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Early Pleistocene sea level and millennial-scale climate fluctuations: a view from the tropical Pacific

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This project aims at deciphering the rate of sea level variability and its effect on millennial-scale climate fluctuations during the final phase of the intensification of northern hemisphere glaciation (NHG).
Millennial-scale climate fluctuations appear to have changed significantly at glacial-interglacial time scales during the late Pliocene and Pleistocene. Thereby, millennial-scale climate fluctuations under a warmer climate during late Pliocene and early Pleistocene show markedly lower ampitudes compared to the fluctuations of the late Pleistocene. Numerous Pleistocene proxy records (e.g. McManus et al., 1999) suggest that this difference can be explained by an ice-volume/sea-level threshold that amplifies millennial-scale climate fluctuations and was not reached prior to the Mid-Pleistocene Transition (MPT). However, new records question the existence of this threshold (Bolton et al., 2010) and indicate that either the amplification of millennial-scale climate fluctuations before the MPT required a higher ice-volume threshold than in the late Pleistocene, that ice-volume had no significant effect on the amplitude of climate fluctuations, and/or the available sea level estimates for the early Pleistocene are inaccurate.
For identifying the mechanisms underlying the dynamics of early Pleistocene ice sheets, material from the tropical Pacific Ocean (ODP Site 849) is studied over a time interval from 2.6 to 2.4 Ma (marine isotope stages 104 to 96). In summary, the main deliverables are (1) the establishment of a precise δ18O chemostratigraphy using the benthic foraminifera Cibicidoides wuellerstorfi by tuning the δ18O dataset to the LR04 benthic isotope stack (Lisiecki & Raymo, 2005), and (2) providing high-resolution ($\sim$700 years) Mg/Ca and δ18O datasets using the benthic foraminifera Oridorsalis umbonatus and the planktonic foraminifera Globigerinoides ruber.
This combined geochemical approach will be used to address the following research questions: (1) Quantification of sea level change from 2.6 to 2.4 Ma; (2) Critically assess the hypothesis of an ice-volume threshold for millennial-scale climate amplification during the early Pleistocene (and if it exists, what its value was); (3) Detailed comparison with late Pleistocene glacials; (4) Model-data comparison to assess the fidelity of model-based sea level estimates; and (5) reconstruction of sea surface temperature fluctuations of the tropical Pacific.

References

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