

BIOMARKER AND CARBON ISOTOPE SYSTEMATIC IN CENOZOIC COAL AND FOSSIL WOOD OF CENTRAL EUROPE

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In the light of recent findings, biomarker and carbon isotope systematic in coal and fossil wood are expected to provide valuable information for the reconstruction of floral assemblages and paleoenvironmental changes during the Cenozoic. Carbon isotope analyses of terrigenous organic matter have been used to reconstruct changes in the isotopic composition of upper ocean and atmospheric carbon reservoirs (Arens et al., 2000). Carbon isotope values of cellulose from tree-rings and fossil wood have also been related to climatic change (e.g. temperature, humidity) via water-use efficiency of land plants.

In this study, we report on biomarker and carbon isotope analyses of coal, resinites, woody macrofossils, and extracted cellulose obtained from lignite deposits of Central Europe (Austria, Bulgaria, Germany, Hungary, Slovenia) covering the time interval from Early Eocene to Pliocene. The concentration of diterpenoid biomarkers (including abietane-, pimarane-, isopimarane-, beyerane-, kaurane-, and phyllocladane-type hydrocarbons) relative to the sum of diterpenoids plus triterpenoid hydrocarbons, containing the structures typical of the oleanane-, the ursane-, or the lupane-skeleton, are used as proxies for the contribution of gymnosperms versus angiosperms to peat formation. Our results demonstrate that bulk organic matter of coal and coaly sediments is influenced by varying contributions of angiosperms and gymnosperms, by different isotopic composition of land plant tissue (e.g. leaves, wood, bark), as well as by microbial activity. The concentration ratios of terpenoid biomarkers in coal seams indicate the predominance of angiosperms in the peat-forming vegetation during Eocene and Early Oligocene, whereas Late Oligocene to Pliocene coals are derived from gymnosperm-dominated (i.e. coniferous) sources. The results are in general agreement with paleobotanical records and demonstrate the potential of biomarker analyses in paleoecological studies.

The $\delta^{13}\text{C}$ variations found in resinites, fossil wood and wood cellulose support their capability to trace paleoenvironmental conditions. In contrast to fossil wood, $\delta^{13}\text{C}$ values of cellulose from woody macrofossils are only negligibly influenced during decomposition. The carbon isotope analyses demonstrate isotopic trends of land plants parallel to the marine record during the Tertiary (Zachos et al., 2001). Furthermore, co-variations of $\delta^{13}\text{C}$ of coals, fossil wood from gymnosperms, and wood cellulose with climatic changes (i.e. mean annual temperature, mean annual precipitation) reconstructed from paleobotanical data from eastern Germany are noticed (Krutzsch et al., 1992; Eissmann, 1994; Krutzsch, 2000). We propose that the observed patterns were primarily produced by variations of the isotope ratios of oceanic and atmospheric carbon reservoirs, and additionally modified by climatic changes due to their influence on plant physiology. Thus, the terrestrial carbon isotope record indicates changing $\delta^{13}\text{C}$ values of atmospheric CO_2 associated with atmospheric $p\text{CO}_2$ and paleoclimate. Carbon isotope studies on fossil wood of known taxa and on their cellulose provide a powerful tool in reconstructing the isotopic record of land plants and its implication for environmental changes during the Earth's history.

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