Geophysical Research Abstracts,
Vol. 10, EGU2008-A-06010, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-06010
EGU General Assembly 2008

Atmospheric CO_2 concentration changes inferred from stomatal frequencies: a calibration and validation approach for palaeoatmospheric reconstructions

W. Finsinger, F. Wagner-Cremer

Institute of Environmental Biology, University of Utrecht, Laboratory of Palaeobotany and Palynology, Utrecht, The Netherlands (w.finsinger@uu.nl)

The most direct way of investigating past variations of the atmospheric CO_2 concentration before 1958 AD, when continuous direct atmospheric CO_2 measurements started, is the analysis of air extracted from suitable ice cores. Detailed CO_2 records from Antarctica indicate that between 1000 and 1850 AD variations of up to 10 ppmv CO_2 occurred. However, these records are affected by smoothing due to enclosure of air in the ice (about 10 years at DE08, Law Dome). This smoothing removes high frequency variations from the record, so the true atmospheric variation may have been larger than represented in ice-core-air records. As an alternative, the inverse relationship between stomatal frequencies (SF) and CO_2 can be used if an accurate and precise model for the plants' response to CO_2 changes is available.

We first assessed the predictive ability of SF inference models using a method of independent validation. A training set of leaves grown between 1843 and 2002 AD was used to generate inference models. These models were then applied to fossil SF data from a well-dated sediment core. We split the obtained SF-inferred CO_2 time series into two periods: validation (after 1850 AD) and reconstruction (1700-1850 AD).

SF-inferred CO_2 values after 1850 AD correspond well to the industrial CO_2 increase apparent in instrumental records and high-resolution ice-cores, corroborating the accuracy of the reconstruction method. However, the better performance of smoothed time-series during the validation period indicates that low-frequency signals are bet-

ter retained than high-frequency signals. Even limiting our view to low-frequency changes (i.e. to multidecadal-scale changes) our SF-inferred CO_2 changes prior to 1850 AD are characterized by a prominent maximum at 1740-1780 AD that is more pronounced than in ice-core records. It does, however, agree with another SF-inferred CO_2 record from eastern North America. This may suggests that CO_2 changes have been larger than previously estimated and may imply that CO_2 changes possibly contributed more to the natural climate variability than estimated by ice-core records.