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Testing the sensitivity of stable carbon isotopes of sub-fossil *Sphagnum* cellulose to past climate variability: a two millennia high resolution stable carbon isotope time series from the peat deposit "Dürres Maar", Germany

Robert Moschen (1), Norbert Kühl (2), Sabrina Peters (1,3), Heinz Vos (4), and Andreas Lücke (1)

(1) Institute of Chemistry and Dynamics of the Geosphere 4: Agrosphere, Forschungszentrum Jülich (Research Centre Juelich), D-52425 Juelich, Germany (r.moschen@fz-juelich.de, 0049-2461612484), (2) Steinmann Institute of Geology, Mineralogy and Paleontology, University of Bonn, D-53115 Bonn, Germany, (3) Department of Geography, Universität zu Köln (University of Cologne), D-50923 Köln, Germany, (4) Institute of Chemistry and Dynamics of the Geosphere 2: Stratosphere, Forschungszentrum Jülich (Research Centre Juelich), D-52425 Juelich, Germany

Peat deposits are terrestrial archives of environmental changes and climate dynamics over time. They are widely distributed and cover a large part of the earth's land surface often within human habitat and, thus, form an excellent basis for evaluating ecosystem and climate dynamics by multiple geochemical and biological methods. Records of the stable carbon composition of cellulose separately extracted from selected *Sphagnum* plant components ($\delta^{13}C_{Sphagnum}$) from the kettle-hole type peat deposit of "Dürres Maar" are presented. Manually separated *Sphagnum* stems, branches and the small leaves covering *Sphagnum* branches were used for cellulose extraction and subsequent isotope measurements, because intra-plant $\delta^{13}C_{Sphagnum}$ variability between different physical components of individual modern plants has been described (Loader et al. 2007). We observed the same isotopic offset between single plant components of sub-fossil *Sphagnum* plant components which is statistically highly significant and observable down-core (Moschen et al. 2009). Using the size fraction of 355-630 μm, which almost exclusively consists of single *Sphagnum* leaves, allows to derive environmental and climate signals based on a plant response to external controls, presumably including temperature and relative humidity. Because down-core changes in the ratio of different plant components in the peat profile seem probable, erroneous interpretations of isotope records are likely if no differentiation into single *Sphagnum* plant components is possible.

A high resolution time series of $\delta^{13}C_{Sphagnum}$ is presented covering the last two millennia, tracing decadal to sub-decadal past environmental and climate dynamics. The thickness of the water film surrounding the chloroplasts of *Sphagnum* plants has been suggested as the most important factor influencing $\delta^{13}C_{Sphagnum}$. This points to bog surface wetness which is primarily driven by precipitation and evaporation temperature as the major control of $\delta^{13}C_{Sphagnum}$. The close coupling of several environmental factors to air temperature, however, presumably also results in an indirect dependency of $\delta^{13}C_{Sphagnum}$ on air temperature, since strong correlation between $\delta^{13}C_{Sphagnum}$ of modern *Sphagnum* plants and local air temperature during the growing season has been observed for altitudinal transects (Skrzypek et al. 2007). We applied potential relationships between our $\delta^{13}C_{Sphagnum}$ and climatological parameters as deducible from existing calibration data sets. Results are compared with quantitative climate reconstructions based on well established palynological methods applied to the same core from "Dürres Maar". Additionally, comparisons of the $\delta^{13}C_{Sphagnum}$ record with time series of meteorological observations are presented to review the potential relationships between $\delta^{13}C_{Sphagnum}$ and climatological parameters.

References:

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