# New evidence of millennial-scale climate variability during the peak warm interval of Marine Isotope Stage (MIS) 9

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Understanding of the natural cycle of past interglacial intervals helps to better comprehend the current and future effect of human influence on the natural cycle. Climate instability during past interglacial intervals may be comparable to the present epoch, termed Holocene or Marine Isotope Stage 1 (MIS 1). Previous studies have shown millennial climate variability during the Holocene and during the peak warm interval of MIS 5e recorded by the paleotemperature proxy oxygen isotope ($\delta^{18}O$) measured in foraminifera. Here we show that comparable variability may be recorded within the warm interval of the MIS 9, MIS 9e. Forty-five sediment samples from ODP (Ocean Drilling Program) Site 984 were used in this study. Oxygen and carbon isotopes record obtained in polar species *Neogloboquadrina pachyderma* (sinistral), subpolar species *Neogloboquadrina pachyderma* (dextral) and *Turborotalita quinqueloba*, and the benthic species *Cibicidoides spp* show well discerned climate variability in 9e. Ice-rafted debris (IRD) data helped define the boundaries of MIS 9 and its subdivisions. High IRD abundance at early MIS 9 indicates the terminal collapse of the ice sheet in the polar North Atlantic and marks the transition from the previous glacial period the MIS 10 into the interglacial period 9. During the peak warm 9e, IRD decrease may possibly be linked to insignificant glacial ice presence at that time. Reduced IRD input along with decreased $\delta^{18}O$-values define the onset and demise of the peak warm interval 9e. Variations of planktonic and benthic $\delta^{18}O$-values within MIS 9e may also indicate possible changes in hydrographic properties of the water column. Melting ice sheets at early MIS 9, also suggest a rise in sea level and the influx of fresh water causing a decrease in salinity and density of the seawater. Benthic$\delta^{13}C$ variation during this period suggests changes in the North Atlantic Deep Water current possibly related to changes in salinity and density. The presence of climate variability within MIS 9e comparable to variability well defined within MIS 1 and 5e indicates the possibility that such variability is common to the warmest substage of past interglacials.