

ACG033-P03

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Climate - ice-sheet - vegetation system in the Arctic region during the mid-Pliocene warm period

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The most prominent climate change is appeared in the Arctic region under the global warming through the atmosphere-ocean-sea ice-land interaction. Paleoclimatic studies about the Arctic climate variability during the past warm/cold periods (e.g., mid-Holocene, last glacial maximum, last interglaciation) could help for the future warming projection (e.g., Otto-Bliesner et al. 2006). The warmer climate sustained for long time during the mid-Pliocene warm period (MPWP) when the atmospheric CO₂ concentration is higher (360~425ppmv) and the global-mean surface temperature is higher (~+3K) than the pre-industrial value. The efforts for simulating the climate in this interval are expected to make substantial contributions to advanced validation of climate models predicting future climate change (e.g., Jansen et al. 2007). The reconstruction of the sea surface temperature during MPWP by the deep sea sediments (Haywood et al. 2010) revealed extremely warmer environment particularly around the northern North Atlantic Ocean. The integrated study about the paleobotanical proxy data showed relatively small ice sheet and poleward shift of the boundaries between temperate forest, boreal forest, and tundra during MPWP (Salzmann et al. 2008) which means the significantly warm climate in the high latitude region.

Although the proxy records are not enough for the sea-ice reconstruction during MPWP for the reasons of the restriction of the geological data, the estimation for the amount of the perennial sea ice by use of the benthic foraminifera accumulation rate and the reconstructed sea surface temperature. Robinson (2009) revealed the possibility about the extremely warmer sea surface (~+18K) than the present day and the seasonal ice-free condition during MPWP estimated from Ocean Drilling Program Sites in the Nordic Seas and the Arctic Ocean based on the ratio of magnesium to calcium in foraminifera and the alkenone unsaturation indices. These new data imply a major reduction of sea ice during MPWP similar to what has been observed in recent summers.

The climate system during MPWP is an example for the equilibrium system under the higher atmospheric CO₂ concentration containing the "slow feedback of the vegetation and ice sheet" (Lunt et al. 2010). Further studies about the Arctic climate during MPWP would help for the development of the knowledge about the climate-vegetation-sea ice interaction system which emphasizes the earth system under the CO₂ forcing.

Keywords: paleoclimate, mid-Pliocene warm period, climate change, atmosphere-sea ice interaction, atmosphere-land interaction