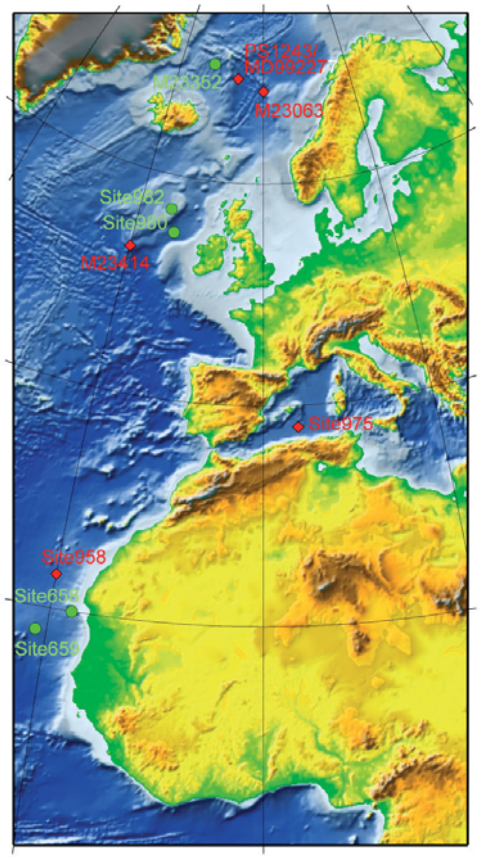
Warm climates of the past - Marine Isotope Stage 11

Within the community of scientists working on climate change it is widely believed that marine isotope stage (MIS) 11, an interglacial climate period centered around 400 ka, can in many ways be seen as the Pleistocene equivalent to the recent interglacial conditions of the Holocene. However, in contrast to this perception a number of paleoceanographic studies from the high-northern latitudes point to systematic differences in the character of atmospheric and oceanic circulation during these two interglacial intervals (see Fig. 2 and Fig. 3).

The goal of the ongoing studies is therefore to evaluate whether isotopic stage 11 may indeed be taken as the adequate interglacial model to describe present and future Holocene climate change. Using a comparative approach by analysing sea surface conditions during stages 11 and 1 in the Northeast Atlantic it is investigated to what extent a fundamentally different character of the atmospheric and oceanic circulation may have determined the specific climate difference between these two warm periods. In detail the character of stage 11 and the Holocene is analysed with a broad methodological approach using a series of geochemical, micropaleontological, and sedimentological proxies from a transect of Northern Hemisphere study sites.

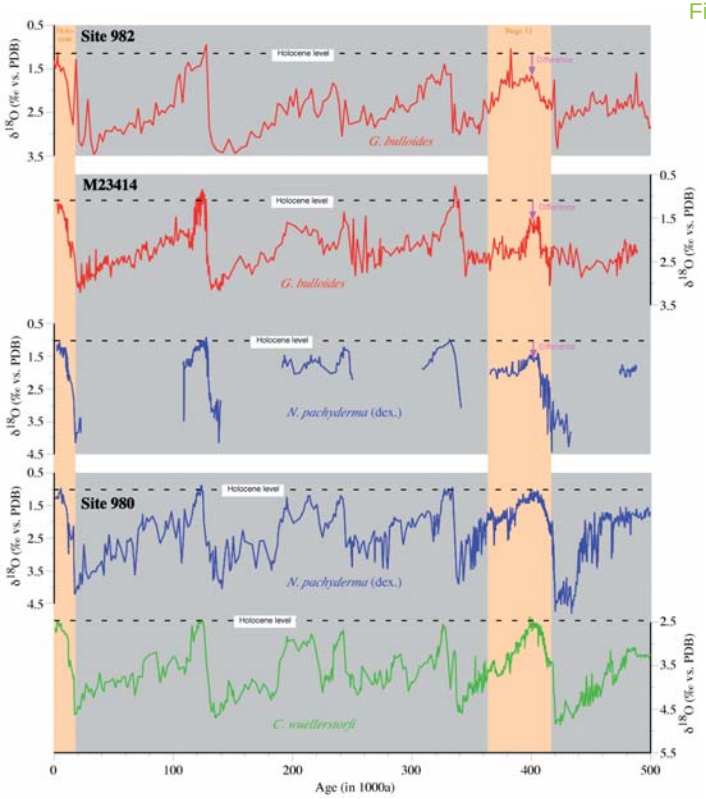
Contact:
Dr. Henning Bauch
Dr. Jan Helmke
Dr. Evgeniya Kandiano

Fig.1



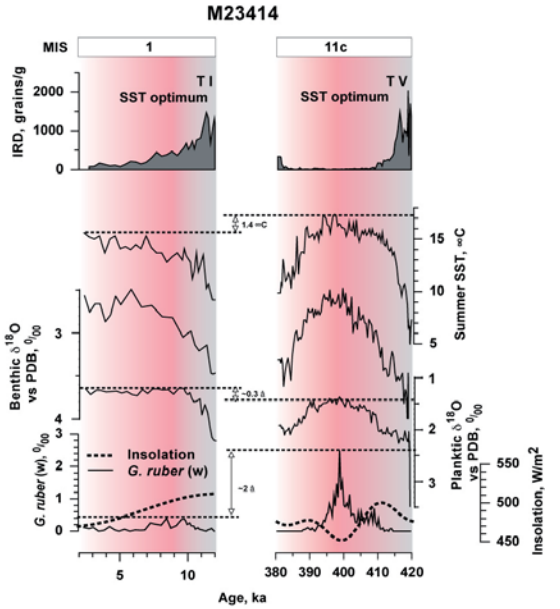
Position of sediment cores used for the studies (all marked by red rhombuses) from the polar and subpolar North Atlantic (PS1243/MD992277, 69°N, 6°W, 2800 m water depth; M23063, 68°N, 0°O, 2300 m water depth; M23414, 53°N, 20°W, 2200 m water depth), the Mediterranean Sea (Site 975, 38°N, 4°O, 2415 m water depth) and the equatorial North Atlantic (Site 958, 23°N, 20°W, 3800 m water depth). Reference sites of importance for the paleoceanographic interpretation are marked by green circles.

Fig. 2



Comparison of planktic isotopes (*G. bulloides*, red curves, and *N. pachyderma* (dex.), blue curves, in addition the results from the benthic species *C. wuellerstorfi* are shown) from 3 sediment sites at the Rockall-Plateau (M23414, Sites 980 (McManus et al., 1999) and 982 (Venz et al., 1999), see Fig. 1). It is obvious that the more western cores M23414 and Site 982 reveal in general heavier planktic oxygen isotope values during MIS 11 than the Holocene. This is in contrast to the more eastern Site 980, where both interglaciations are in this respect likewise. This seems to indicate an at least regionally different character of surface water masses in the subpolar North Atlantic during stage 11 and the Holocene.

Fig. 3



Downcore distribution of various proxy data from core M23414 (see Fig. 1) vs. age for Holocene and MIS 11 sections (from top to bottom: Ice rafted debris (IRD); sea surface temperature (SST - record is based on faunal analysis and represents averaged results retrieved from different mathematical approaches); benthic (*C. wuellerstorfi*) and planktic (*N. pachyderma* dextral) isotope records; relative abundance of tropical species *G. ruber* (w.) along with Mid-June summer insolation at 65 °N after Berger, 1978). Glacial terminations (T) are marked, interglacial SST optima are indicated by red color intensity. Striking differences in climate evolution during MIS 11 and the Holocene can be observed: Contrary to the Holocene, when changes in SST dynamics were consistent with the insolation regime and SSTs reached their maximum immediately after the end of T I, the SST optimum during MIS 11 occurred approximately 10 ka (thousand years) after the end of the termination process when insolation was at its lowest. Higher SSTs and heavier planktic isotope values during MIS 11 point to differences in surface water configuration between MIS 11 and the Holocene, which imply that despite a resemblance in greenhouse gas content and insolation dynamics the analogy between these two periods is not warranted.