Geophysical Research Abstracts, Vol. 7, 09848, 2005
SRef-ID: 1607-7962/gra/EGU05-A-09848

Productivity highs in the subarctic North Pacific: implications for THC intensity during Pleistocene peak interglacials

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The terminus of the global Thermohaline Circulation (THC) is located in the subarctic North Pacific, where the "salinity conveyor belt" comes close to the surface waters, but today is barred from reaching the actual surface by a major low-salinity layer. Paleo-proxy records from this area may provide valuable information on past intensity changes of the THC and both vertical and meridional mixing. Since only few paleoceanographic records are available from this area, it remained a sort of “mare incognita” for the geoscience community. In this study we present new multiproxy records with submillennial resolution of SST and paleoproductivity obtained from IMAGES sites MD01-2416 and MD02-2489 in the northwestern and northeastern Pacific, 52˚ / 54˚N. The records cover time spans from the Holocene back to 900 ka (MIS 22, MD01-2416) and 95 ka (MIS 5.2, MD01-2489), focusing on results for terminations I to V (MIS 1-11), and the subsequent interglacials. Our paleoceanographic interpretations are based on records of stable oxygen and carbon isotopes, ice rafted debris (IRD), calcium content, chlorins, biogenic opal, and the faunal composition of planktic foraminifera. AMS 14C ages, paleomagnetic events, and tuning to stacked d18O reference records serve for age control.

The majority of glacial terminations show a similar stepwise succession of paleoproductivity/nutrient signals:

(1) Depleted d13C-values indicate "old", nutrient enriched deep water;

(2) Increased chlorin accumulation rates match the end of IRD deposition, and finally (3) maxima in biogenic opal accumulation rates and especially of CaCO3 deposition (based on Ca XRF-counts).

Sea Surface Temperatures (SST; based on census counts of planktic foraminifers and transfer functions) culminate during an early stage of deglaciations. Different from this pattern, Termination II shows no distinct biogenic opal peak after the chlorin maximum and a "delayed" SST- maximum only during the second half of interglacial stage 5.5. Glacial- to-interglacial caloric summer SST differences only range from 1.5 - 2.5 ˚C such as since the mid-Holocene.

Mid-to-late interglacial sea surface salinities (SSS's) were lowered by 2-3‰ relative to peak deglacial times. The present SSS low is a result of early to mid Holocene change.

We attribute the changes in paleo-productivity (and in parts of SST and SSS) to an intensification and decline of upwelling in the subarctic North Pacific. Paleoproductivity maxima were reaching levels similar to those of mid-Pliocene times prior to 2.73 Ma. They indicate recurrent short-term events of mid-Pliocene-style intense upwelling in the Pleistocene.