experiments, we examine the role of high latitudinal freshwater pulses resulting from cryosphere melting or/and sea ice melting and sea water freezing. The Miocene ocean circulation is shown to be sensitive to such freshwater impacts. There are noticeable changes in all major ocean parameters, i.e., the ocean heat transport, meridional overturning, sea surface elevation, etc, caused by the changes of deep-ocean thermohaline structure.

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WHAT CAUSED THE EXTINCTION OF DEEP-SEA FORAMINIFERA IN THE MIDDLE PLEISTOCENE?

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The last major extinction of deep-sea benthic foraminifera began in the late Pliocene but mostly occurred during the Middle Pleistocene Climatic Transition (1.2-0.6 Ma). Globally it caused the disappearance of at least 2 families, 17 genera and over 65 species (~20 % of the deep-sea foraminiferal biodiversity). These taxa had similar morphologies, being elongate cylindrical, dominantly uniserial, and included all species with apertures that were slit lunate, hooded with two teeth (Pleurostomellidae), necked with a secondary tooth (Stilostomellidae), or cribrate (Chrysalogonium).

In the South-west Pacific, North Atlantic and Caribbean, the absolute abundance of this group of elongate, cylindrical foraminifera exhibit dramatic declines during the late early and middle Pleistocene. The rate of decline was pulsed, with declines often associated with the onset of glacial intervals, and partial recoveries in intervening interglacials. The timing of the declines and the last occurrence levels of individual extinct species varied between the nine DSDP and ODP sites studied so far. Over a period of several hundred thousand years leading up to its extinction, the group appears to have withdrawn progressively from upper bathyal and abyssal deep water sites into mid-lower bathyal sites bathed in intermediate waters. The peak period of local disappearances was 0.95-0.7 Ma, with the youngest occurrence of any of the extinct species (Stilostomella extinction) similar in all sites (0.7-0.58 Ma).

The middle Pleistocene extinction was the final phase in the progressive world-wide decline of elongate, cylindrical taxa, which reached their greatest abundance in the late Eocene, and exhibited major declines during periods of global cooling at the end of the Eocene, and in the middle-late Miocene. The precise mechanism causing the middle Pleistocene extinctions (e.g. rapid changes in food supply, increased ventilation) is not yet determined, but was clearly distinct from the cause of the other two major deep-sea extinction events, during the Cretaceous and Paleocene-Eocene Thermal Maximum, which had no impact on this group of foraminifera.

Does the pattern and timing of this extinction reflect changes in the global deep and intermediate water circulation patterns during the middle Pleistocene ?

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INTENSIFICATION OF CLIMATE CONTRASTS IN THE NORTHERN NORTH ATLANTIC (NORDIC SEAS) BETWEEN 1.5 AND 0.35 MA

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We used sedimentological and geochemical proxy records of a deep-sea sediment core from the southern central Nordic seas (MD992277, 69°N, 6°W) to reconstruct the development of glacial and interglacial conditions during the Early and Middle Pleistocene, i.e., late Matuyama to middle Brunhes Chron (1.5 to 0.35 Ma). An enhancement of both glacial and interglacial characteristics is observed during early Brunhes oxygen isotope stages (OIS) 16 and 15, respectively. Any intensification of the climatic conditions prior to this, as was previously described for the eastern part of the Nordic seas, is not recognized at our study site. Of all glacial periods investigated OIS 12 is characterized by the most severe conditions, showing both maximum input of iceberg-rafted debris (IRD) as well as planktic foraminiferal oxygen isotope values comparable to those of the Last Glacial Maximum. Within the studied time period OIS 11 is by far the longest interglacial interval and the first to show fully developed interglacial conditions, i.e., Holocene-like oxygen isotope values and a minimum of IRD deposition. Hence, in general our study indicates a gradual intensification of glacial-interglacial climate contrasts at the high northern latitudes during the Middle Pleistocene interval.

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HIGH RESOLUTION BENTHIC FORAMINIFERAL STABLE ISOTOPE RECORDS FROM THE LATE EARLY OLIGOCENE

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The Oligocene (33.5-23.8 Ma) represents in many ways the "neglected middle child" of Cenozoic palaeoceanography – caught between the early Paleogene greenhouse and the well-developed Neogene icehouse. This situation is attributed to the view that the Oligocene marks a persistent interval of relative stasis in palaeoclimate and biotic turnover, reflected in deep-sea micropalaeontological communities by conservative body plans, confusing taxonomy and low biostratigraphic resolution. However, in some respects this interval represents the most interesting episode of the Cenozoic palaeoceanographic puzzle because it allows us to unravel the processes that lie behind the transition from a world free of large-scale continental icecaps and rapid eustatic sea-level oscillations to one dominated by these climatic changes.

Here we present a high-resolution (~3 ka) epi- (Cibicidoides grimsdalei) and infaunal (Oridorsalis umbonatus) benthic foraminiferal stable isotope (oxygen, carbon) record of the late Early Oligocene equatorial Pacific (ODP Site 1218) between magnetochrons C11n.2n and C12n (29.9-31 Ma) in order to assess and quantify on astronomical timescales palaeoclimatic and palaeoceanographic changes.

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BENTHIC FORAMINIFERA AS A TOOL TO RECONSTRUCT TEMPORAL VARIABILITY OF CARBON FLUX AND PALEOPRODUCTIVITY: EXAMPLES FROM THE SOUTH CHINA SEA AND THE WALVIS BASIN

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Benthic foraminiferal assemblages of two ODP Sites were analysed in order to investigate their reaction to organic carbon flux and paleoproductivity changes. Site 1143 is located in the southern South China Sea. Carbon flux related faunal trends reflect productivity changes that indicate variations in monsoonal intensity and consequently circulation patterns in the relatively oligotrophic South China Sea. Site 1082 is located in the Walvis Basin, at the outer edge of the Namibian upwelling cell. The faunal assemblages collected in this high productivity area reflect clear variations in organic flux rates and thus surface productivity. In both cores significant alterations in the benthic foraminiferal compositions are observed in the upper Pliocene and middle Pleistocene. These periods are times of major global climate system changes that had also influence on the stability of the deep-sea environment and therefore the distribution and evolution of some benthic foraminiferal species. The investigation emphasizes that the use of benthic foraminiferal assemblages, their diversity patterns, accumulation rates and abundances of index species provides good tools for the projection of relative carbon flux changes, independent of generally high or low carbon flux rates. Even older assemblages from the Miocene and Pliocene that already show slightly different species compositions compared to modern assemblages are reliable proxies for relative carbon flux changes until the tests are well preserved and not influenced by dissolution processes.

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CHRONOS NETWORK FOR EARTH SYSTEM HISTORY: INTEGRATED DATABASES AND TOOLKITS ACCESSIBLE THROUGH A COMMON PORTAL - WWW.CHRONOS.ORG

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Modern Earth system history research depends increasingly upon the analysis of voluminous, multidisciplinary, time-calibrated data. The process of determining the availability or even the existence of Earth history data remains a time-consuming and error-prone enterprise because there are no centralized depositories or Web-enabled means for locating and retrieving data. The goal of CHRONOS (www.chronos.org) is to deliver a dynamic, interactive and time-calibrated framework for Earth system history as a network of comprehensive databases and data files containing information related to the evolution and diversity of life, climate change, geochemical cycles, geodynamical processes, and other aspects of the Earth system. With a 'central hub' coordinating a continually expanding network of individual databases and files linked by geologic time, the fast-growing, community-based CHRONOS system serves as a major portal for geological research and outreach, equipped with powerful, interactive analytical and visualization toolkits to enable the exploration and understanding of our evolving planet.

Given the wealth of existing Earth history data that can be integrated with state-of-the-art information technologies and advanced correlation tools, we also anticipate that the continued implementation of CHRONOS will result in an order of magnitude increase in the precision of global and regional geological time scales, e.g. through the EarthTime project (http://eaps.mit.edu/earthtime/). This alone represents a major advance in Earth system history research, and is expected to lead to new insights into the rates and magnitudes of important geological processes, many of which are relevant to understanding Earth system changes influenced by human activity. Beyond facilitating studies of scientific issues of immediate concern, the CHRONOS community is working on educational and community involvement projects by networking information and pedagogical activities on topics of general interest (e.g., evolution, extinction events) in CHRONOSLab. A partner of the 'GeoInformatics' initiative, CHRONOS is a multi-institution project funded by the National Science Foundation fostering active international collaborations.

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BIOMARKERS FROM DSDP SITE 231 REVEAL ORBITAL VARIABILITY IN THE HABITATS OF HOMINID EVOLUTION

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DSDP Site 231 in the Gulf of Aden provides a sedimentary record of environmental change through critical periods of human evolution. Terrestrial records suggest a long term shift from forest to grassland in East Africa during the Neogene (Cerling and Hay, 1988; Cerling, 1992; Wynn, 2000). Paleosol records do not resolve the high frequency climate variability which is a significant feature of high and low latitude climate during the Plio-Pleistocene (eg Shackleton et al., 1990, deMenocal, 1995). Proximal marine sediments offer the possibility of resolving environmental changes in East African hominid habitats over orbital timescales throughout the past 13Ma. We use organic geochemical techniques to assess vegetation change from the biomarker record. Molecular distributions diagnostic of