1262, Walvis Ridge (South Atlantic). Spectral analysis of this record clearly demonstrates orbital modulation of both the carbon cycle and climate during this interval, and reveals the evolving response of the climate-system to orbital forcing, both preceding and following the PETM. The benthic oxygen-isotope record shows low frequency oscillations in deep-water temperatures of up to 3°C between long-eccentricity minima and maxima, as well as higher frequency oscillations in the precession bands, but essentially no variability in obliquity, save for a few brief intervals. The carbon isotope record exhibits variance concentrated in all primary orbital bands, but with the largest amplitude cycles in the 400 kyr band over most of this interval. Additionally, complimentary %coarse fraction (%CF) and Fe intensity records from Site 1262, show coherent long and short-term changes in regional saturation and CCD depth, thus providing insights into the coupling of the carbon cycle, climate and regional ocean circulation during this period.