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Stomatal density of fossil laurel and myrtle leaves from the Messel Pit: Preliminary studies for the reconstruction of atmospheric CO_2 and climate of the Middle Eocene

M. Grein (1), A. Roth-Nebelsick (1), V. Wilde (2), W. Konrad (1)

(1) University of Tübingen, Institute for Geosciences, Germany, (2) Senckenberg Research Institute, Frankfurt am Main, Germany

As CO_2 represents an important greenhouse gas, changes in atmospheric CO_2 concentrations - among others - are held responsible for the development of global temperatures during the last 65 million years. Hence, knowledge of palaeoatmospheric CO_2 and its change is crucial for exploring the coupling of global climate change and atmospheric CO_2. It has often been observed that many plants change the stomatal density of their leaves inversely with atmospheric CO_2 (in order to optimize photosynthesis by maximizing assimilation and minimizing transpiration). Thus, stomata (pores on the leaf surface) have attracted considerable interest as a CO_2 proxy for past palaeoclimates.

In this project, palaeoatmospheric CO_2 and climate of the Middle Eocene will be reconstructed by using fossil plant material from the Messel Formation. The Messel Pit (representing an UNESCO World Heritage near Darmstadt, Germany) provides complete and very well-preserved plant material. The obtained data will comprise stomatal data from a limited number of species, carbon isotope data from fossil leaves and climatic data. Climate reconstruction will be carried out using the stomatal density of both laurel and myrtle leaves, carbon isotope data, Leaf Margin Analysis and the Coexistence Approach applied to the whole Messel flora. Palaeoatmospheric CO_2 will be reconstructed using a mechanistic theoretical approach which couples the biochemical process of photosynthesis, diffusion, transpiration, leaf anatomical data (stomatal

density and anatomy) and palaeoclimatic/palaeoenvironmental parameters.

In this contribution, first results of stomatal density counting on fossil laurel and myrtle leaves (forming a frequent element of the Messel leaf flora) are presented.