Capturing Late Miocene ice volume variability from a global benthic foraminiferal oxygen isotope stack (8.0-4.0 Ma)

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Abstract

Benthic foraminiferal stable isotope stratigraphies track changes in past deep-sea temperatures, global ice volume and the carbon cycle in response to astronomical forcing. Our understanding of Plio-Pleistocene climate has improved significantly through the study of global (LR04; Lisiecki & Raymo, 2005, Paleoceanography) and regional benthic foraminiferal δ18O and δ13C compilations (Ceara Rise; Wilkens et al., 2017, *Climate of the Past*). Here we present the first global Late Miocene benthic foraminiferal δ18O stack spanning 8.0-4.0 Ma. We use nine high-resolution, continuous benthic stable isotope stratigraphies to compile a "Base Stack", with data from the Atlantic (ODP Sites 982 (N), 926 (E) and 1264 (S)), Indian (IODP Site U1443) and Pacific Oceans (IODP Sites U1337, U1338 (E), (I)ODP Sites 1143, 1146, U1488 (W)). Where needed, we verified the stratigraphy and established independent astrochronologies to avoid miscorrelation of individual excursions. To complement the "Base Stack", we also compile a "Global Comprehensive Stack", which incorporates all available high-resolution single-hole benthic δ18O stratigraphies to optimise global coverage. This new global Late Miocene benthic δ18O stack represents a reference section back to 8.0 Ma, which is tied to the Geomagnetic Polarity Time Scale from Chrons C2Arto C4n.2n using the Site U1337 magnetostratigraphy. We recognise new Marine Isotope Stages in the δ18O stack between 7.7 and 6.5 Ma. An exceptional global response, with 40-kyr cyclicity, is imprinted on all sites from 7.7-6.9 and 6.4-5.4 Ma. This response is dampened between 6.9-6.4 Ma, when sites display regional differences to astronomical forcing. The influence of deep-sea temperature and ice volume on benthic δ18O is explored at Site U1337 using Mg/Ca data combined with cycle shape analysis. The 40-kyr dominated δ18O cycles are asymmetric, suggesting dynamic ice volume control. The asymmetry is especially distinct from 7.7-6.9, prior to the late Miocene cooling and the growing influence of high-latitude processes.

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Lisiecki, L. E., & Raymo, M. E. (2005). A Pliocene-Pleistocene stack of 57 globally distributed benthic δ18O records. *Paleoceanography*, *20*(1), 1–17. https://doi.org/10.1029/2004PA001071
Wilkens, R. H., Westerhold, T., Drury, A. J., Lyle, M., Gorgas, T., & Tian, J. (2017). Revisiting the Ceara Rise, equatorial Atlantic Ocean: Isotope stratigraphy of ODP Leg 154 from 0 to 5 Ma. *Climate of the Past*, *13*(7), 779–793. https://doi.org/10.5194/cp-13-779-2017

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