Abstract

This thesis elucidates the significance of long-chain *n*-alkanes and *n*-alkan-1-ols as palaeoenvironmental indicators. Special emphasis is placed on the distribution patterns and molecular stable carbon isotopic signatures of these biomarkers, because they appear to be suitable proxies to trace climate dependent changes in the predominance of C_4 or C_3 land plants. Grasses (Poaceae) are an important source of C_4 biomass in the geological record of soils as well as lacustrine and marine sediments. Grasses are found across the world in broad latitudinal belts in dry subtropical grasslands and savannas, where the C_4 species successfully outcompete C_3 plants (e.g. C_3 grasses, trees and shrubs). An extension or regression of grassy vegetation depends on the climatic conditions. Thus, the fossil record of indicators of subtropical grass holds important ecological information related to continental vegetation in the geological past. Long-chain leaf wax lipids of 35 C_4 grasses and three C_3 grasses of abundant species in southern Africa were analysed and their molecular signatures compared to the physiological classification in three C_4 subtypes (NADP-ME, NAD-ME and PCK) and phylogenetic systematics of these plants on a subfamily level. These investigations revealed that C_4 grass waxes are distinguishable from those of C_3 species by significantly higher compound-specific $\delta^{13}C$ values, high contents of *n*-C_{31} and *n*-C_{33} alkanes and the abundance of the *n*-C_{32} alkanol, which is largely absent in C_3 grasses. Especially species of the subfamily Chloridoideae or of species using the NAD-ME or PCK C_4 metabolism exhibit longer-chain wax homologues. These species preferably thrive in habitats of extremely arid climatic conditions. Comparison with published data substantiated these findings.

The specificity of long-chain aliphatic wax components in C_4 plants for palaeoenvironmental assessment was determined by investigating Southwest African continental margin sediments from nine drill and piston cores on a North to South transect from the Congo Fan (4°S) to the Cape Basin (30°S). Four time slices of the recent geological history were investigated representing two glacial (MIS 2 and 6a) and two interglacial stages (MIS 1 and 5e). Airborne particulate material was deposited in significant amounts at the southern oceanic sampling locations. This material is rich in organic matter from C_4 plants, because it is derived from the western and central southern African hinterland dominated by deserts, semi-deserts and savanna regions. The northern sites of the transect get most of their terrestrial material from the Congo Basin and the Angola highlands dominated by C_3 plants. Signatures of long-chain *n*-alkanes and *n*-alkanols were correlated with those of pollen taxa in the same sediments concerning glacial/interglacial changes in major phytogeographic zones on the adjacent continent. Latitudinal trends southwards in the transect exhibited higher molecular $\delta^{13}C$ values accompanied by a shift in the distribution pattern maxima of the wax components to longer-chain homologues and more C_4 pollen contribution in all time slices. Only the average chain length (ACL) of the *n*-alkanols did not follow this trend. The *n*-alkanol signatures appear to be comprised of assemblages from different organisms, i.e. C_3, C_4 and CAM plants as well as marine biota. C_4 proportion estimates based on weighted mean $\delta^{13}C$ values for *n*-alkanes and *n*-alkanols paralleled each other and those afforded by pollen counts. Glacial/interglacial changes were characterised by a significant shift to a higher contribution of C_4 plants in the northern part of the transect during glacial stages. It can be inferred that open grass-rich vegetation shifted northwards and desert and semi-desert areas expanded. Further to the South, the glacial/interglacial differences decrease until they become insignificant. At the two southernmost sites less Poaceae pollen and a higher contribution of C_3 pollen during glacial stages suggest a northward shift of the winter rain vegetation (mostly C_3 and CAM plants). The results of the study demonstrate that this combination of pollen data and compound-specific geochemical proxies can be effectively applied in the reconstruction of past continental phytogeographic developments.