Geophysical Research Abstracts
Vol. 13, EGU2011-8079-2, 2011
EGU General Assembly 2011

Atmospheric CO2 at the Oligocene/Miocene transition reconstructed by using fossil plant material

Michaela Grein (1), Christoph Oehm (2), Anita Roth-Nebelsick (1), Wilfried Konrad (2), and Torsten Utescher (3)

(1) State Museum of Natural History Stuttgart, Stuttgart, Germany (michaela.grein@smns-bw.de, anita.rothnebelsick@smns-bw.de), (2) Institute for Geosciences, University of Tuebingen, Tuebingen, Germany (christoph.oehm@gmx.de, wilfried.konrad@uni-tuebingen.de) , (3) Steinmann-Institute, University of Bonn, Bonn, Germany (utescher@geo.uni-bonn.de)

During the Cenozoic, global climate turned from greenhouse to icehouse conditions accompanied by faunal and floral changes. Atmospheric greenhouse gases (such as CO2) have an essential influence on the global climate. Also in the Cenozoic, the atmospheric CO2 concentration is largely credited for the development of the global climate. The time interval from the Oligocene to the Miocene roughly marks the changeover from greenhouse to icehouse climate. Most studies dealing with atmospheric CO2 indicate that during the early and middle Paleogene CO2 was significantly higher than today but decreased drastically to the early Neogene, remaining at a more or less constant level during the last 22 million years.

Commonly, geochemical models and various proxies, such as boron isotopes, pedogenic carbonates and the frequency of plant stomata are applied in order to calculate trends in atmospheric CO2 during the last 65 million years. In this project, well-preserved fossil plant material from the late Oligocene to the early Miocene is used for reconstructing trends in the atmospheric carbon dioxide concentration. The fossil plant material includes species in the Fagaceae, Lauraceae and Platanaceae from various sites in Germany (Weisselster Basin and Lausitz Basin) and Austria (Oberdorf). CO2-calculations are based on a mechanistic model which provides a quantitative derivation of stomatal density response to changes in atmospheric carbon dioxide. The model includes a) diffusional processes, b) processes in C3-photosynthesis and c) an optimisation principle describing the adjustment of stomatal conductance to varying environmental conditions. In order to calculate atmospheric CO2, various anatomical and morphological parameters have to be estimated from measurements on extant representatives of the fossil species. The necessary environmental data (such as temperature, relative air humidity and water availability) are obtained from the Coexistence Approach and carbon isotope data. A test run on extant plant species in the Ginkgoaceae, Fagaceae, Platanaceae, Lauraceae and Myrtaceae proved the applicability of the model.

Preliminary results indicate high atmospheric CO2 near the Oligocene/Miocene transition (up to 900 ppm) and clearly lower values in the late Oligocene and early Miocene (between 300 and 700 ppm).