Geophysical Research Abstracts, Vol. 9, 05738, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-05738

Antarctic sea-ice expansion during the Pleistocene: implications for atmospheric CO_2 and high-low latitude teleconnections

A. Martínez-Garcia (1), A. Rosell-Melé (1,2), E. L. McClymont (3)

(1) Institut de Ciència i Tecnologia Ambientals, UAB, Spain (2) ICREA, (3) School of Geography Politics and Sociology, Newcastle University, UK. (alfredo.martinez@uab.es)

In recent years several authors have proposed that the Southern Ocean plays a key role in modulating changes in deep ocean circulation and atmosphere-ocean gas exchange during glacial-interglacial cycles as well as in long timescales. It has been argued that during glacial stages lower atmospheric CO_2 could be explained by a decrease in deep-water ventilation, as a result of increased sea-ice cover and water column stratification which would have also given rise to a reduced air-sea gas exchange in high latitude locations. Here we show, using alkenone indices, that the extension of the polar waters and hence the sea-ice cover are strongly coupled to changes in deep ocean ventilation through the Pleistocene, providing further support to the mechanism described before for the reduction of atmospheric CO_2 concentration. The long term trend of our record shows an expansion of polar water masses that took place around 1.5-1.2 Ma, synchronously with a reduction in deep ocean ventilation as reconstructed from $\delta^{13}C$ profiles, and an increase in glacial export productivity around 1.15 Ma. These changes suggest a decrease in glacial atmospheric CO_2 concentrations at the onset of the MPT. This fact could have had great implications for the global climate system, as several models have proposed that a decrease in atmospheric CO_2 concentrations could have led to the crossing of a climatic threshold that through different mechanisms would have changed the pacing of the G-IG cycles. Alternatively, the timing of the expansion of Antarctic sea-ice is coincident with the intensification of the tropical pacific east-west SST gradient, providing supportive evidence for the hypothesis that Southern ocean cooling and Antarctic sea-ice expansion may have been transmitted to the tropics through the thermocline circulation, causing an intensification of the Walker circulation that in turn favoured ice sheet growth in the Northern Hemisphere.