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Constraints on late Miocene ice volume variability from a global benthic $\delta^{18}O$ compilation (8.0-5.0 Ma)

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Accurate stable isotope stratigraphies are essential for understanding how past climates are influenced by orbital forcing. Deep-sea benthic foraminiferal $\delta^{18}O$ and $\delta^{13}C$ stratigraphies can provide precise astronomical age control and record changes in past deep-sea ocean temperatures, global ice volume and the carbon cycle. Our understanding of Plio-Pleistocene climate dynamics has improved through the development of global (LR04; Lisiecki & Raymo, 2005) and regional stacks (Ceara Rise; Wilkens et al., 2017). However, the late Miocene climate system remains poorly understood, in part because the late Miocene benthic foraminiferal $\delta^{18}O$ stratigraphy is notoriously low amplitude.

Here, we present the first global late Miocene global benthic foraminiferal $\delta^{18}O$ compilation spanning 8.00-5.33 Ma. We formed a “Base Stack” using six continuous benthic stratigraphies from the Atlantic (ODP Sites 982 (N), 926 (E) and 1264 (S)) and Pacific Oceans (IODP Sites U1337 and U1338 (E), ODP Site 1146 (W)). To avoid misidentification of individual excursions between sites, we verified existing splices, generated isotope data where necessary and established independent astrochronologies. To accompany the “Base Stack”, we compiled a “Comprehensive Stack”, which incorporates single-hole benthic $\delta^{18}O$ stratigraphies to optimise global coverage.

The new global late Miocene benthic foraminiferal $\delta^{18}O$ stack represents a stratigraphic reference section back to 8.00 Ma. The stack is accurately tied to the Geomagnetic Polarity Time Scale between Chrons C3r and C4n.2n using the magnetostratigraphy from IODP Site U1337. We recognise 68 new $\delta^{18}O$ Marine Isotope Stages (MIS) between 7.7 and 6.5 Ma. An exceptional global response is imprinted on the dispersed sites between 7.7-6.9 & 6.4-5.4 Ma, when a strong 40 kyr heartbeat dominates the climate system. The origin of these cycles remains unclear. The influence of deep-sea temperature on the benthic $\delta^{18}O$ stack is explored at IODP Site U1337 using Mg/Ca data. The dominant 40-kyr $\delta^{18}O$ cycles are asymmetric, suggesting at least a partial ice volume imprint and raising the possibility that these cycles relate to early signs of northern hemisphere glaciation.