Reconstruction of continental climate using the molecular and isotopic composition of land-plant biomarkers in deep-sea sediments of the Atlantic Ocean

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Southwest African continental margin sediments from nine sites on a North-South transect from the Congo Fan (4°S) to the Cape Basin (30°S) representing two glacial (MIS 2 and 6a) and two interglacial stages (MIS 1 and 5e) were examined. Contents, distribution patterns and molecular stable carbon isotope signatures of long-chain n-alkanes (C27-C33) and n-alkanols (C22-C32) as indicators of land plant vegetation of different biosynthetic types were correlated with concentrations and distributions of pollen taxa in sediments of the same time horizons. Selected single pollen type data reveal details of vegetation changes, but the overall picture is best illustrated by summing pollen known to predominantly derive from C4 plants or C4 plus CAM plants. The C4 plant signals in the biomarkers are recorded in the δ13C data and in the abundances of C31 and C33 n-alkanes, and the C32 n-alkanol. Calculated clusters of wind trajectories for austral summer and winter situations for the Holocene and the Last Glacial Maximum afford information on the source areas for the lipids and pollen and their transport pathways to the ocean. This multidisciplinary approach provides clear evidence of latitudinal differences in leaf wax lipid and pollen composition, with the Holocene sedimentary data paralleling the current major phytogeographic zonations. The northern sites (Congo Fan area and northern Angola Basin) get most of their terrestrial material from the Congo Basin and the Angolan highlands dominated by C3 plants. Airborne particulates derived from the western and central South African hinterland dominated by deserts, semi-deserts and savannah regions are rich in organic matter from C4 plants. As can be expected from the present and glacial positions of the phytogeographic zones, the carbon isotopic signatures of n-alkanes and n-alkanols both become isotopically more enriched in 13C from North to South. In the northern part of the transect the relative importance of C4 plant indicators is higher during the glacials than in the interglacials, indicating a northward extension of arid zones favoring grass vegetation. In the south, where grass-rich vegetation merges into semi-desert and desert, the difference in C4 plant indicators is small.