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# Mid-Oligocene climate dynamics using benthic foraminifera from the Central Eastern Pacific Ocean

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The Oligocene marks the onset of major Antarctic ice sheets and hence the first step into a “icehouse” world, which continues to the present day. To understand the evolution of the Antarctic ice sheet, it is fundamental to assess and quantify changes in the ocean circulation pattern and the intensity of Pacific equatorial upwelling (PEU) since the initiation of southern hemisphere ice caps during the Eocene-Oligocene transition.
It is well known that combined variations in the eccentricity, obliquity and precession of Earth′s orbit influence long-term climate fluctuations, notably the build up and decay of ice volume. To unravel the importance of orbital forcing on ice volume changes and to estimate its impact on paleoproductivity in the Central Eastern Pacific Ocean, we focused on the Oi-2b event about 26.8 Ma ago, being the most important glacial episode in the mid-Oligocene (Pälike et al., 2006).
We calculated benthic foraminifer accumulation rates (BFAR) to reconstruct organic matter flux to the sea floor and hence surface water productivity. Furthermore, to assess and differentiate between changes in productivity and dissolution, a planktic foraminifera-based fragmentation index (FI) was calculated.
BFAR values range between 16 and 217 NBF/cm-2/kyr (average: 65 NBF/cm-2/kyr). Increased BFAR indicate phases of higher supply of organic matter to the sea floor and thus enhanced surface water productivity. Our BFAR record indicates variable but generally lower productivity conditions during the glacial event compared to pre- and post-Oi-2b conditions. However, the transition into the Oi-2b event which is documented in heavier $\delta$18O of Cibicidoides grimsdalei (2.1 per mil to 3.0 per mil ) and Oridorsalis umbonatus (1.7 per mil and 2.6 per mil) is characterized by a higher productivity, which is also supported by the assumption of increased productivity for the onset of Oi-2b based on $\Delta\delta$13C variations of planktic and benthic foraminifera from ODP Site 1218 (Wade & Pälike, 2004). The sample material is characterized by a good preservation which is documented in our FI record with constantly lower FI percentages during Oi-2b. This assumption is also supported by the relatively high $CaCO_3$ content of >80 wt.% within the succession studied.
So far, no astronomical tuned age model exists for Site U1334. However, to establish a preliminary age model for our studied interval of Site U1334, we used ODP Site 1218 as a reference site because it is hitherto the most complete sedimentary succession for the Oligocene (Pälike et al., 2006). As a first attempt, we used our initial age model to calculate spectral analyses of the BFAR record of Site U1334 to determine the presence of main orbital parameters (Milankovitch cycles). Cyclic variations are discernible during the whole BFAR and FI record. Frequencies are most likely related to variations on long eccentricity forcing (425 kyr; 99 % level) for the BFAR record. Our FI record reveals spectral power concentrations around the long eccentricity period (425 kyr; 99 % level), obliquity (43 kyr; 95 % level) and precession (22 kyr; 99 % level). Thus, productivity and dissolution appear to be sensitive to Earth′s orbital variations.

References

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