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C-isotope composition of fossil sedges and grasses

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C4 plants differ from C3 plants regarding their anatomy and their C-isotope composition. Both features can be used in the geological record to determine the presence of C4 plants. Yet, the evolution of the C4 pathway in the fossil record is enigmatic as palaeobotanical and geological evidence for C4 plants is sparse. The oldest structural evidence for Kranz anatomy has been found in Late Miocene permineralized grass leaf remains. But studies on the C-isotope composition of sedimentary organic matter indicate that abundant C4 biomass was present in N-America and Asia throughout the Miocene in expanding savannahs and grasslands. The success of C4 plants appears to be related also to an increasing seasonal aridity in the tropical climate belts and the co-evolution of grazers. However, C- isotope composition of palaeosols or vertebrate teeth only allows to estimate the abundance of C4 plant biomass in the vegetation or in the diet without further taxonomical specification which plant groups would have had C4 metabolism. In this contribution the first extensive C-isotope analysis of fossil seeds of sedges and a few grasses are presented. The age of the carpological material ranges from Late Eocene to Pliocene and was collected from several central European brown coal deposits. The 52 different taxa studied include several species of Carex, Cladiocarya, Eriopherum, Eleocharis, Scirpus, Sparganium. Most of them representing herbaceous elements of a (sub)tropical vegetation growing near the edge of a lake. The C-isotope composition of the fossil seeds varies between -30 and -23 o/oo indicating C3 photosynthesis. This first systematic inventory shows that C4 plants were absent in the European (sub)tropical brown coal forming wetland vegetation during the Tertiary. These preliminary data are in agreement with phylogenetic studies which predict the origin of C4 plants outside the European realm.