Geophysical Research Abstracts, Vol. 8, 01546, 2006
SRef-ID: 1607-7962/gra/EGU06-A-01546

Use and abuse of Keeling plots in paleoatmospheric research: What can we learn from $\delta^{13}CO_2$ in polar ice cores?

H. Fischer (1), J. Schmitt (1), P. Köhler (1)

(1) Alfred-Wegener-Institut for Polar and Marine Research, Columbustrasse, 27568 Bremerhaven, Germany, (hufischer@awi-bremerhaven.de)

The alternation of ice and warm ages is connected to glacial/interglacial CO_2 concentration changes of approximately 80-100 ppmv with significant fine structure during Termination I [Monnin et al., 2001]. Changes in the carbon isotopic signature of CO_2 during that time are expected to add to our understanding what processes were responsible for the observed CO_2 changes. First measurements revealed a glacial/interglacial change in $\delta^{13}CO_2$ of 0.2-0.3 $^\circ/_{\circ\circ}$ [Leuenberger et al., 1992] but significantly higher variations during the termination [Smith et al., 1999]. Using the so called Keeling plot approach ($\delta^{13}C = a/CO_2 + b$, where b is taken as representative of the isotopic signature of carbon added or extracted from the atmosphere) it was concluded that the terrestrial biosphere was of major importance for CO_2 changes in the glacial and the Holocene [Smith et al., 1999]. However, this approach known from terrestrial carbon cycle research represents essentially a carbon isotopic mass balance of a two reservoir system and its application on paleoclimatic CO_2 changes is not straightforward. Here we revisit the Keeling plot approach on paleoclimatic time scales using ice core observations, theoretical considerations and modeling results. Based on output of transient model runs from our global carbon cycle model BICYCLE during the last transition [Köhler et al., 2005] we constrain the conclusions to be drawn from ice core $\delta^{13}CO_2$ data and Keeling plot analyses [Köhler et al., 2006].

Köhler, P., H. Fischer, G. Munhoven, and R. E. Zeebe (2005), Quantitative interpretation of atmospheric carbon records over the last glacial termination, *Global Biogeochemical Cycles*, **19**, (GB4020), doi:10.1029/2004GB002345.

Köhler, P., J., Schmitt and H. Fischer (2006), On the application and interpretation

of Keeling plots in paleo climate research – Deciphering δ^{13}C of atmospheric CO_2 measured in ice cores, *Biogeosciences Discussion*.
Leuenberger, M., U. Siegenthaler, and C. C. Langway (1992), Carbon isotope composition of atmospheric CO_2 during the last ice age from an Antarctic ice core, *Nature*, **357**, 488-490.
Monnin, E., A. Indermühle, A. Dällenbach, J. Flückiger, B. Stauffer, T. F. Stocker, D. Raynaud, and J.-M. Barnola (2001), Atmospheric CO_2 concentration over the last termination, *Science*, **291**, 112-114.
Smith, H. J., H. Fischer, M. Wahlen, D. Mastroianni, and B. Deck (1999), Dual modes of the carbon cycle since the Last Glacial Maximum, *Nature*, **400**, 248-250.