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Composition of lipids from the First Lusatian lignite seam of the Konin Basin (Poland): relations to vegetation, climate and carbon cycling during the mid-Miocene Climatic Optimum

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Samples of detrital lignite have been collected for organic geochemical and carbon isotope analyses from the First Lusatian lignite seam at the Adamów, JóÅºwin IIB and TomisÅ‚awice opencast mines, deposited after the last peak of the Mid-Miocene Climatic Optimum. The aim of the study is to improve the chemotaxonomic value of biomarkers by relating the results to existing paleobotanical data, and to gain information about the influencing factors on $\delta^{13}C$ of lignite and lipids. Furthermore, biomarker and isotopic proxies are tested for their applicability in paleoclimate studies.

The relative abundances of mid-chain (C_{23}, C_{25}) *n*-alkanes and their 1–2‰ higher $\delta^{13}C$ values compared to long-chain *n*-alkanes (C_{29}, C_{31}) argue for a minor contribution of macrophytes (graminoids, etc.) to peat formation, enhanced during periods of raised water level. The presence of ferruginol and dehydroferruginol testifies the contribution of taxodioid Cupressaceae. The abundances of pimarane-type diterpenoids and the presence of non-aromatic abietane-derivatives argue for the contribution of Pinaceae. Based on the presence of lupeol and lupane-type triterpenoids, an input of Betulaceae can be concluded. The contribution of further angiosperms cannot be specified based on the composition of pentacyclic triterpenoids. However, the results indicate mixed vegetation, and are in agreement with paleobotanical data highlighting abundant conifers of the Cupressaceae and Pinaceae families, as well as angiosperms of various families (e.g., *Nyssa, Quercus, Fagus*), including Betulaceae (e.g., *Alnus, Betula, Corylus*). Based on the relationship between the carbon preference index of *n*-alkanes and mean annual air temperatures, obtained from a global database of peatlands, an average temperature of 24.5 °C is obtained. This value is significantly higher as estimated from paleobotanical data (15.7–19.7 °C), probably due to the influence of changes in vegetation on carbon preference index.

The relative abundances of diterpenoids versus di- plus angiosperm-derived triterpenoids in detrital lignite samples revealed variable contributions of gymnosperms and angiosperms during the middle Miocene. Consistent with these results, a positive relationship exists between the

di-/(di- + tri-) terpenoid biomarker ratios and $\delta^{13}C$ of lignite samples, indicating the dominating role of varying gymnosperm/angiosperm contributions on the carbon isotopic composition of lignite. The C-isotope data of long-chain n-alkanes, diterpenoids, and angiosperm-derived triterpenoids co-vary within the profiles, arguing for an overall control of changes in $\delta^{13}C$ of atmospheric CO_2 on $\delta^{13}C$ of plant lipids. Fluctuations in $\delta^{13}C$ of individual compounds may also be related to changes in carbon cycling within the peat, humidity and air temperature.